Study of physiological variation in serum insulin level and blood glucose level (fasting blood sugar and post prandial blood sugar) among young healthy individuals with special reference to Deha Prakriti

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Abstract

Prakriti is the nature, behavior, or psychosomatic constitution of an individual. It represents the doshic state of individual. Prakriti is an important tool which can affect the line of treatment/management, prognosis, diagnosis, and occurrence of the disease. Diabetes mellitus is a non-communicable, long-term metabolic disorder. Prakriti of an individual and their health along with occurrence, treatment/management as well as prognosis of a disease has a close relationship. Keeping these facts in the mind, such study has been designed to find possible relationship between level of insulin and blood glucose level in different prakriti persons. A total of 89 volunteers were registered for the purpose of the study having age group between 18 and 30 years. Prakriti was determined by pro forma designed for the same, based on Ayurvedic classics. Their blood glucose level and serum insulin level were tested. It has been observed that level of insulin was found maximum 85.846 ± 3.68 in person having Kapha Prakriti, whereas, in Pitta Prakriti individuals, serum insulin level was found in minimum (lower) range. It was also observed that mean of fasting blood sugar level was maximum in volunteers of Kapha Prakriti. Serum insulin level was found in maximum (upper) range in Kapha Prakriti person.

Key words: Blood sugar, diabetes mellitus, insulin, Madhumeha, blood sugar, Prakriti

INTRODUCTION

According to the WHO, approximately 150 million people are suffering from diabetes mellitus (DM) (Madhumeha) worldwide and are supposed to get double by the year 2025. Type 2 DM (T2DM) is a metabolic disorder and mainly occurs due to impaired function of the pancreas, especially beta cell, which secretes insulin. DM is a heterogeneous disease involving various organs of the body. It is characterized by chronic enhancement of the blood sugar level due to malfunctioning of insulin hormone, including insulin formation, secretion, and insulin resistance.

Chronic increase in the blood sugar (glucose) level is a leading cause of renal failure, visual loss, hepatic disorder as well as cardiovascular disorder.

As per Ayurveda, Agni is responsible for the various types of chemical conversion taking place in our body. Insulin also performs various functions of the Agni, as it is involved in various metabolic processes as well as chemical conversions.

REVIEW OF LITERATURE

Prakriti

Prakriti is also known as psychosomatic constitution of an individual. Prakriti is the sum total of physical, physiological, and mental functioning of an individual.
and psychological qualities of an individual. Prakriti represents the doshik state of an individual.

**Formation of Prakriti**

Prakriti is formed by the Uikatata (predominance) of one, two, or all three Doshas at the time of samyoga (union) of shukra (sperm) and shonita (ovum) in the garbhashaya (uterus).[9]

**Development of Prakriti**

Development in this context refers to the causation of specific features in the individual of the prakriti in such a way that two persons belonging to one ”prakriti” also differ from each other.[7] In our body, doshas, dhatus, and malas maintain our internal environment (homeostasis).[8]

Vata in its normal state is responsible for all activities of the body. Vata, in fact, constitutes the life of living beings.[9] Vitiation of Tridosha (Vata, Pitta, and Kapha) may be taking place in different seasons as for example - physiological predominance of vata dosha is seen in varsha ritu (Rainy season). Hence, the Prakriti formed in this season (due to fertilization) may be mostly Vatika in nature.[10]

Various researches have been done, taking Prakriti into consideration. The mean of serum urea was observed maximum (nearer to upper normal limit) in shishir ritu and minimum (nearer to lower normal limit in grishma ritu in all Prakriti group). Prakriti also affects the serum urea level in different season.[11] Incidence of occurrence of amavata is found considerably high among Kapha Prakriti, whereas low in Vataj Prakriti. Pitta Prakriti cases shown a high percentage of recovery rate than kaphaj and vataj.[12] Seasons influence the aggravation, accumulation, and pacification of humors, which might affect the functions in various constitutions.[13]

There are many factors determines the uniqueness of Prakriti. Acharya Charka has described six Bhavas which are the determinant of the development of Garbha. (Ch.Sha.3/3).[14]

Vagbhata has also mentioned that Prakriti is dependent not only on Shukra and Shonita but also on diet and behavior of the pregnant women, nature of Garbhasya and Kala (A.H.Sha.3/83).[15]

Acharya Charaka considers that Dehagni (Jaṭharagni) is the cause of life, complexion, strength, health, nourishment, lusture, oja, teja (energy), and prana (life energy) (Ch.Chi. 15/5).[16]

Insulin is anabolic, increasing the storage of glucose, fatty acids, and amino acids. Glucagon is catabolic, from glucose, fatty acids, and the amino acids ores into the bloodstream. The two hormones are thus in their overall action and are reciprocally secreted most circumstances. Insulin excess causes hypoglycemia, which leads to convulsions and coma. Madhumeha (DM) (Characterised by chronic elevation of blood glucose), caused by deficiency of Insulin, if untreated is eventually fatal. Glucagon deficiency can cause hypoglycemia, and glucagon excess makes diabetes worse. Excess pancreatic production of somatostatin causes hyperglycemia and other manifestation of diabetes.

**Effect of Insulin on Carbohydrate Metabolism**

Insulin promotes muscle glucose uptake and metabolism. It also helps storage of glycogen in muscle. It promotes liver uptake, storage, and use of glucose. It promotes conversion of excess glucose into fatty acids and inhibits gluconeogenesis.[2]

**MATERIALS AND METHODS**

Topic of the research was passed by ethical clearance committee of the Institute of Medical Science (BHU).

For the purpose of the present study, a total of 89 volunteers who were registered having age group between 18 and 30 years were selected.

**Exclusion Criteria**

1. Subjects aged <18 years or more than 30 years were excluded.
2. Only young healthy individuals were selected for the study. Subjects not fulfilling the criteria of “Clinically Healthy” status as per the pro forma were excluded.
3. The subjects, who were known to have any disease/chronic illnesses before or during study, were excluded.

**Assessment of Prakriti**

Subjects were assessed to understand their Prakriti using Prakriti assessment pro forma Vandana et al., (2009).

Volunteers were assessed for their health by general health examination pro forma.

Prakriti of the subjects based on most dominant Dosha was categorized into 1. Vataja Prakriti (includes Vata-Pitta and Vata-Kapha), 2. Pittaja Prakriti (includes Pitta-Vata and Pitta-Kapha), and 3. Kaphaja Prakriti (includes Kapha-Vata and Kapha-Pitta) Prakriti.

**Estimation of Serum Insulin Level**

Measurement of serum insulin level was done in the Department of Kriya Sharir, Faculty of Ayurveda, Institute of Medical Science, Banaras Hindu University, Varanasi.

**Collection of Venous Blood**

Regarding this study, for the biochemical parameters, 5 ml of
venous blood was collected from the subjects in their hostels early in the morning during 6–8 AM. Serum was separated from the blood. Separation of the serum was done by centrifuging the blood sample at 3000 r.p.m. for 5–6 min and preserved in deep fridge at −20°C till the estimation. Diametra ELISA Kit was used for insulin estimation.

Followed ELISA protocol which was mentioned in Diametra ELISA Kit manual; then using a microtiter plate reader which was read at 450 nm and 630 nm wavelength. The test is performed on ERBA ELISA READER SEMI-AUTOMATIC MACHINE. The reagent kit was intended for the direct “in vitro” quantitative determination of serum insulin level.

**Blood Sugar Estimation**

Blood sugar was estimated by one touch glucometer. Fasting blood glucose level was estimated in between 6 am and 8 am. Thereafter, for each volunteer, 75 g glucose was dissolved in 200 ml of water and was asked to drink. Postprandial blood glucose level was tested after 1 h (post prandial blood sugar level in 1 h [PPBS1]), 1.5 h (PPBS after 1.5 h [PPBS2]), and 2 h (PPBS after 2 h [PPBS3]). In between this period, all volunteers were asked not to eat or drink anything more.

**OBSERVATION AND RESULT**

It has been observed that level of insulin was found maximum (in upper range, 85.846 ± 3.68) in person having *Kapha Prakriti* [Table 1].

Mean of fasting blood sugar (FBS) was observed maximum (95.30 ± 9.44) in Kapha Prakriti.

PPBS level in 1st h (PPBS1) was observed maximum (131.11 ± 13.82) in *Pitta Prakriti* person.

PPBS after 1.5 h (PPBS2) was observed maximum (110.58 ± 16.11) in *Kapha Prakriti* individual.

Similarly, PPBS after 2 hour (PPBS3) was observed maximum (94.80 ± 9.95) in *Kapha Prakriti* individual.

**DISCUSSION**

Maximum level (85.846 ± 3.68) of insulin was observed in person having *Kapha Prakriti*. It may be due to a good amount of *agni-bala* (digestive and metabolic fire) in them.

During the study, it was also observed that serum insulin level was almost same in *Vata Prakriti* (85.840 ± 1.22) individuals and in *Kapha Prakriti* (85.846 ± 3.68) individuals. This similarity in the level of insulin may be due to fluctuating level of insulin level in *Vata Prakriti* individuals.

Mean of FBS was observed maximum (95.30 ± 9.44) in *Kapha Prakriti*.

PPBS level in 1st h was observed maximum (131.11 ± 13.82) in *Pitta Prakriti* person.

PPBS after 1.5 h was observed maximum (110.58 ± 16.11) in *Kapha Prakriti* individual.

Similarly, PPBS after 2 h was observed maximum (94.80 ± 9.95) in *Kapha Prakriti* individual.

Mean of FBS (95.30 ± 9.44) and PPBS level in 1.5 h (110.58 ± 16.11) and 2 h (94.80 ± 9.95) was observed maximum in *Kapha Prakriti*. It may be due to nature of minimum physical and mental activity/behavior (Gambhirbuddhi) of *Kapha Prakriti* persons.

It can be hypothesized that comparatively higher level of blood sugar in *Kapha Prakriti* individual may be an important cause for more prevalence of NIDDM (T2DM/Madhumeha) in *Kapha Prakriti* individual, in comparison to *Pitta* and *Vata Prakriti*.

**CONCLUSION**

On the basis of above findings, we can conclude that the biochemical and hormonal concentration of an individual can be affected by Prakriti of an individual. Such type of variation in the blood sugar level and insulin level was observed due to the effect of different level of *agni and Bala* in different Prakriti person. The research may pave the path for prevention, treatment/management of various diseases, especially Madhumeha (DM), which is most dangerous metabolic disorder in the present era.

For the purpose of the present study, 89 volunteers were registered. Their Prakriti was determined/assessed by pro forma.

It was observed that mean of FBS level (95.30 ± 9.44) was maximum in volunteers of *Kapha Prakriti* group.

On the basis of above finding of FBS (Empty stomach in morning) and PPBS after 1.5 hour and 2 hour after meal, was observed in maximum range in *Kapha Prakriti* individuals. This may be an important cause that *Kapha Prakriti* individuals are more susceptible and prone to develop T2DM (Madhumeha).
Whereas, in Pitta Prakriti individual, serum insulin level was found in minimum range (84.26 ± 3.07). It indicates that insulin is more utilized in glucose metabolism in pitta prakriti individuals. It may be an important cause that pitta prakriti person develops least/less resistance to the insulin.

REFERENCES


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Prevention and management of Katishool through yoga and exercise

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Abstract

Nowadays Katishool (lumber Spondylosis) is a common lifestyle disorder among all age group especially 40-70 years in society. Globally, nearly 40% people have pain at lower side at some point in their life. Poor or bad posture especially forward slouch, wrong sleeping position, prolong sitting, sedentary mode of living, stress or strain due to heavy weight lifting or sports, excess bike riding and incorrect nutrition are the common cause of low back pain. Lumber Spondylosis is progressive and irreversible degenerative disorder of lumber vertebrae. Yoga Asanas and exercise can play a vital role for relieving pain and stiffness of back. To alleviate back pain one should practice Yoga Asanas and physical exercise regularly in proper method and proper guidance. Many research works have shown that various Yoga practices and physical exercises plays beneficial role in maintenance of spinal health and the management of Katishool.

Key words: Yoga, exercise, lumber Spondylosis, prevention, management

INTRODUCTION

Nowadays, Katishool (lumber Spondylosis) is a common lifestyle disorder among all age group especially 40-70 years in society; globally, nearly 40% people have pain at lower side at some point in their life. Common cause of low back pain is poor or bad posture especially forward slouch, wrong sleeping position, prolong sitting, sedentary mode of living, stress or strain due to heavy weight lifting or sports, excess bike riding or traveling, stress or strain due to heavy weight lifting or sports, and incorrect nutrition. Lumber spondylosis mean degenerative change such as osteoarthritis of vertebral joint and degenerating intervertebral discs in low back.

Yoga and exercise play a key role in prevention and management of back pain. Yoga and exercise should be practiced regularly in proper method and guidance for alleviate back pain. Many research works have shown Yoga and exercise play a beneficial role in the maintenance of spinal health and the management of Katishool.\(^{[1]}\)

COMMON PATHOLOGY

Potential source of low back pain includes degeneration or injuries of intervertebral discs, facet joint, vertebrae, neural structures, muscles, ligaments, and fascia. Lumber spondylosis comprehends lumbar disc bulges, herniation, facet joint degeneration, disc degeneration, spinal canal stenosis, and vertebral bony overgrowths (osteophytes).

Lumber spondylosis is a spine condition that describes the natural degeneration of lower spine due to age and compression. On both side of vertebra joint and disc made of soft tissue to allow vertebra movement. The lower back of lumber spine is to support and stabilize most of body’s weight. The repetitive incorrect turning, lifting heavy weight, and increasing body weight are the reason that compresses vertebral discs resulting into tearing of discs, and displacement of discs.

The constant pressure can cause the discs and joints to gradually degenerate and possibly develop other spinal condition such as spinal stenosis. The formation of osteophyte can cause neural Forminal stenosis which will produce pain due to pressure on spines and nerves.

CAUSES AND RISK FACTORS OF LUMBER SPONDYLOSIS

There are many causes and risk factors for developing lumber spondylosis:

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1. Genetic - A specific type of gene HLA-B27 is more responsible for developing lumber spondylosis
2. Age - Lumber spondylosis is a degenerate condition that develops more common in older age (40–70 years)
3. Lifestyle - Certain lifestyle habit such as lack of exercise, sedentary life, and smoking is contributing risk factors for developing Katishool
4. Obesity - Overweight put extra load on lumber joints of back region, progressing lumber spondylosis due to bear and tear of the lumber region
5. Injury - Spinal injury due to fall or accident leads to dislodgement of vertebral joints or discs causing lumber spondylosis
6. Other cause - Prolong sitting in abnormal position, more biking, traveling, etc
7. Unhealthy diet - Continuous deficiencies of calcium and Vitamin D in the diet may lead to degeneration spines.

**SYMPTOMS OF LUMBER SPONDYLOSIS**

Initially, some patients suffering from lumber spondylosis do not have symptoms. However, when symptoms do appear, they can notice the following symptoms:

- Back pain and stiffness in morning
- Sitting prolong time increase pain
- Worsening pain after repeated movement such as lifting and bending
- Regional tenderness
- Pain of back may be radiate into legs
- Numbness and tingling sensation in the limbs
- Weakness of affected limb due to nerve compression
- Loss of bladder or bowel control (may be possible only in very advanced stage).

**PREVENTION AND MANAGEMENT OF LOW BACK PAIN**

Practices of some Yoga and exercises in a controlled, progressive and under expert guidance, have many benefits including:

- Strengthening the muscles of spine, removing pressure from the spinal discs and facet joint
- Relieving stiffness and improving mobility, improving range of motion and overall mobility
- Improving circulation to better distribute nutrient through body, including to the spinal disc
- Some beneficial hormones like endorphin can relieve pain naturally. Endorphins can reduce the pain and can also elevate the mood and allow the mind to find a calm and meditative state.

**YOGA ASANAS**

Yoga Asana is a natural technique that focuses on controlled breathing through various body postures. Many of the postures in Yoga Asanas bring certain muscles flex, while other stretch is promoting relaxation and flexibility in the muscles, joints, and spine and strengthen the muscles of the back.

A list of best Yoga Asanas and other component are useful for back pain as given below:

1. Tadasana
2. Trikonasana
3. Ardha Kati chakrasana
4. Ushtrasana
5. Ardh Matsyendrasana
6. Marjariasana
7. Bhujangasana
8. Makarasana
9. Dhanurasana
10. Vipreet Naukasana
11. Uttanpadasana
12. Matsyasana
13. Dhyan (meditation)

We can select some Asanas according to the condition of the back pain and the deformities of the spine, and advice the patient for regular practice of selected Asanas. If the deformities of spine have been noticed then physician advice is necessary. Muscular activities such as stretching and flexing increases blood flow with nutrients, toxins to flow out, and overall nourishment of the muscles and soft tissues in lower back. Meditation and Anulom Vilom Pranayama are also useful in the management of lower back pain. Meditation reduces stress and enhances mood. These mental benefits play an important role in reduce back pain.

These Asanas are helpful in removing strain from the back and give strength and flexibility to the back. Its bring back elasticity to the back and remove stiffness and relieves pain from back region. Its give strength the back muscles and good stretch to the ligaments and nerves, which provide flexibility to the spine and make it more supple and healthy.

**EXERCISE**

In spite of this Yoga, there are many stretching and twisting exercises, which are beneficial in preventing and managing back pain. Some of the important stretching and twisting exercises for back pain are given as below:

1. Hamstring stretch exercise
2. Legs up the wall exercise
3. Spine stretching exercise
4. Spine twisting right and left exercise
5. Twisting the spine forward and backward.

Some of exercises are similar to Yoga in doing method and beneficial effect. The purpose of doing back stretches and spine twist is multifaceted. These are essential to maintain mobility, joint health, sustain a good posture, and normalize forces on discs. Back stretches and spine twist will also maintain the flexibility of the spinal ligament, muscles, and fascia.

CONCLUSION

Yoga and exercise are the most effective ways of preventing, managing and treating low back pain or chronic back pain. Strengthening muscles that support the spine with Yoga and exercise can prevent, reduce and eliminate lower back pain in some cases, the core muscles are muscles of the back, the abdomen, and buttocks, which work together support the spine. The core muscles help maintain normal posture and stabilize the spine. Yoga and exercise play an important role in prevention and management of low back pain. Both are effective as standard physical therapy for prevention and treating moderate to severe chronic back pain. A carefully adapted set of Yoga and exercise practiced under guidance of well-trained Yoga instructor. These may help reduce back pain and improve function. Both Yoga and exercise are excellent nondrug approaches for prevention and management of low back pain.

REFERENCES


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Antimicrobial study of *Nagar-Ativishadi* yoga in childhood *Atisara* (diarrhea): A review

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**Abstract**

*Atisara* is very common disease in children, and it is well-described in almost all textbooks of Ayurveda. The description about the disease *Atisara* clearly correlates with diarrhea. However, a number of drugs/recipes in different textbooks of Ayurveda are mentioned for the treatment of *Atisara*, it is difficult to decide which one drug is more effective in particular dosha specific *Atisara*. *Nagar-Ativishadi* yoga is described in *Chakradatta, Vrind madhav*, and *Bhaishajya Ratanvali* for the management of different types of *Atisara* in children. Nagaradi yoga contains five components, i.e., Nagar, Ativisha, Mustaka, Indrayava, and Balaka. It is used for the treatment of all types of *Atisara* in children. This literary review article shows antimicrobial activity against various microorganism which causes diarrhea in children.

**Key words:** Antimicrobial activity, *Atisara*, childhood diarrhea, dosha, *Nagar-Ativishadi* yoga

**INTRODUCTION**

Diarrhea is most frequent gastrointestinal disorder in childhood, and it causes a large proportion about (9%) of childhood death. It is second most cause of death in children, and approximately 0.71 million death occur per year globally. Global mortality may be decline rapidly, but the overall incidence of diarrhea has only decline from 3.4 to 2.9 episodes per-child year in past two decades. The decline in diarrheal mortality is the result of preventive rotavirus vaccination, improved case management of diarrhea, improved nutritional status of children and widespread home, and hospital-based oral rehydration therapy. Early and repeated episodes of diarrhea among young children can be associated with malnutrition, micronutrient deficiency, and significant deficit in psychomotor and cognitive development.[1]

**DEFINITION OF DIARRHEA (WHO)**

Diarrhea is defined as the passage of three or more loose or liquid stools per day. Frequent passing of formed stools is not diarrhea, nor is the passing of loose, “pasty” stools by breastfed babies.

**CAUSATIVE AGENT**

About 70% of cases of acute gastroenteritis in children are caused by viruses such as rotaviruses, noroviruses, and adenoviruses. About 40% of cases of acute diarrheal illness in the first 5 years of life are caused by rotaviruses, while a further 30% are caused by other viruses, mainly noroviruses, and adenoviruses. In about 20% of affected children, a bacterial pathogen can be identified in the stool (*Campylobacter Jejuni, Yersinia, Salmonella, Shigella, Pathogenic Escherichia coli*, or Clostridium difficile). Parasites are the cause in fewer than

**MATERIALS AND METHODS**

This literary survey was conducted with the help of several important Ayurvedic and Modern textbook, research paper, and journal to collect information on *Nagar-Ativishadi* yoga, which is used in the management of childhood *Atisara* (diarrhea).
5% (Giardia lamblia, Cryptosporidium parvum, Entamoeba histolytica, and others).

**TYPES OF DIARRHEA**

**Acute Diarrhea**

Acute diarrhea is the presence of three or more stool, which is loose and watery in nature within 24 h. These acute episodes subside within 7 days.

**Chronic Diarrhea**

It is defined as an insidious onset diarrhea of more than 2 weeks duration in children and more than 4 weeks in the adult. It is a common problem in children.

**Persistent Diarrhea**

It is an episode of diarrhea, of presumed infectious etiology, which start acutely but last for more than 14 days.

**Dysentery**

When bloody diarrhea accompanied with complaint of pyrexia, tenesmus, suprapubic discomfort, and cramps abdominal pain, it is known as dysentery.[2]

**Complications**

The possible complications of an acute diarrheal illness include dehydration, metabolic acidosis, impaired consciousness, convulsions, circulatory shock, and prerenal azotemia.

**Investigation**

Stool R/M (pH, reducing substance, fungal hyphae, occult blood, ova, and cyst), stool C/S, blood tests are complete blood count, acid-base status, glucose, electrolytes, creatinine, and blood urea nitrogen.

**Differential-diagnostic studies**

Ultrasonography or another type of imaging study is indicated if there is clinical suspicion of intussusception. Endoscopic procedures for the obtaining of biopsy samples are reserved for special situations, e.g. in patients with an underlying illness to exclude other possible diagnoses, such as chronic inflammatory bowel disease.

**MANAGEMENT**

**Oral Rehydration**

Oral rehydration is recommended for patients with clinically manifest mild dehydration (>3% weight loss). Oral rehydration with hypotonic rehydration solution is the treatment of choice. It is applicable, and successful, in 90% of children with mild to moderate dehydration.

**Pharmacotherapy**

**Antibiotics**

Most episodes of diarrhea are self-limiting and do not require any drug therapy except in few situations. Antibiotics are not recommended for routine treatment of acute diarrhea in children. In acute diarrhea, antimicrobials are indicated in bacillary dysentery, cholera, amebiasis, and giardiasis.[2]

**Antisecretory**

Racecadotril is an enkephalinase inhibitor that reduces pathologically increased secretion within a few hours in diarrhea of either viral or bacterial origin.

**Probiotics**

Microorganisms that exert beneficial effects on human health when they colonize in the bowel have been proposed as adjunctive therapy in the treatment of diarrhea. Several microorganisms such as Lactobacillus rhamnosus, Enterococcus faecium, and Saccharomyces boulardii have been shown to some efficacy in reducing the acute diarrhea.

**PREVENTION**

1. Adequate breastfeeding: Mother’s milk protects against infection, including acute infectious enteritis
2. Maintain General hygienic measures, i.e., hygienic handling of food: Bacterial infections acquired through food usually arise because of the consumption of incompletely cooked meat (Yersinia, Campylobacter, and Salmonella), raw eggs (Salmonella), and unpasteurized milk (enterohemorrhagic E. coli infections)
3. Rotavirus vaccination.

**ANTIMICROBIAL ACTIVITIES OF NAGAR-ATIVISHADI YOGA [TABLES 1-5]**

As per the previous antimicrobial studies, the antimicrobial effect of each component of Nagar-Ativishadi yoga has been tabulated in [Tables 1-5].
Table 1: Nagar (Zingiber officinale)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Name of bacteria and fungus</th>
<th>In vivo or in vitro</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science direct food and chemical toxicology[3] 46 (2008) p. 409-420</td>
<td>P. aeruginosa, Salmonella typhimurium, E. coli, C. albicans</td>
<td>In vitro</td>
<td>This drug is effective against these bacteria and fungi.</td>
</tr>
</tbody>
</table>


Table 2: Ativisha (Aconitum heterophyllum)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Name of bacteria</th>
<th>In vitro or in vivo</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJAR[7] Vol. 2 Issue 7 2014</td>
<td>S. aureus, B. subtilis, E. coli</td>
<td>In vitro</td>
<td>The plant is effective against the listed bacteria</td>
</tr>
<tr>
<td>JEIMC[8] Vol. 23 Issue 6 2008</td>
<td>S. typhi P. aeruginosa</td>
<td>In vitro</td>
<td>This drug is having antibacterial activity.</td>
</tr>
</tbody>
</table>


Table 3: Musta (Cyperus rotundus)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Name of bacteria</th>
<th>In vitro or in vivo</th>
<th>Result</th>
</tr>
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ATISARA

Atisara (diarrhea) has been much detail described in the ayurvedic text, but not in term of children. It is of six types, i.e., Vataja, Pittaja, Kapkaja, Samipataya, Bhayaja, and Shokaja (Amaja). However, certain specific disorder in which diarrhea is the major symptoms have been reported in ancient ayurvedic literature such as Ksheeralasaka, and Graha roga (Putana, Sheet putana, and Andha putana).

DEFINITION OF ATISARA

Atisara is the excessive passage of liquid through the anus. Brihatrayi. Acharya Dalhana on his commentary on Sushruta samhita stated that passing of watery stools in increased quantity is a characteristic feature of Atisara.

SYNONYMS OF ATISARA

The synonyms of atisara are Bhinnavarcha and Udaramaya.

ETIOLOGY OF ATISARA[16]

The etiology of Atisara is as follows: Excess intake of Guru, Snigdha, Ushna drava, and Sheeta food items. intake of incompatible food items, taking of food in Ajirna, Adhyasana,
In this Atisara stool is yellowish, greenish, or blackish in color, with foul smell and burning sensation, thirst, sweating, and fainting.

Kaphaja Atisara

In this Atisara stool is unctuous, white, slimy, thready, and heavy stool with mucus. Horripilation, nausea, and tenesmus are present.

Sannipataja Atisara

Due to imbalance of all doshas in Sannipataja Atisara, stool may be yellowish, greenish, bluish, or reddish in color and it may be painful or painless.

Shokaja Atisara

In this Atisara signs and symptoms are similar to Vataja atisara.

Amatisara

In condition of Amatisara, stool is passed with difficulty, is of various colors and large in number. Various authors have enumerated six types of Atisara (Vataja, Pittaja, Kaphaja, Sannipataja, Shokaja, and Bhayaja) but with a slight variation in respect to Bhayaja Atisara which has been replaced with Amaja Atisara by Sushruta. Charaka has included Amaja.
Atisara in Sannipataja-Atisara because grief and fear both have relation with psyche, so the description of Sushruta seems to be more logical.

Keeping in with the line of treatment Charaka has divided each Atisara in Ama and Pakva. It may be presumed that due to this reason Charaka has not mentioned Amaja Atisara separately. Few texts have mentioned Raktaja Atisara separately also, which has been said to be caused by consumption of Pitta enhancing diet in Pittaja Atisara.

**Atisara Nivritti Lakshana**

The symptoms of recovery from Atisara are- Proper elimination of urine, flatus, and stool, enhancement of Agni and feeling of lightness.

**Chikitsa Sutra**

Atisara chikitsa is planned after seeing the sama and nirma avasta of the dosa. Therapies which are mainly of deepana, pachana, and langhana should be adopted in the ama avasta of the disease. In the nirmavasta, the drugs which have stambhana properties are to be selected. Acharya Sushruta, Bhava Prakasha, and Bhaishaja Ratnavali all have stated that since the treatment of atisara is not apart from the treatment of ama and pakva, hence in all kinds of atisara signs and symptoms of ama and pakva should be determined first.

**Pathya**

The pathya of Atisara is as follows: Mand, vilapi, bilva, dhanyaka, mudga, dalaya, goat-milk, langhna, sleep, rest etc.

**Apathya**

The Apathya of Atisara is as follows: Pea, Nishpava, Barley, heavy and unctuous food, overeating, exertion, smoking, etc.

**PHARMACOLOGICAL ACTION OF NAGARADI YOGA AS FOLLOWS**

   Doshik Action: Kapha-Vata, Shamaka, Use: Rochan, Pachan, and Grahi
   Doshika Action: Kapha-Pitta Shamak, Use: Aam, Atisara, Visha, and Kriminashak
   Doshika Action: Kapha-Vata Shamak, Use: Deepan, Pachan, Grahi, and Krimignha
4. Indrayava: [23] Rasa: Katu, Virya: Sheeta, Doshika

**CONCLUSION**

Atisara (Diarrhea) is one of the most commonly occurring diseases in children, and it causes a large proportion of childhood death. This review drug (Nagar-Ativishadi yoga) is well described in Chakradatta,[25] Vrindamadhav,[26] and Bhaishyaj Ratnavali [27] for the management of different types of Atisara in children. It has Deepan, Pachan, Grahi, Krimignha, and Atisaraghna property and this drug also have antimicrobial activity against those microorganism which causes diarrhea in children. Hence, due to all these property, Nagar-Ativishadi yoga is used in childhood Atisara (diarrhea).

**REFERENCES**


**Source of Support:** Nil. **Conflict of Interest:** None declared.
Phytochemical study of Drakshadi yoga extracts W.S.R. Kasa

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Abstract

Aim of study: Phytochemical evaluation of the efficacy of Drakshadi yoga in the children suffering from Kasa. Drakshadi Yoga which contains Draksha, Pippali, Haritaki, and Vasa. Material and method: All these drugs have been described to have anti-cough properties and antimicrobial properties in different texts. Observation and result For the phytochemical study, the dried samples of contents of Drakshadi Yoga were re-suspended in high-performance liquid chromatography grade ethanol. In phytochemical study, out of the 7 phenolic standards used, Draksha contained 4 compounds, whereas vasa and Haritaki contains 5 compounds while Pippali contains 6 phenolic compounds, it means Drakshadi yoga having high antioxidant property.

Key words: Antioxidant property, cough, high-performance liquid chromatography, Kasa, phytochemical study

INTRODUCTION

Respiratory complaints are well-known clinical presentation in the modern medical science. They are classified under the broader heading of respiratory tract disorders, which contains group of different symptoms and diseases. In developing and even developed countries, pediatric outdoor patients department has more than 50% of patients having respiratory tract complaints,¹² in recent years, there has been an extraordinary increase of incidence related to respiratory system. According to National Center for Health Statistics, 62 million cases of common cold and cough occurs each year. Cough is the fifth most common symptom for which patients seek medical care. Kasa has been described under various categories in the classics of Ayurveda - as independent disease,³⁴ symptom⁵ complication,⁶ and sequel. Kasa is a common upper respiratory tract ailment prevalent nowadays, and it is increasingly annoying and irritating the individual in his routine activity. Nonjudicious use of antibiotics and corticosteroids⁷ in contemporary system of medicines during present era has led to the iatrogenic suppression of host immunity and birth of multidrug-resistant traits of pathogens.⁸ This phenomenon, in turn, results in the recurrence of respiratory tract infection.⁹ The developing countries dependent on traditional medicine for a variety of diseases.¹⁰ In the past two decades, there has been increased interest in the investigation of natural products as a source of new antibacterial agents. Several experimental studies have contributed scientific evidence for the pharmacological effects of medicinal plants observed in folk medicine.¹¹ Although to achieve the best result out of this holistic approach, it is essential to understand completely the basic fundamentals and also the approach of that system and has to prove these drugs on the standard of scientific parameters.

MATERIALS AND METHODS

The test plants were identified and authenticated in the Department of Botany, Banaras Hindu University, Varanasi, with the voucher specimen no. as given: 1. _Adhatoda vasica_ Nees. (Voucher specimen No. Acanth. 2017/4) 2. _Piper longum_ L. (voucher specimen No. Piper 2017/2) 3. _Terminalia chebula_ Retz. (voucher specimen No. Combret. 2017/1) 4. _Vitis vinifera_ L. (Voucher specimen no Vita. 2017/1).

The phytochemical study was conducted in the Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, BHU, Varanasi.

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For the study, drug extract was prepared in the Department of Dravyaguna, IMS BHU by the Soxhlet method of extraction. Ethanolic extract of each drug was collected in a separate sterile vial and preserved at temperature 4°C. The dried samples were re-suspended in high-performance liquid chromatography (HPLC) grade ethanol for HPLC analysis. Shimadzu LC-10A (Japan) was used that was equipped with the dual pump LC-10A binary system, ultraviolet detector SPD-10A, and Phenomenex (Torrance, USA) C18 column (RP-Hydro, 4 µm, 250 mm × 4.6 mm). Shimadzu Class VP series software was used to integrate the data separation of phenolics was achieved with acetonitrile/water (1:1 v/v) containing 1% acetic acid in a linear gradient program (Singh et al., 2009). The solvent flow rate was 1.0 ml/min.

The standards used for the study are given below:

<table>
<thead>
<tr>
<th>Standard</th>
<th>RT</th>
<th>Area (A1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallic acid</td>
<td>3.668</td>
<td>42990104</td>
</tr>
<tr>
<td>Fumaric acid</td>
<td>3.851</td>
<td>14086081</td>
</tr>
<tr>
<td>P-Aminobenzoic acid</td>
<td>5.409</td>
<td>43953033</td>
</tr>
<tr>
<td>Syringic acid</td>
<td>7.434</td>
<td>46304381</td>
</tr>
<tr>
<td>Succinic acid</td>
<td>10.343</td>
<td>1759363</td>
</tr>
<tr>
<td>Ferulic acid</td>
<td>10.884</td>
<td>67716478</td>
</tr>
<tr>
<td>P-Coumaric acid</td>
<td>11.201</td>
<td>16724881</td>
</tr>
</tbody>
</table>

The beneficial effects derived from phenolics compounds have been attributed to their antioxidant activity. It means Drakshadi yoga has high antioxidant property.

### OBSERVATION AND RESULT [TABLE 1]

In phytochemical study, out of the 7 phenolic standards used, **Draksha** contains 4 phenolic compound, i.e., gallic acid, fumaric acid, P-amino benzoic acid, and P-coumaric acid whereas **Vasa** contains 5 phenolic compounds, i.e., gallic acid, fumaric acid, syringic acid, succinic acid, and P-coumaric acid and **Pippali** contains 6 compounds as shown in the table. Ferulic acid was detected only in Haritaki, and syringic acid was not detected in Haritaki. Five phenolic compounds, i.e., gallic, fumaric acid, P-amino benzoic acid, succinic acid, and ferulic acid, were detected in Haritaki.

### DISCUSSION AND CONCLUSION

In phytochemical study, out of the 7 phenolic standards used, **draksha** contained 4 phenolic compounds, i.e., gallic acid, fumaric acid, P-amino benzoic acid, and P-coumaric acid whereas **Vasa** contained 5 phenolic compounds, i.e., gallic acid, fumaric acid, syringic acid, succinic acid, and P-coumaric acid and **Pippali** contained 6 compounds as shown in the table. Ferulic acid was detected only in Haritaki, and syringic acid was not detected in Haritaki. Five phenolic compounds, i.e., gallic, fumaric acid, P-amino benzoic acid, succinic acid, and ferulic acid, were detected in Haritaki. The beneficial effects derived from phenolics compounds have been attributed to their antioxidant activity. It means **Drakshadi yoga** has high antioxidant property.

### REFERENCES


Source of Support: Nil. Conflict of Interest: None declared.
A review on meditational plants described in Ayurvedic classics having antidiabetic activity

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Abstract

Ayurveda an ancient system of medicine is derived from two words Ayu and Veda, “Ayu means “Live or longevity” and Veda means “Science.” Ayurveda is one of the oldest systems of medicine which is still practicing worldwide today. Ayurvedic drugs are consider as safe because drugs are used in this system of medicine is natural in origin and obtain from plants, animals, and minerals. This review focuses on plants which are useful in diabetes mellitus. In the present era, diabetes is a common and major problem, and it is a metabolic disorder occurring due to lack of insulin or insensitivity of insulin receptor. In Ayurvedic classic, several plants are described which are found effective in diabetes and are discussed in the present paper.

Key words: Ayurveda, diabetes, insulin, medicine, plant etc.

INTRODUCTION

Ayurveda an Indian system of medicine primarily has two motives: To prevent the health of healthy individuals and to cure the diseased one. In ayurvedic system of medicine, plants, animals, and minerals are a source of drugs and considers as safe as synthetic medicine used in modern system of medicine.

About 25.8 million children and adults in the United States are affected by diabetes mellitus, and it is a major problem in India also. The percentage of diabetic patients is increasing rapidly in India. Demand of herbal medicines is highly increasing in the past few years because of their natural origin, low cost of the product, and less side effect to the body. In Ayurveda and other traditionally used medicinal system, more than hundred medicinal plants are used in the treatment of the diabetes mellitus. An expert committee of the World Health Organization (WHO) is so much interested in the investigation of diabetes treatment method in Ayurveda system of medicine.¹

ETYMOLOGY

The term diabetes mellitus is derived from Greek word diabetes which means “To go through.” Diabetes is a chronic metabolic disorder characterized by increased level of blood glucose in the body due to improper function of insulin. Insulin hormone is highly required to convert carbohydrate, starch, sugar, and other food into energy.

TYPES OF DIABETES

Diabetes mellitus is two types:

• Type-1: It is insulin-dependent diabetes, in which pancreas produced little or no insulin and usually diagnosed in children, young adults and it appears in any stage.

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E-mail: ashwinikumarkushwaha2014@gmail.com
Table 1: List of some common plant found in India having antidiabetic activity

<table>
<thead>
<tr>
<th>Classical/Common name</th>
<th>Botanical Name</th>
<th>Family</th>
<th>Part Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilva/Bael</td>
<td>A. marmelos</td>
<td>Rutaceae</td>
<td>Fruit, Leaves</td>
</tr>
<tr>
<td>Palaandu/Pyaja</td>
<td>A. cepa</td>
<td>Amaryllidaceae</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Rason/Lahsun</td>
<td>A. sativum</td>
<td>Liliaceae</td>
<td>Ripe bulbs</td>
</tr>
<tr>
<td>Kalmegh</td>
<td>A. paniculata</td>
<td>Rutaceae</td>
<td>Whole</td>
</tr>
<tr>
<td>Nimba/Neem</td>
<td>A. indica</td>
<td>Meliaceae</td>
<td>Whole bulbs</td>
</tr>
<tr>
<td>Kuberaksha/Kantakikaranja</td>
<td>C. bonducella</td>
<td>Leguminosae</td>
<td>Twak, Leaf, Flower</td>
</tr>
<tr>
<td>Bimbi/Kundaru</td>
<td>C. indica</td>
<td>Cucurbitaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Haridra/Haldi</td>
<td>C. longa</td>
<td>Zigeraceae</td>
<td>Rhizome</td>
</tr>
<tr>
<td>Meshashringi/Gurmar</td>
<td>G. sylvestre</td>
<td>Asclepiadaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Sakkarkand</td>
<td>I. batatas</td>
<td>Convolvulaceae</td>
<td>Rhizome</td>
</tr>
<tr>
<td>Jambu/Jamuna</td>
<td>S. cumini</td>
<td>Myrtaceae</td>
<td>Fruit, leaf, stem bark</td>
</tr>
<tr>
<td>Karvellaka/Karela</td>
<td>M. charantia</td>
<td>Cucurbitaceae</td>
<td>Fruit, leaf</td>
</tr>
<tr>
<td>Kadali/Banana</td>
<td>M. paradisiacal</td>
<td>Musaceae</td>
<td>Seed, fruit</td>
</tr>
<tr>
<td>Sursa/Tulsi</td>
<td>O. sanctum</td>
<td>Labiatae</td>
<td>Dry leaf</td>
</tr>
<tr>
<td>Bhumamalki</td>
<td>P. amarus</td>
<td>Euphorbiaceae</td>
<td>Whole</td>
</tr>
<tr>
<td>Kasthdaru</td>
<td>P. longifolia</td>
<td>Annonaceae</td>
<td>Bark</td>
</tr>
<tr>
<td>Bijaka/Indian Malabar</td>
<td>P. marsupium</td>
<td>Leguminosaeae</td>
<td>Sara</td>
</tr>
<tr>
<td>Methika/Methi</td>
<td>T. foenum</td>
<td>Papilionaceae</td>
<td>Seed</td>
</tr>
<tr>
<td>Guduchi</td>
<td>T. cordifolia</td>
<td>Menispermaceae</td>
<td>Whole</td>
</tr>
<tr>
<td>Pishach karpas/Devil cotton</td>
<td>A. augustum</td>
<td>Sterculiaceae</td>
<td>Root</td>
</tr>
<tr>
<td>Talispatra</td>
<td>A. pindrow</td>
<td>Pinaceae</td>
<td>Root, leaf</td>
</tr>
<tr>
<td>Shallaki</td>
<td>B. serrata</td>
<td>Burseraceae</td>
<td>Gum, resin</td>
</tr>
<tr>
<td>Kanchnaar/Orchid tree</td>
<td>B. variegata</td>
<td>Fabaceae</td>
<td>Bark</td>
</tr>
<tr>
<td>Amalaki</td>
<td>E. officinalis</td>
<td>Phyllanthaceae</td>
<td>Fruit, seed, leaf</td>
</tr>
<tr>
<td>Bhringraj</td>
<td>E. alba</td>
<td>Asteraceae</td>
<td>Whole</td>
</tr>
<tr>
<td>Aadhaki/Arhar</td>
<td>C. cajan</td>
<td>Fabaceae</td>
<td>Leaf, seed, fruit</td>
</tr>
<tr>
<td>Asvatha/Peepal</td>
<td>F. religiosa</td>
<td>Moraceae</td>
<td>Bark</td>
</tr>
<tr>
<td>Tea</td>
<td>C. sinensis</td>
<td>Theaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>Marsh barbel</td>
<td>H. auriculata</td>
<td>Acanthaceae</td>
<td>Aerial part</td>
</tr>
<tr>
<td>Madhuka/Mulethi</td>
<td>G. glabra</td>
<td>Fabaceae</td>
<td>Root</td>
</tr>
<tr>
<td>Anantmula</td>
<td>H. indicus</td>
<td>Asclepiadaceae</td>
<td>Root</td>
</tr>
<tr>
<td>Hapusa/Juniper berry</td>
<td>J. communis</td>
<td>Cupressaeceae</td>
<td>Dried berries</td>
</tr>
<tr>
<td>Akshota/Walnut</td>
<td>J. regia</td>
<td>Juglandaceae</td>
<td>Root, unripe fruit</td>
</tr>
<tr>
<td>Tandula/Rice bran</td>
<td>O. sativa</td>
<td>Gramineae</td>
<td>Root, coat seed</td>
</tr>
<tr>
<td>Maruaka/Vantulsi</td>
<td>O. vulgare</td>
<td>Lamiaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>Kaidarya/Curry leaf</td>
<td>M. koenigii</td>
<td>Rutaceae</td>
<td>Leaf, fruit juice</td>
</tr>
<tr>
<td>Aamra/Mango</td>
<td>M. indica</td>
<td>Anacardiacaeae</td>
<td>Stem bark, leaf</td>
</tr>
<tr>
<td>Karvi/Black cumin</td>
<td>N. sativa</td>
<td>Ranunculaceae</td>
<td>Oil seed</td>
</tr>
<tr>
<td>Bhallatak</td>
<td>S. anacardium</td>
<td>Anacardiacaeae</td>
<td>Fruit, nut</td>
</tr>
<tr>
<td>Asvagola/Ispaghula husk</td>
<td>P. ovata</td>
<td>Plantaninaceae</td>
<td>Seed, husk</td>
</tr>
<tr>
<td>Erandarkarati/Papaya</td>
<td>C. papata</td>
<td>Caricaceae</td>
<td>Leaf</td>
</tr>
<tr>
<td>Babhul</td>
<td>A. Arabica</td>
<td>Leguminosaeae</td>
<td>Stem bark, fruit</td>
</tr>
<tr>
<td>Ghritkumari</td>
<td>A. barbadensis</td>
<td>Asphodelaceae</td>
<td>Gel, leaf</td>
</tr>
<tr>
<td>Ashwagandha</td>
<td>W. somnifera</td>
<td>Solanaceae</td>
<td>Root</td>
</tr>
</tbody>
</table>

(Contd...)
Upadhyay, et al.: Medicinal plants with anti diabetic activity

• Type-2: It is non-insulin-dependent diabetes, in which body cells cannot use blood sugar efficiently for energy possibly due to insulin resistance, and especially, occur in older age.

SYMPTOMS OF DIABETES MELLITUS

Frequent urination, weight loss (Type 1), fatigue, excessive thirst, high blood level of glucose, nausea, vomiting, and blurred vision.

AYURVEDIC VIEW ON DIABETES MELLITUS (MADHUMEHA)

In Ayurvedic literature, diabetes mellitus is considered as Madhumeha. Acharya Charaka in Charaka Samhita Sutra Sthana seventeen beautifully described its pathogenesis, excessive intake of heavy, oily, acidic and salty diet, intake of newly mature grains and excess of liquids, habits of sleeping on a comfort bed, free from any worry and exercise, devoid of any biopurification, and increase the amount of Kapah, Pitta, Meda, and Maans in the body, these excess amount obstructed the flow of Vayu (air), and hence, Vayu gets aggravated and this aggravated vayu takes oja dhatu in the vasti (urinary bladder) region and produced kricchasadhya (control with difficulty) and Madhumeha (diabetes mellitus).\(^2\)

MEDITONAL PLANT USED AS ANTIDIABETIC

The term “medicinal plant” includes various types of plants used as medicines. The ancient Acharya believed that plants are only solutions to cure a number of health-related problems and diseases. They conducted several studies about the same and experimented to arrive at exact conclusions about the efficacy of different herbs that have medicinal value. The ethnobotanical information reports suggested that near about 800 plants have antidiabetic potential.\(^3\) Most of the medicines, thus prepared, are free of any side effects or reactions, and due to this reason, herbal medicines are growing in popularity across the globe. The plants having medicinal properties provide rational means for the treatment of several diseases, which are otherwise considered difficult to cure.

LIST OF AYURVEDIC MEDICINAL PLANTS WITH ANTIDIABETIC ACTIVITY AND RELATED BENIFICAL PROPERTY

1. Momordica charantia: It contains Charantin, ascorbic acid, and momordicine chemicals. Fruit decoction of karela taking in the morning empty stomach at least 1 month it is helpful to bring back the blood glucose level normal. Ethanolic extracts of M. charantia (200 mg/kg) showed a hypoglycemic effect on normal and Streptozotocin induce diabetic rats.\(^4\)
2. *Gymnema sylvestre*: It contains gymnemic acid, gymnastrogenin, and gymnemagenin chemicals. It cures diabetes by decreases high glucose level in the blood and leads to proper functioning of insulin and also minimizes or stops eating sweets in the diabetes patients. According to the Sushruta it helps to care for Madhumeha, i.e., glycosuria.[5]

3. *Mangifera indica*: It contains mangiferin, catechin, and protocatechin acid. The aqueous extract produces decreases of blood sugar level in normoglycemic but no any effect on streptozotocin diabetic-induced mice under the same condition compared oral dose of chloropamide. Thus, *M. indica* shows hypoglycemic activity.[6]

4. *Allium cepa*: It contains flavonoids, flavonols, cycloalliin, quercetin-3-glucoside, fructose, and mannose. The dried onion powder produces antihyperglycemic activity in diabetic rabbits by various ether soluble fractions as well as insoluble fractions. S-methyl cysteine sulfoxide (SMCS) (200 mg/kg for 45 days) sulfur-containing compound amino acid from *A. cepa* to alloxan-induced diabetic rats controlled blood glucose. Single dose of onion juice (50 gm) taken orally decreases post-prandial glucose level in diabetic patients.[7]

5. *Allium sativum*: It contains sulfur-containing compounds that is Allin, which is produced enzymatically from Allin. It also contains 2.3% organosulfur compound, 28% carbohydrate, 2% proteins, 2% free amino acid (mainly arginine), 65% water, 1.5% fiber, 0.15% lipids, 0.07% saponins, and 0.08% phytic acid. In *Allium sativum*, a sulfur-containing compound Allin showed to have important hypoglycemic activity due to improved hepatic metabolism, better insulin release from pancreatic beta cells.[9]

6. *Aegle marmelos*: It contains tannins, alkaloids (agueeline and aegelin), active principle (marmelosin), and coumarin (marmesin). The leaf extract of *A. marmelos* shows hypoglycemic activity in streptozocin-induced diabetes.[9]

7. *Acacia arabica*: It contains mixture of calcium, potassium, and magnesium salts of Arabic acid. The gum also contains peroxidase, pectinase and oxidase, and L-arabinose. The plant extract of *A. arabica* acts as an antidiabetic agent by increasing the secretion of insulin. When administer 2, 3, and 4 g/kg body weight, seed fine particles of *Acacia arabica* to normal rabbit’s induce hypoglycemic effect by enhancing release of insulin from b cells.[10]

8. *Azadirachta indica*: *Azadirachta indica* also containing nimbidinin, nimbin, nimboline, nimbidic acid and nimbinin. Gedunin is a major source from neem’s seed. It also contains tannin, gallic acid, margolonen and polysaccharide. It also contains azadirachitin, mahmoodin. Hydroalcoholic extract of *Azadirachta indica* showed anti-hyperglycemic effect and hypoglycemic effect in normal streptozocin induced diabetic rats because deposition of glycogen in the isolated rat hemidiaphragm.[9]

9. *Coccinia indica*: It contains flavonoids, resins, alkaloids, fatty acids, asparagine, and proteins in high amount. Methanolic fruit extract contains glutamic acid, saponin, tannin, steroids, and ellagic acid. *C. indica* decreases blood glucose level in diabetic patient treated with dried extract for 6 weeks. It has restore lipoprotein lipase enzyme activity, lactate dehydrogenase, and glucose 6 phosphatase which was increased in diabetic patient.[10]

10. *Curcuma longa*: It contains curcumin, volatile oils, curcuminoids, zingiberene, sesquiterpenes, zingiberene, and resins. Aqueous extract dose of *C. longa* after 30 min incubation shows hyperglycemic condition to inhibit release insulin and decreases oxidative stress in diabetic animals.[11]

11. *Murraya koenigii*: It contains quercetin, carboxale, and murrayacine chemicals. It is very beneficial for Type 1 diabetic patient. Everyday chewing of 6–8 *Murraya koenigii* leaves reduces glucose level in blood.[12]

12. *Pterocarpus marsupium*: It contains pterostilbene and pterocarpol. It helps renewal of the damaged beta cells. The presence of tannates chemical in *P. marsupium* plant extract shows hypoglycemic activity. Studies have revealed that ethanol and aqueous extracts of PM heartwood, their subfractions, and (-)-epicatechin from *Pterocarpus marsupium* bark increase insulin release. Ethanol extract of PM heartwood given for 10 days increased serum insulin concentration in Streptozotocin-induced diabetic rats.[13] Flavonoids fraction *P. marsupium* shows pancreatic B-cell regeneration activity.[14]

13. *Ocimum sanctum*: It contains volatile oil such as eugenol and carophyllene, flavonoids, saponins, and triterpenoids such as ursoic acid and rosmaninic acid. The leaf aqueous extract of *O. sanctum* reported decreases in blood glucose level in both normal and induced diabetic rats (by alloxan).[15,16] A mild changes or decreases in total cholesterol levels were also noted.

14. *Phyllanthus amarus*: This plant is rich in chemical components such as brevifolin, carboxylic acid, astragalin, methyl salicylate, alkaloids, cymene, lignans, ellagic acid, nirurin, niruretin, niruriside and phyllanthin etc. Conventionally, *P. amarus* is used in diabetes treatment. The methanolic plant extract also decreases the blood glucose level in alloxan diabetic rats.[17]

15. *Trigonella foenum graecum*: It contains carbohydrates, fiber, proteins, and amino acid such as 4-hydroxyleucine. Chemicals isolate from *Trigonella foenum graecum* seed fibers, proteins, and saponins given 21 days to alloxan induce diabetic dog, and it shows antihyperglycemic activity with decrease high plasma glucose. *Trigonella foenum graecum* seeds also increase glucose metabolism and normalize creatinine kinase activity in skeletal muscle, heart, and liver of diabetic rats.[18]

16. *Enicostemma littorale*: It is a rich source of bitter principle like swertimarine, ophelic acid, and alkaloids such as gentianine and tannins. Methanolic extract of *E. littorale* shows hypoglycemic activity and antioxidants property. This extract increases insulin lavel and antioxidant property also in diabetic induce rats.[19]

17. *Andrographis paniculata*: It contains bitter substance
such as Kalmeghin and andrographolide and also contains diterpene lactones. It decreases blood glucose level by the glucose tolerance test. Ahmad and Asmawi reported that the drug inhibits glucose absorption in the intestine.\textsuperscript{[20]}

18. *Caesalpinia bonducella*: It contains Caesalpinia F and bitter principle such as bonducin. Karanj aqueous extract was tasted in fasted, fed, glucose-loaded and streptozocin-induced diabetic rat. This drug shows a positive effect in streptozocin-induced diabetic rat, alloxan diabetic rat, and glucose loaded. This drug is best oral hypoglycemic agents.\textsuperscript{[21]}

19. *Musa paradisiaca*: It is a rich source of vitamins, carbohydrates, minerals, and proteins such as albumin, glutelaine, prolamine, and globulin. Amylose presents in unripe fruit. It also contains iron, calcium, sodium, gamma aminobutyric acid, magnesium, and phosphorus. Vitamins present in fruits are niacin, ascorbic acid, foliac acid, carotene, and inositol. The hypoglycemic effect of green and mature fruits of *M. paradisiaca* methanolic extract reduces blood glucose level normal and chlorpropamide induce diabetic rats.\textsuperscript{[22]}

20. *Polyalthia longifolia*: It contains alkaloids, polyphenolic compound, saponin, glycosides, tannins, and diterpenoids. The chloroform extract of stem bark of Kasthodaru was examined by alloxan induce diabetic rat and euglycemic rats after a single dose of 200 mg/kg p.o and prolonged treatment of 100 mg/kg p.o for 10 days. The results show antihyperglycemic activity (P<0.01). Glibenclamide showed hypoglycemic activity in euglycaemic rats, but the said extract did not show hypoglycemic activity.\textsuperscript{[23]}

21. *Tinospora cordifolia*: It contains alkaloids, steroids, diterpenoid lactones, phenolic, aliphatic compounds, sesquiterpenoid, and glycosides. Calcium and phosphorus are present major amount in leaf. Root extract of *T. cordifolia* orally administered for 6 weeks, it reduces blood and urine glucose level in lipids, serum, and tissue in alloxan-induced diabetic rats. Alcoholic and aqueous extract of guduchi reduces blood glucose level and increases glucose tolerance in rodents.\textsuperscript{[24]}

**DISCUSSION**

In Ayurvedic literature, diabetes mellitus is considered as Madhumeha, it is a type of Vataja Prameha and caused by aggravation of Vata either due to obstruction of channels created by Kapha, Pitta, Meda, and Mansa or due to Dhatu Kshaya. In Ayurveda, plants are a natural source of drugs; their medicinal value are studied by different scholars for antidiabetic activity, and most of the plants along with hypoglycemic activity also show antioxidant activity as required in diabetic patient (Table 1). Traditional medicinal plants having bitter and astringent taste shows hypoglycemic activity due to their Kapha and Pitta pacifying action medo shoshak properties.

**CONCLUSION**

Diabetes is probably the world’s highest growing metabolic disease, herbal medicines are more and more becoming trendy, and hence, it is careful to search for options from medicinal plant extracts for new antidiabetic hypoglycemic substances. Plant products can be used as adjuvant or even may change the artificial drugs in the antidiabetic treatment, as they have no confirmed side effects. Therefore, there is a need of more well-documented clinical trials and more laboratory work to isolate the active principles in medicinal plants and their pharmacological actions and toxicity.

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Ethnopharmacology and pharmacology of Kigelia africana (Lam.) Benth.

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Abstract

African plant Kigelia africana (Lam.) Benth. belonging to the family Bignoniaceae is widely distributed in the South, Central, and West Africa. Tree of K. africana is approximately 20 m long, either evergreen or deciduous depending on the rainfall condition in different part of the world. Due to its huge sausage or cucumber-like fruit, K. africana is commonly referred to as sausage or cucumber tree. Different parts of K. africana have been used for various medicinal purposes in different parts of the world. In India, K. africana is well known as Balmkheera. A very famous slogan is used in different parts of Uttar Pradesh (India) for K. africana as “Balamkheera jo bana de pet ko heera.” Different parts of this plant used by ethnic groups throughout the world for the treatment of common skin diseases such as fungal infections, psoriasis, eczema, boils, leprosy, syphilis, skin cancer, gynecological complaints, constipation, tapeworm infection, jaundice, ulcers, sores, pneumonia, diabetes, and waist pain. Pharmacological activities of different extracts as well as isolated compounds of the plant are reported as analgesic, antipyretic, anti-inflammatory, hepatoprotective, antidiabetic, antibacterial, antifungal, nematocidal, antiamebic, antiviral, antitrypanosomal, antiamebic, antimalarial, antidiarrheal, anticancer, antioxidant, aphrodisiac, and wound healing activity have been studied using different methods. In the present article, data have been collected on the ethnopharmacology and pharmacology of K. africana up to June 2017.

Key words: Balamkheera, Kigelia africana, Muratina, sausage tree

INTRODUCTION

Kigelia africana, belongs to the family Bignoniaceae, is native from Africa.[1] It is widely distributed in the South, Central, and West Africa. Plant of K. africana is a moisture-loving tree mostly found on river banks, along streams, in floodplains of Nigeria, Cameroon, Kenya, Guinea, Senegal, and open woodland from KwaZulu-Natal (South Africa) to Tanzania, Chad, and Namibia.[2] In India, K. africana is well known as Balmkheera. A very famous slogan is used in different parts of Uttar Pradesh (India) for K. africana as “Balamkheera jo bana de pet ko heera.”[3] Due to its huge sausage or cucumber-like fruit, K. africana is commonly referred to sausage or cucumber tree.[4] Tree of K. africana is approximately 20 m long, either evergreen or deciduous depending on the rainfall condition in different parts of the world.[5] The bark of K. africana is gray and smooth at young while peeling occurs on older tree. It can be 6 mm thick on a 15 cm branch.[6] The leaves of K. africana are about 30–50 cm long, pinnate, and leaflets are up to 20 cm long and 6 cm broad.[7] The wood of plant is pale brown or yellowish in color.[8] Flowers of K. africana are bell-shaped, orange-to-red or purplish green with up to 10 cm width. It hangs down from branches on long flexible stems and bloom at the night.[9] Flower of K. africana has five-lobed calyx and corolla. Corolla is yellowish on outside and purplish on inside.[10] The fruit of K. africana is incredibly large, and it can grow up to 1 m × 18 cm with a weight up to 12 kg.[11] The fruit of K. africana is indehiscent with a woody wall and heavily marked with lenticels at the pod surface. The fruit of K. africana is gray-brown in color and contains many seeds when matured.[5] The fruit of the plant is fibrous and unripe fruit being poisonous when taken internally.[12] Although the unripe fruits of K. africana are toxic yet it is used externally as a medicine in Africa.[10]

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ETHNOPHARMACOLOGY

Different parts of K. africana have been used for various medicinal purposes in different parts of the world.[2] The tree is most widely used in the treatment of various common skin diseases such as fungal infections, psoriasis, eczema, boils, leprosy, syphilis, and skin cancer.[13] Root decoction of K. africana is drunk to treat gastrointestinal problems.[14] In Nigeria, decoction of the roots of K. africana is used in antenatal and post-natal disorders, fibroid, and conception.[15] In South Africa and Ethiopia, hot macerated of the roots of K. africana is taken orally in gynecological complaints, constipation, and tapeworm infection.[16] The root bark of K. africana is also recommended for the treatment of uterus cancer.[17] Root barks of K. africana are also useful in the treatment of venereal diseases, hemorrhoids, and rheumatism.[18] Stem bark of K. africana is useful in the treatment of rheumatism, dysentery, venereal diseases, gynecological conditions, hemorrhages, epilepsy, wounds, sores, abscesses, diarrhea, and edema.[19] In Cameroon, decoction of stem bark was taken orally as abortifacient, in the treatment of filariasis and cataract.[20] In Tanzania and Nigeria, hot decoction of stem bark was taken orally after parturition as galactagogue.[21] In South Africa and Cameroon, decoctions of powdered stem bark were mixed in porridge and taken orally for the treatment of infertility.[21,22] The decoction of the stem bark of plant is drunk for relief from headaches and treatment of epilepsy.[14] Infusion of stem bark of K. africana was taken orally in the treatment of hyperpyrexia and gonorrhea in Tanzania.[23] In Benin, Ivory Coast, and South Africa, decoction of the leaves of the plant is drunk for the treatment of jaundice. [24] Ash of K. africana leaves is mixed with honey and used for the treatment of high blood pressure.[14] In Central Africa, unripe fruit of K. africana is used for the dressing of wounds, for the treatment of rheumatism and hemorrhage.[25] In Botswana, K. africana fruits are boiled with milk, cooled, and taken orally as sexually transmitted diseases remedy.[26] In Tanzania, K. africana fruits are boiled and taken orally for the treatment of anemia, especially for pregnant women.[23] The paste of K. africana fruits is used for leprosy in Kurukshetra district in Haryana (India). In Africa and India, the paste of powdered K. africana fruits is rubbed around the infected area of skin for the treatment of skin cancer and to reduce the breast metastasis.[27] In Central Africa, K. africana fruits are used to treat rheumatism.[14] Tonga women of Zambezi valley regularly apply cosmetic preparation of K. africana fruits on their faces to ensure a blemish-free complexion. [28] Unripe K. africana fruits are used as vermifuge.[29] Beer (Muratina) prepared from the extract of K. africana fruits is used during children bath for the treatment of measles. Either fresh or crushed dried fruits of K. africana are used for the treatment of ulcers, sores, and syphilis.[31] In South Africa, chopped stem bark and fruits of K. africana are boiled in 2 L of water for 1 h, cooled before straining, and taken orally half a cup thrice a day for blood cleansing and pelvic pains during pregnancy. For the treatment of dysmenorrhea, equal amounts of dried or fresh stem bark of K. africana and Searstia nebulosa are mixed together and three handfuls are boiled in 2 L of water for 30 min and cooled before straining, and half a cup of this decoction is taken twice a day.[21] In Namibia and South Africa, stem and leaves of K. africana are crushed together, boiled in water till concentrate, and used to wash or rub onto the infected skin parts for the treatment of eczema and herpes.[30] Fruits and stem bark of K. africana ground and boiled in water and taken orally for the treatment of stomach ailments usually worms infection in children.[31] In South Africa, a handful of leaves and roots of K. africana, chopped Hypoxis hemerocallidea corn, and crushed Senecio serrulatoides are boiled in 5 L of water and half a cup taken thrice a day for the treatment of sexually transmitted infections and sores.[32] K. africana fruits, stem bark, and roots are boiled and used medicinally to cure post-parturition hemorrhage.[33] K. africana is also used for internal applications including the treatment of dysentery, worm infestations, pneumonia, toothache, malaria, diabetes, venereal diseases, convulsions, and antidote for snakebite.[22,23,34] In South Africa, roasted seeds of K. africana are eaten for the treatment of pneumonia, malaria, diabetes, and waist pain and applied on the affected area of the body to cure fungal infection and eczema.[5,35] In Kenya, the roasted seeds of K. africana are mixed with beer and taken orally for the enlargement of sexual organs.[36]

PHARMACOLOGICAL ACTIVITIES OF K. AFRICANA

Analgesic Activity

Methanol extract of the stem bark of K. africana (100, 200, and 500 mg/kg body weight orally) was evaluated using hot plate test and mouse writhing assay in mice for the evaluation of analgesic activity. A significant dose-dependent decrease in writhing was recorded in the extract-treated (500 mg/kg body wt. p.o.) and aspirin-treated (100 mg/kg body wt. i.p.) mice (29.6 ± 7.31 and 36.8 ± 5.8/30 min, respectively) as compared to the control mice (85.0 ± 1.34/30 min). Intrapitoneal injection of acetic acid (0.6% in normal saline, at a dose of 10 mL/kg body weight) was administered 60 and 30 min, respectively, before the administration of test and standard drugs. In the mouse writhing assay, extract caused statistically significant (P < 0.0001) inhibition of the number of writhes. Extracts at the dose of 200 and 500 mg/kg produced a higher inhibition as compared to standard drug aspirin (100 mg/kg). The inhibitory effect was 139 and 124% of the effect produced by aspirin at 200 and 500 mg/kg doses, respectively. The extract failed to increase mice reaction time on hot plate. The difference between the mean reaction time of the K. africana-treated groups and the control group was not statistically significant at all doses tested. Its effect was not comparable to morphine which had a mean reaction time of more than 2 min which was the cutoff point (P < 0.0001).[37] Inhibition of acetic acid-induced writhing in mice suggests that the analgesic effect of the extracts may be
peripherally mediated through the inhibition of the synthesis and release of prostaglandins.[30] Analgesic activity of the roots of *K. africana* was found less effective as compared to its stem, leaves and fruits.[16,39] The methanol extract of flowers of *K. africana* decreased the number of acetic acid-induced writhing in mice treated orally at the dose of 100, 200, and 400 mg/kg as compared to control animals. The analgesic activity of the extract was found in dose-dependent manner with inhibition of writhing of 48.72%, 53.42%, and 80.77%, respectively, for the designated doses of the extract, whereas the standard drug (diclofenac sodium 20 mg/kg) showed writhing inhibition of 76.50%. Reaction time was prolonged significantly and dose dependently in hot plate test at different time intervals. The extract also decreased the number of licking times of the hind paw in both the first and second phases in formalin-induced nociception in mice.[39]

Analgesic activity of ethanol extract of the leaves of *K. africana* was carried out using hot plate method on albino rats. Paracetamol (150 mg/kg) was used as standard drug. The extract at the dose of 100, 200, and 400 mg/kg showed statistically significant elongation in hot plate reaction time (*P* < 0.0001) as compared with the standard drug paracetamol (150 mg/kg). The extract at the dose of 400 mg/kg was found more effective than the standard drug paracetamol.[40]

**Antipyretic Activity**

The methanol extract of stem bark of *K. africana* showed antipyretic activity on turpentine-induced pyrexia in male Wistar rats. Administration of extract (50, 100, and 150 mg/kg body weight) showed decrease in the level of elevated rectal temperature in dose-dependent manner. Aspirin (100 mg/kg body weight) was used as reference drug. The maximum antipyretic activity of extracts was occurred in the 4th h (50 mg/kg, 100 mg/kg, and 150 mg/kg body weight) as well as the aspirin reduced elevated rectal temperature by 1.41%, 2.09%, 3.07%, and 2.40%, respectively, indicating slow but steady passive diffusion of the bioactive compounds across the cell membrane. The antipyretic activity of the extract at the dosages of 50 mg/kg and 100 mg/kg body weight showed no statistically significant difference (*P* > 0.005) as compared with the control group. However, the group treated with extract at the dosage of 150 mg/kg body weight was comparable to the group of rats treated with standard drug aspirin (*P* > 0.05).[41]

**Anti-inflammatory Activity**

Anti-inflammatory activity of methanol extract from the leaves of *K. africana* was evaluated in carrageenan-induced paw edema in rats. Methanol extract showed a significant anti-inflammatory activity at the dose level of 150 mg/kg as compared to the standard drug diclofenac sodium (15 mg/kg body weight) by reducing the hind paw diameter by 0.21% and 1.10%, respectively.[42] The ethanol extract of stem bark at the dosage of 100, 200, and 500 mg/kg body weight has been reported to have anti-inflammatory activity against carrageenan-induced paw edema in guinea pigs. Indomethacin was used as a reference drug. It was found that extract showed anti-inflammatory effect in a dose-dependent manner with maximum activity at the dose of 500 mg/kg body weight dose. Reduction in the paw volume in animals treated with the extract (500 mg/Kg) was found comparable with the standard drug indomethacin (10 mg/Kg), the percentage inhibition produced by the extract was 98% at the 24h, 94.8% at the 34h, and 85% at the 5th h.[37]

Compounds, verminoside, and verbascoside isolated from the methanol extract of fruits showed anti-inflammatory activity. It was found that verminoside inhibits the nitric oxide synthase (iNOS) and NO release from macrophages as stimulated by bacterial lipopolysaccharides,[11] while verbascoside inhibits nuclear factor-κβ activation, tumor necrosis factor-α release, iNOS activity, and nuclear translocation.[43,44]

**Hepatoprotective Activity**

Aqueous leaves extract of *K. africana* showed significant hepatoprotective activity in paracetamol-induced liver damage in rats.[45]

Methanol extract of the fruits of *K. africana* was assessed for its effect in CCL4-induced liver toxicity in male Wistar rats. Silymarin (50 mg/kg) was used as a standard drug. *K. africana* fruits extract are found to be toxic (but not fatal) to Wistar rats when given at the dose of 100, 200, and 400 mg/kg orally. *K. africana* fruit extracts changes the growth rates, cytoplasmic fatty vacuolation, and necrosis of the centrilobular hepatocytes in the liver attributed to the increases in the activity of enzyme aspartate aminotransferase and lower concentration of albumin and decreased activity of alanine transaminase.[40] *K. africana* fruit extract (100 mg/kg) showed protective effects for liver disease due to its ability to act as an antioxidant.[45]

**Antidiabetic Activity**

Methanol extract of the leaves of *K. africana* (100–400 mg/kg) was evaluated for its antidiabetic activity in alloxan (120 mg/kg)-induced diabetic rats where glibenclamide (5 mg/kg) was used as a standard drug.

Methanol extract of the plant at the dose of 200–400 mg/kg decreases the level of blood glucose significantly while extract at the dose of 100 mg/kg failed to do so. Treatment of diabetic rats with methanol extract (200–400 mg/kg) of the plant produced a significant reduction in serum levels of triglyceride and cholesterol in a dose-dependent manner which was found comparable to standard drug glibenclamide.[47]

Daily administration of the defatted methanol extract (for 21 days) of flower of *K. africana* in streptozotocin-induced
Antibacterial Activity

Antibacterial screening of different stem bark extracts as well as isolated compound was carried out using disk diffusion method using amoxicillin (2 mg/discs) as positive control. Negative control was prepared using 10% dimethyl sulfoxide as a solvent. The methanol extract of stem bark was suspended in water and successively extracted with n-hexane-EtOAc, EtOAc, and water. One Gram-positive bacteria, *Staphylococcus aureus* CIP 7625, and three Gram-negative bacteria, *Pseudomonas aeruginosa* CIP 76110, *Salmonella typhi*, and *Escherichia coli* ATCC 25922, are used as test microorganisms. Zone of inhibition (mm) of methanol extract of stem barks was found to be 6.0 ± 0.0, 6.0 ± 0.0, 0.0 ± 0.0, and 0.0 ± 0.0 for *E. coli*, *P. aeruginosa*, *S. typhi*, and *S. aureus*, respectively. Zone of inhibition (mm) of n-hexane-EtOAc fraction for *E. coli*, *P. aeruginosa*, *S. typhi*, and *S. aureus* was found to be 6.0 ± 0.0, 6.0 ± 0.0, 0.0 ± 0.0, and 7.0 ± 0.0, respectively. EtOAc fraction showed that zone of inhibition for *E. coli*, *P. aeruginosa*, *S. typhi*, and *S. aureus* was found to be 0.0 ± 0.0, 0.0 ± 0.0, 0.0 ± 0.0, and 6.0 ± 0.0, respectively. Zone of inhibition of aqueous fraction of stem bark was found to be 6.0 ± 0.0, 7.0 ± 0.0, 6.0 ± 0.0, and 8.0 ± 0.0 for *E. coli*, *P. aeruginosa*, *S. typhi*, and *S. aureus*, respectively, while the zone of inhibition of standard drug amoxicillin for *E. coli*, *P. aeruginosa*, *S. typhi*, and *S. aureus* was found to be 0.0 ± 0.0, 6.0 ± 0.0, 0.0 ± 0.0, and 0.0 ± 0.0, respectively.[49]

Isolated compound 2-acetylfuro-1, 4-naphthoquinone showed the zone of inhibition 6.0 ± 0.0 mm for *P. aeruginosa* and *S. aureus*. Zone of inhibition of p-coumaric acid was found to be 6.0 ± 0.0 mm for *E. coli*, *P. aeruginosa*, and *S. aureus* while 7.0 ± 0.0 mm for *S. typhi* at the concentration of 0.452 mg/mL. Caffeic acid showed sensitivity only against *E. coli* with a zone of inhibition 6.0 ± 0.0 mm. Isolated compound 2-(4-hydroxyphenyl) ethyl ester showed zone of inhibition 6.0 ± 0.0 mm for *E. coli* and *P. aeruginosa*. Kigelolin showed antibacterial activity against *E. coli* and *S. aureus* with zone of inhibition 6.0 ± 0.0 mm and 8.0 ± 0.0 mm, respectively. β-friedelin showed the zone of inhibition against *P. aeruginosa* (6.0 ± 0.0 mm) and *S. aureus* (6.0 ± 0.0 mm) at the concentration of 1.7575 mg/mL. Pomolic acid was found active only for *P. aeruginosa* with zone of inhibition 7.0 ± 0.0 mm at the concentration of 1.80 mg/mL. Kojic acid gives zone of inhibition for all bacterial strain *E. coli* (6.0 ± 0.0 mm), *P. aeruginosa* (8.0 ± 0.0 mm), *S. typhi* (6.0 ± 0.0 mm), and *S. aureus* (11.0 ± 0.0) at the concentration of 1.744 mg/mL. Minimum inhibitory concentration (MIC) value of p-coumaric acid was found >0.83 ± 0.0 mg/mL for *E. coli*, *P. aeruginosa*, and *S. aureus*, whereas 0.41 ± 000 mg/mL for *S. typhi*.[51]

The aqueous, methanol, and chloroform extracts of *K. africana* bark were tested for antibacterial activity against *E. coli*, *Enterobacter aerogenes*, *Klebsiella pneumoniae*, *S. typhi*, *Proteus vulgaris*, *P. aeruginosa* (Gram-negatives), *S. aureus*, and *Bacillus cereus* (Gram-positives) using disc diffusion method. Streptomycin (10 mg/disc) was used as standard drug. The ethanol and aqueous extracts of *K. africana* bark showed antibacterial activity with zone of inhibition 20 mm and 17 mm.[52] It has been found that organic extracts showed greater activity as compared to aqueous extract.[53]

Ethanol extract of the fruit of *K. africana* presented a higher activity than the aqueous extract with zone of inhibition 17 mm and 20 mm, respectively. Kirby–Bauer disc diffusion method was used for the evaluation of antibacterial study. The highest activity was exhibited against *S. typhi* and *P. vulgaris*, whereas moderate activity was found against *E. coli*, *S. aureus*, and *B. cereus*. Less activity was observed against the remaining strains, namely, *E. aerogenes*, *K. pneumoniae*, and *P. aeruginosa*.[54]

Methanol extracts of the fruits and roots of *K. africana* showed a significant inhibitory effect against Gram-positive bacteria tested but found nonsignificant against the Gram-negative bacteria. Streptomycin sulfate was used as the standard antibacterial agent and showed zone of inhibition 18–26 mm at the concentration of 1 mg/mL against the Gram-positive organisms. It was observed that isolated compounds from the root of *K. africana*, sesamin, 3-(2-hydroxy-ethyl)-5-(2-hydroxypropyl) dihydrofuran-2 (3H)-one, 2-acetyl naphtho (2,3-b) furan-4,9-quinone, 2-(1-hydroxyethyl)-naphtho (2,3-b) furan-4,9-dione, 4-hydroxy cinnamic acid, and ferulic acid were responsible for antibacterial and antifungal activity.[55] Alkaloids showed promising activity against the bacteria *Helicobacter pylori*.[56]

**Antifungal Activity**

Antifungal activity of methanol extracts of leaves and stem bark of *K. africana* was performed against *Candida albicans* using disk diffusion method. Chloramphenicol (1 mg/mL) and clotrimazole (1 mg/mL) were used as standard drugs. Zones of inhibition of methanol extract of leaves at the dose of 10 mg/mL, 20 mg/mL, and 50 mg/mL were found to be 15.50 ± 0.5, 18.50 ± 0.5, and 23.35 ± 0.45 mm, respectively. Methanol extract of *K. africana* stem bark showed zone of inhibition 12.55 ± 0.55 mm, 15.50 ± 0.50 mm, and 18.5 ± 0.0 mm.
0.25 mm at the concentration of 10 mg/mL, 20 mg/mL, and 50 mg/mL, respectively. Zone of inhibition of standard drug clotrimazole was found 25.50 ± 0.50 mm. MIC value of leaves extract against *A. albicans* was found 2.5 mg/mL while clotrimazole showed MIC value 0.025 mg/mL.[57] The chloroform extract of *K. africana* stem bark showed the highest antifungal activity (MIC value 0.625–1.25 mg/mL) as compared to the petroleum ether and methanol extract of *K. africana* stem bark against the fungal strains *Cryptococcus neoformans*, *Candida tropicalis*, *Trichophyton rubrum*, *Microsporum furfur*, and *Epidermophyton floccosum*.[58]

Aqueous, methanol, and ethyl acetate extracts of the fruits of this plant exhibited a broad spectrum of antifungal activity. Antifungal activity was performed by modified disc diffusion method using ampicillin (2 µg) and nystatin (100 µg) as standard drugs. Fungi *Aspergillus niger*, *C. albicans*, and *Penicillium chrysogenum* used as test microorganism. Methanol, water, and ethyl acetate extracts inhibited the growth of fungi tested (75%). Only *P. chrysogenum* was found resistant to all these extracts. Methanol extract showed the strongest inhibition to the growth of fungi *A. niger*, *C. albicans*, and *P. chrysogenum* with the MIC value of 1238, 841.2, and 989.7 µg/mL, respectively. MIC value of aqueous extract for fungi *A. niger*, *C. albicans*, and *P. chrysogenum* was found to be are 2487, 2060, and 2768 µg/mL, respectively, while MIC value of ethyl acetate was 1463, 1278, and 1744 µg/mL for the fungi *A. niger*, *C. albicans*, and *P. chrysogenum*, respectively.[59] The methanol extract of the fruit of *K. africana* was found to be active against *C. neoformans* with minimum fungicidal concentration >1 g/mL.[60]

**Nematicidal Activity**

Isovitexin, isolated from *K. africana*, was studied against the *Meloidogyne incognita* (a cotton root-knot nematode) and it also produced a significant nematocidal mortality rate (39.76%) compared against the control (2.18%). *M. incognita* eggs extracted from *Solanum melongena* L. roots used as test organism oxamyl served as control. Tolaside isolated from the plant found more active than the standard compound oxamyl at 30 min of exposure to the *M. incognita* with a percentage mortality of 29.43%, whereas standard drug oxamyl showed 20.22% mortality. The crude methanolic extract of *K. africana* showed only a few hatches. The lowest concentration (25%) allowed some hatching, while the higher doses (50 and 75%) completely inhibited the hatching of eggs.[61,62]

**Antimicrobial Activity**

Butanol extract of the stem bark of *K. africana* exhibited antimicrobial activity (*in vitro*) against HK-9 strain of *Entamoeba histolytica* by microdilution method using metronidazole as standard drug. Verminoside isolated from stem bark of *K. africana* have 2-fold antimicrobial activities than standard drug metronidazole while antimicrobial activity of specioside was found comparable with metronidazole.[63] Minecoside and verminoside isolated from the butanol extract of stem bark of *K. africana* also possess antimicrobial activity.[64]

**Antiviral Activity**

Antiviral activity of leaves extract of plant was performed against HIV-1 reverse transcriptase. Extract of the plant showed a weak inhibitory effect (11.13% and 33.07% inhibition at the dose of 50 µg/mL and 100 µg/mL, respectively). Methanol extract of fruits of the plant showed 13.20% inhibition of reverse transcriptase at the dose 100 µg/mL while found inactive at the dose of 50 µg/mL. Methanol extract of the fruits was tested against various viral strains showed a weak activity against vesicular stomatitis virus while no any effect against herpes simplex virus Type 1, Coxackie B2, and Semliki forest virus A7.[65]

**Antitrypanosomal Activity**

*In vitro* antitrypanosomal activity was performed for the compounds (isopinonnal, kigelinol, isokigelinol, and 2-(1-hydroxyethyl)-naphtho-(2,3-b)-furan-4,9-quinone) isolated from the dichlomethane extracts of stem and root, exhibited antitrypanosomal activity against *Trypanosoma brucei*. Pentamidine was used as standard drugs.[66]

**Antimalarial Activity**

*In vitro* antiplasmodial activity of hexane and ethyl acetate fraction of methylene chloride/methanol (1:1) extract of stem bark and isolated compounds was performed using W-2 (MRA-157), CAM10, and SHF4 strains. Ethyl acetate fraction showed a significant plasmoidal growth inhibitory activity (IC50 value 11.15 µg/mL, 4.74 µg/mL, and 3.91 µg/mL for W-2, CAM10, and SHF4 strains, respectively), whereas n-hexane fraction showed a weak activity against W-2 (IC50 value 73.78 µg/mL) and SHF4 (IC50 value 21.85 µg/mL).

Specioside isolated from ethyl acetate fraction showed highest activity against W-2 (IC50 value 1.54 µg/mL) followed by 2β,3β,19α-trihydroxy-urs-12-en-28-oic acid and atranorin isolated from n-hexane fraction with IC50 value 1.60 µg/mL and 4.41 µg/mL, respectively. p-Hydroxycinnamic acid isolated from ethyl acetate fraction showed the least activity against W-2 strain with IC50 value 53.84 µg/mL. Chloroquine phosphate and ethyl acetate fraction showed antimalarial activity against CAM10 strain with IC50 value 0.13 ± 0.02 and 4.74 ± 1.18 µg/mL while the IC50 value of chloroquine phosphate, n-hexane, and ethyl acetate fraction against SHF4 was found to be 0.10 ± 0.01, 21.85 ± 0.12, and 3.91 ± 0.98 µg/mL, respectively.

Isolated compounds atranorin, 2β,3β,19α-trihydroxy-urs-12-en-28-oic acid, specioside, p-hydroxycinnamic
acid, and chloroquine phosphate (standard drug) showed antiplasmodium activity against CAM 10 strain with IC_{50} value 2.81 ± 1.07, 2.17 ± 0.55, 2.34 ± 1.15, 7.13 ± 3.35, and 0.25 ± 0.04 µg/mL, respectively. Kigelolin, isokigelolin, isopinnatal, and 2-(1-hydroxyethyl) naphtha (2, 3-b) furan-4,9-dione obtained from the roots of plants showed effective antimalarial activity. Lapachol isolated from the roots and wood of plant shows antimalarial activity. Another compound, 2-(1-hydroxyethyl)naphtho [2,3-b]furane-4,9-quinone obtained from the root bark of K. africana also shows an antimalarial activity against drug-resistant strains of Plasmodium falciparum. Antimalarial activity of pinnatal was investigated against P. falciparum, and ECV-304 cell line displayed high inhibitory activity with IC_{50} value 2.2 ± 0.3 µg/mL. Both the aqueous and organic extract of K. africana leaves show antimalarial activity against P. falciparum parasite strains, K39 and V1/S with an IC_{50} value 53.2 ± 9.8 and 42.2 ± 12.2 µg/mL, respectively.

Antidiarrheal Activity

Antidiarrheal activity of methanol roots extract of K. africana was performed in castor oil-induced diarrhea in rats using loperamide (4 mg/kg) as standard drug. Methanol extract of the roots of plant demonstrated a dose-dependent antidiarrheal effect which was assessed by measuring the incidence of feces, prevention of loose feces, production, and delaying the onset of diarrhea. Methanol extract of roots at the dose of 500 and 1000 mg/kg body weight significantly reduced the frequency of diarrheal feces and the spontaneous propulsive movement of isolated jejunum (in vitro). Extract at the dose of 500 mg/kg prolonged the onset of diarrhea (P > 0.05), reduced the frequency of stooling and inhibited loose stool production. At a higher dose (1000 mg/kg), it produced greater effects, revealing that the extract produces dose-dependent antidiarrheal activity. Aqueous extract of roots of K. africana also possesses antidiarrheal activity.

Anticancer Activity

Aqueous, ethanol, and dichloromethane extracts of the stem bark and fruits of K. africana were studied for anticancer activity against four melanoma cell lines and a renal cell carcinoma line (Caki-2) using (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) and sulforhodamine B assays. Lapachol isolated from these extracts found effective in the treatment of solar keratosis and Kaposi sarcoma (an HIV-related skin ailment). Lapachol shows cytotoxicity against Artemia salina in the brine shrimp bioassay, indicating antitumor potential. It was reported that the phytoconstituents norviburtinal and isopinnatal found active against melanoma cell lines. Seed oil of K. africana showed a significant antiproliferative effect against human colon adenocarcinoma (Caco-2) and human embryonic kidney (HEK-293) cells. The seed oil of K. africana suppressed cell growth of both HEK-293 and Caco-2 in a dose-dependent manner. Verminoside (an iridoid derivative) and verbascoside (a phenylethanoid compound) were reported for their genotoxic tendencies.

ACTIVITY ON CENTRAL NERVOUS SYSTEM (CNS)

Ethanol extract of stem bark of K. africana exhibited CNS stimulant activity at the dose of 400 mg/kg body weight in barbiturate-induced sleeping time and the rotarod bar test. The difference in sleeping time was found significant in dose-dependent manner. The effect of extract of stem bark was also compared with standard drug caffeine and observed that extract of stem bark produces shorter duration of sleeping time as compared to caffeine (P < 0.05) indicating better stimulant properties. The extract of stem bark of plant had no any sedative effect as the animals maintained their balance during entire period of the experiment in rotarod test.

APHRODISIAC EFFECT

Aqueous extract of fruits reported to have fertility enhancing effect in rats. It improves the sperm quality of African catfish (Clarias gariepinus) and enhanced weight of testes. In vitro studies using extracts of the K. africana fruits in adult male Sprague - Dawley rats for 28 days significantly increased (P < 0.001) the sperm count of rats and sperm motility above 70%. Stem bark of K. africana also shows strong aphrodisiac properties. Saponin present in the plant enhances the aphrodisiac properties due to their stimulatory effect on androgen production.

WOUND-HEALING ACTIVITY

Leaves of K. africana showed more potent activity in excision wound model and showed statistically significant influences (P < 0.05) on wound closure from 7th to 15th day after treatment while the methanol extract of stem bark exhibited similar effects on wound healing but from 10th to 18th day after treatment. Verbascoside isolated from the plant showed wound healing as well as antinociceptive properties. Aqueous extract of stem bark showed wound-healing activity at the dose of 250 and 500 mg/kg.

ANTIOXIDANT PROPERTIES

In vitro antioxidant activity of different extract of the roots of K. africana was measured by 1,1-diphenyl-2-picrylhydrazyl assay using α-tocopherol as standard antioxidant. Ethyl acetate extract of K. africana roots showed a higher antioxidant
value and total antioxidant activity peaked at 0.25 mg/mL and declined at higher concentration. Hexane extract of the roots of K. africana showed an increase in total antioxidant activity as concentration increases in dose-dependent manner. Methanol root extract of plant showed the highest activity at 0.2 mg/mL. The IC$_{50}$ values of the methanol extracts of leaves and stem bark extract of plant were found to be 56.9 and 13.7 µg/mL, respectively, in MTT assay.

CONCLUSION

K. africana is important medicinal plant which has been used traditionally for the treatment of various diseases. Approximately 149 compounds have been isolated from K. africana belonging to iridoids, naphthoquinones, terpenes, terpenoids, limonoids, steroids, coumarins, flavonoids, and phenolics category which have a wide range of biological activities. Several experiments of extracts and isolated compounds of plant provide meaningful justification of their use. Further, clinical study of isolated compounds of plant may be conducted to get potential candidates for the treatment of diabetes, cancer, malaria, diarrhea, liver disorders, etc. Thus, K. africana is the plant of choice for future research purposes, and will surely attract the attention of research scholars in the fields of pharmacology, drug discovery, and phytochemistry.

ACKNOWLEDGMENT

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Singh, et al.: Pharmacology of Kigelia africana


A review on Samanya Sodhana of Parad

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Abstract

Ayurveda, which has been widely recognized as a system of health care, has its historical roots in the Indian subcontinent. It has been practised in India for more than 5000 years. Glory of Ayurveda is spreading worldwide. Ayurvedic medicines basically are of herbal as well as of mineral origin. According to classics, drugs of herbo-mineral origin, i.e., the rasaushadhis are best in therapeutics. Mercury is backbone of Rasashastra as the whole branch is named after it. However, many questions are now being raised by scientific and non-scientific community worldwide regarding the safety and efficacy of rasaushadhis. Global resurgence of Ayurveda has necessitated its scientific validation in terms of both therapeutic efficacy and safety that ultimately depends on the quality control of ayurvedic pharmaceutical processes. Rasashastra has the potential to convert a poisonous substance into therapeutically useful drug after undergoing through a number of processes among which Sodhana is very important. Sodhana in Ayurveda is not only just elimination of undesired substances but also enhances medicinal properties, reduces toxic principles, addition of extraneous properties etc. A lot of methods are mentioned in Rasashastra for paradshodhana, of which the widely used are the sodhana by garlic, lime, and rock salt or by nagavalli, ardrak, and kshartraya. To show the acceptability of parad as a medicine, it is the need of hour to prove that these procedures not only reduce the toxicity but also enhance the therapeutic efficacy. Mercury must be used for medicinal purpose only after preclinical studies, i.e., quality, safety, and efficacy of the drug. A number of researches have been done in this regard. In this study, we have made an attempt to review on such researches to make out the probable outcome of Sodhana of Parad.

Key words: Nagvalli, Parad, Rason, Sodhana

INTRODUCTION

Rasashastra (science of alchemy) is a branch dealing with the study of substances used as medicines in Ayurveda and their detoxification and processing. It deals with Parad (mercury) which is considered to be the heart of Rasashastra. Rasa Dravyas include minerals and metals which are mainly Bhumij in origin (obtained from earth), and Parad (mercury) is also one among them.

Without shodhan we cannot use any drug in medicine. In the texts of Rasashastra, many purification methods described for metals and minerals. Depending on the toxicity, few are purified with the general purification (Samanya shodhana) methods and some with specific (Visheshsodhan) methods. By the purification, physical and chemical impurities are removed, and hence, metals are free from toxicity and metals become suitable for the further procedures like Marana. That is why shodhan is very essential for Ayurvedic herbomineral preparations. Parad is available in liquid state and it has quality to easily absorb, the metals, and minerals. For the purification of parad, several methods have been adopted in the rasa texts.

As Ayurveda is itself a huge science, it does not need any explanations but to reveal its glory in modern globalised era it’s the need of hour to explain its concepts scientifically according to modern science. So here an attempt has been made to explain the concept of samanyasodhan of parad on the grounds of modern science based on several scientific research articles published in leading journals and publications.

MATERIALS AND METHODS

The review centralizes on published research articles in the MEDLINE, PubMed, Google Scholar, Science direct, ASL, Etc.
and Scopus. Study criteria based on research articles and publications related to Parad sodhana, scientific explanations of reactions in parad sodhana, and biochemical reactions related to garlic, mercury, lime, salt etc. Method adopted is prospective logical scientific literary research.

**Concept of Sodhan**

Before preparation of herbomineral combination, purification of metallic substances is necessary to reduce the concentration of chemicals.\(^1\) It is essential because higher concentrated chemical may cause adverse effect on human body.\(^2\) Hence, these chemicals should be neutralized to its normal pharmacological actions. Hence, this *shodhan* concept is very important.

The process of eliminating the impurities of the metallic substances by means of *Svedana* (vaporising), *Mardana* (grinding), *Prakashalana* (performing frequent ablations), *Galana* (straining fluids), *Avapa* (substances are added into the liquefied metals), *Nirvapa* (metals are burnt to red hot and dipped in liquids), *Bhavana* (levigation), and *Bharjana* (frying in pan) specific process and techniques with the help of specifically mentioned *Aushadha dravya* (plant juices or animal products) is known as *Sodhana*.

Sodhan in Ayurveda is not only elimination of undesired substance but also it has some outcomes such as:-

- Conversion of metals and minerals into herbomineral/organomineral compound
- Enhancing/masking medicinal properties
- Reducing toxic properties
- Chemical and physical properties get changed
- Extraneous matter is added to impart the therapeutic effect into original matter.

**Samanya Sodhan of Parad (Mercury)**

In Ayurveda, various *doshas* are mentioned in different *Rasgranthas*, observed during the use of *Ashodhit parad*. It has also mentioned that the *shudha parad* is not toxic and possesses *roganashak* property and acts as medicine. Hence, in the present era, the toxicity of mercury is produced by the *Ashudh* form of mercury. Several methodologies have been adopted by *Acharyas* time to time as per circumstances for *parad sodhana*:

<table>
<thead>
<tr>
<th>Rasagritha</th>
<th>Parad Samanya Sodhan by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rasatarangan(^3)</td>
<td>• Sudharaj (lime), Rason (garlic), Saindhav lavan (rock salt)</td>
</tr>
<tr>
<td></td>
<td>• Nagvalli (betel), Ardrak (ginger), Kshartraya (Vayakshar, Sajikshar, Tankad)</td>
</tr>
<tr>
<td>Ayurved Prakash(^4)</td>
<td>• Ghrulkumari, Chitrak, Rakt-sarshap, Brihati, Trifala kashay</td>
</tr>
<tr>
<td></td>
<td>• Guda (jaggery), Trikatu, Yavani, Lavan panchak, chitrak chhal, Trifala, Kshartraya</td>
</tr>
<tr>
<td>Rasendra Sar Samgrah(^5)</td>
<td>• Lime, Grihdoom, Haridra, Ishitta churna</td>
</tr>
<tr>
<td></td>
<td>• Rason (garlic), Raai (<em>Brassica juncea</em>), Kaanji, Gwarpatha, Kakmachi, Trifala, Saindhav lavan, Nausadar</td>
</tr>
<tr>
<td></td>
<td>• Shrikhand, Devdaru, Kakjangha, Jayanti, Musali, Ghrulkumari</td>
</tr>
<tr>
<td></td>
<td>• Gandhak, Jambeeri nimbu, Jayanti, Erand, Ardrak, Makoya</td>
</tr>
<tr>
<td></td>
<td>• Haridra, Ishitta churna, Grihdoom, Trifala, Ghrulkumari, Chitrak, Trikatu</td>
</tr>
</tbody>
</table>

Among all these, the widely used methods for samanya sodhan of Parad are by *Rason* (garlic), *Sudharaj* (lime), and *Saindhavavlan* (rock salt) or by *Nagvalli* (betel leaves juice), *Ardruk* (ginger rhizome juice), and *Kshartraya* (*Vayakshar, Sajikshar, and Tankan*).

In the first method, parad is triturated with equal quantity of lime for 3 days and strained through a double-layered cotton cloth, and then, it is further triturated with equal amount of scraped garlic and rock salt (half of *parad*) till the paste becomes black. Then, the blackish paste is washed with water to get *suddha parad*.

In the second method, *parad* is triturated with expressed juice of betel leaves and fresh rhizomes of ginger along with *Kshartraya* (*Vayakshar, Sajikshar, and Tankan*) for 3 days and washed with Kanji to get *Suddha parad*.

**Explanation of Parad Sodhan**

Chemical and electrical processes take place on the surface of mercury. A study shows that even the irradiation effect of mercury while trituration is suppressed and neutralized by garlic.\(^6\) Due to churning, surface tension decreases and increment in temperature takes place.\(^7\) Heat produced due to friction of the pestle and mortar seizes the heat labile impurities. Open trituration in *khalva* allows atmospheric oxygen to react within a self-created magnetic field. Mercury interferes with the capacity to quench highly reactive oxygen species to form inorganic mercury compounds.

Lime is a preferred precipitant for the removal of heavy metals.\(^8\) The mechanism governing the metal removal
process is determined as chemical precipitation and adsorption at high pH.\textsuperscript{[9]} Unlike the case for many heavy metals, high pH does not reduce mercury solubility. Except for cadmium, little fraction of copper and lead in the adsorption residues desorbs in acidic media. Hence, lime also provides alkaline media to stabilize mercury and enhance the removal of copper, cadmium, lead, and other heavy metals.

Garlic has been proved as a best antidote for heavy metal poisoning.\textsuperscript{[10]} Hence, processed garlic is augmented with antidote itself. So one step ahead in safety to select it as a best drug for sodhana of parad and logically used. Fresh bulb of garlic contains allin, allicin, and volatile oils.\textsuperscript{[11]} When garlic is crushed, enzyme alliinase is exposed which converts allin into its optical isomer Allicine within 10 s.\textsuperscript{[12]} Allicin is unstable (pure Allicine at room temperature has a half-life of 2–16 h) and converts readily into mono-, di-, tri-, and poly-sulfides, sulfur oxide, and other compounds such as ajoene, which is a secondary degradation product of allin, are presumably the most active compound responsible for any multiple bonding along with mercury.\textsuperscript{[13]}

\[ \text{Hg} + \text{Ajoene (Sulfur oxide)} \rightarrow \text{Mercuric sulfuroxide} \]

Garlic (Allicin-organosulfur) and Hg reaction is a redox. Sulfur and mercury form a best covalent bond, and as a result, the triturated product turns black in color though many of mercury salts are turned to white powders or crystals. It is a miniature concept of Kajjali (mercuric sulfide) itself. Hence, the drug designers of ancient time have proposed parad samanya shodhana using garlic.

A give and take principle is followed between mercury and garlic. The raw Parad (mercury) contains of iron (4.7800), copper (4.5840), zinc (1.2280), silver (0.304), tin (3.7560), cadmium (2.0534), lead (2.3400), and arsenic (2.6500) elements in ppm levels before the purification.\textsuperscript{[14,15]} After the purification with the help of AAS analysis, the results of elements are iron (2.5760), copper (2.6520), zinc (0.2800), silver (0.044), tin (1.6090), cadmium (0.1330), lead (0.9036), and arsenic (1.0146) ppm levels.\textsuperscript{[16]} Hence, by above mentioned purification method, the ppm levels of these elements are greatly reduced. It also incorporates new elements in Shodhit Parad (new elements such as B, Ca, Cr, and Ti are detected). The selenium and germanium trace elements found in garlic extract\textsuperscript{[17]} are another area of explanation showing some unknowing effect on mercury.

Saindhav lavan (rock salt) consists of 95–98% sodium chloride, 2–4% polyhalite (potassium, calcium, magnesium, sulfur, oxygen, and hydrogen), 0.01% iodine, and micro amounts of numerous trace minerals.\textsuperscript{[18]} It also aids the process along with garlic.

When the whole blackish paste is washed with water at the end of the procedure, the mercuric sulphuroxide get hydrolyzed to produce mercury. In this mercury, heavy metals such as iron, copper, zinc, silver, tin, cadmium, lead, and arsenic are reduced in concentration while some new elements are added such as B, Ca, Cr, and Ti.

**DISCUSSION**

As per the concept of Ayurveda, “even a strong poison can be converted to an excellent medicine if processed and administrated properly.”\textsuperscript{[19]} On the other hand, even the most useful medicine may become a poison if handled incorrectly.”

Over time, Ayurvedic practitioners have tried to develop a number of traditional methods to convert toxic substances to useful medicines. It may be justified that traditional system of purification (Sodhana) can influence the physicochemical, pharmacological, and toxicological profile of the raw drugs and thereby useful in increasing safety profile and efficacy of the drugs. It is worthwhile to adopt Sodhana processes as per Indian system of medicine in the development of herbomineral formulations with application of modern technology to assess its safety and efficacy.

This review discusses the Sodhan procedure of ayurvedic pharmaceutics which is relevant to answer queries regarding the safety of rasashadhis. Considering the above concepts, this review emphasizes on possible correlation of classical particulars and researches of contemporary time. We have tried to pace with recent advances, and thus, a primitive theoretical explanation is proposed. Particular drug or media mentioned for specific methods of sodhana indicate some basic relation between the indicated drug and parad. We can also explain the possible interactions of these organic and inorganic constituents with Parad on account of surface tension, heat transfer, redox reaction, adsorption, and formation of organometallic compounds. Ultimately, these are the molecules used for further procedures or therapeutics.

**CONCLUSION**

For the shodhan of Parad, many methods were adopted in the rasa texts, but most common method described in Rasatarāṅgini in which Parad is triturated with equal quantity of lime for 3 days and strained through a double-layered cotton cloth, and then, it is further triturated with equal amount of scraped garlic and rock salt (half of parad) till the paste becomes black. Then, this blackish paste is washed with water to get suddha parad. Sulfur present in garlic forms covalent bond with mercury. It causes to potentiate the therapeutic efficacy besides isolating impurities. After the purification, iron, copper, zinc, silver, tin, cadmium, lead, and arsenic in ppm levels reduce and come within the permissible limits. Some new elements are also added in the final outcome such as B, Ca, Cr, and Ti.

Thus, this method may be explained on the grounds of modern science, how scientific methodology has been
developed by ayurvedic experts of those days for making mercury (parad) therapeutically useful by using garlic, lime saindhav.

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A review on safety and efficacy of Kuchala

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Abstract

In ancient system of healing, all ayurvedic drug formulations have an inbuilt safety profile, but it is necessary to produce the evidence-based documents for the safety and efficacy of ayurvedic drugs, which mainly depends on quality control of pharmaceutical processes. The branch Rasashastra and Bhaishajya Kalpana provides various techniques for the purification and detoxification of drug ingredients. A great debate is emerging time to time that the several ayurvedic drugs are not safe. The facts speak that the toxicity and adverse effects of drugs occur due to avoiding or the negligence of classical references of safety and efficacy. Modern pharmaceutical science gives stress to the application of standard operating procedures in the drug manufacturing. Furthermore, Ayurveda refers “A wise physician may use the poisonous material like nectar with following the proper directions, which are time-tested and safe.” Kuchala (Strychnos nux-vomica Linn.) is a well-known poisonous plant in Indian system of medicine. It contains the poisonous substances which may harm to the body if not processed or applied properly. The present paper is an attempt to show under the glimpse of modern scientific researches that even a poisonous drug like Kuchala, if applied abiding ayurvedic guidelines from manufacturing to administration, will be therapeutically efficacious even safe too.

Key words: Efficacy, Kuchala, safety

INTRODUCTION

The medicine in the present era is much advanced and evidence-based. Ayurveda offers a unique opportunity to evolve a science of healthy, harmonious, and long life. Its holistic approach to health and disease, involving body, mind, and spirit, can provide a broader framework to understand research data emerging from reductionist biomedical sciences. A fresh perspective on the scope of scientific research on the basic concepts of Ayurveda came from a decadal vision document highlighting the importance of Ayurvedic biology. Kuchala (Strychnos nux-vomica Linn.), a well-known plant in Indian system of medicine is being used extensively in different classical formulations with great therapeutic significance. It has been stated categorically that strong poisons could be the best medicine, if it is used after proper detoxification (shodhan), in proper therapeutic dose and formulation. On the contrary, a good medicine may affect adversely unless it is used for a proper person in the proper dose. Rasratnasamucchaya described 11 number of Upavisha, Upavisha is the group of drugs which were less toxic in nature and not so lethal but produce certain toxic symptoms on consumption or administration. They are having less toxic potency. Although the plant Kuchala is described under the “Upavisha varga” (sub poisonous group), it’s seeds have been used successfully in different formulations to combat different diseases after proper Shodhan sanskar (processing of purification).

KUCHALA

Scientific Classification

Kingdom: Plantae
Subkingdom: Tracheobionta
Super division: Spermatophyta
Division: Angiosperms
Class: Eudicots
Subclass: Asteroidea
Order: Gentianales
Family: Loganiaceae
Genus: Strychnos
Species: S. nux-vomica L.

In Ayurveda: Sthavara Vanaspatik vish, Upavisha, phala visha (beija visha).

In Modern medicine: Neurotoxin spinal excitant poison.

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Major chemical constituents:[9]

- Brucine
- Strychnine
- Vomicine
- Kajine and novocain (N-methyl pseudobrucine)
- Strychnine and isostrychnine
- Cuchiloside
- Loganic acids.

Safety of Kuchala

Kupeelu (S. nux-vomica Linn.) is described under the “Upavisa Varga” (semi-poisonous group),[10] and its seeds have been used successfully in the cure of many diseases after proper Shodhana.[11]

Although 16 alkaloids have been separated and identified from crude nux-vomica, 80% of them are strychnine and brucine and their derivatives such as isostrychnine and brucine N-oxide.[12] The major chemical constituents of nux-vomica (strychnine and brucine) have been reported for their adverse effects.[13] The specific sodhana procedures mentioned in Ayurvedic classics reduces these alkaloids and establish their values under the safe limit for therapeutic use. Various research studies show percentage change of strychnine and brucine [Table 1] alkaloids of shodhit seeds of S. nux-vomica. It shows that cotyledon portions contain a higher percentage of strychnine than that present in seed coat for the entire sample except for the milk purified seeds. Purification with milk markedly reduces the toxicity of crude nux-vomica than the sample treated with Ghrita.[14]

It has been reported that LD50 values of the seeds treated with different processing methods ranged from 2.18 to 2.57 mg/kg (in the mouse), while that of the unprocessed seeds was 1.21 mg/kg. Thus, the processing of S. nux-vomica decreased the toxicity down to one half that of the unprocessed substance. On heat treatment, the contents of the major alkaloid Strychnine (C21H22N2O4) and Brucine (C23H26N2O4) declined significantly[16] (apprx. 63%) with an increase in the amount of isostrychnine, isobrucine, strychnine –N-oxide, and brucine N-oxide. The cleavage of an ether linkage and the occurrence of N-oxidation have been demonstrated by heat treatment of authentic strychnine and brucine isolated 16 alkaloids from heat treated and untreated seeds of nux-vomica. Isobrucine N-oxide, isostrychnine -N-oxide, and 2 hydroxy 3 methoxy strychnine were new alkaloids found in heat-treated samples.[12] Oral dose of 30–50 mg seeds are toxic in nature while 60–125 mg dose of suddha (purified) seeds is recommended.

Thus, if Kuchala is used in formulations after the proper sodhan procedure, in proper dose as per Ayurvedic classics, then it is quite safe.

Efficacy of Kuchala

Seeds of S. nux-vomica were used as a nerveine tonic, alexiteric, aphrodisiac, anthelmintic, digestive, purgative, and stimulant. Detoxified S. nux-vomica seeds used in various ayurvedic drugs such as Agnitundi vati, Navjeevan Rasa, and Vishatinduka vati as an important ingredient.[17] Ayurvedic properties of Kuchala are as follows:[18]


Either S. nux-vomica or its alkaloids have been reported for their analgesic, anti-inflammatory,[22] antioxidant,[23] antitumor,[24] anti snake venom,[25] antidiarrheal,[26] and hepatoprotective[27] activities in different modern literature.

CONCLUSION

Kuchala is a well-known spinal poison to modern science. It is used in Ayurvedic pharmacopœia from the ancient period. Ayurveda texts such as Rasa tarangini, Rasratnasamucchaya, Raj Nighantu, and Bhavaprakasha mentioned detail description of the plant, basic properties, sodhan methods, therapeutic uses, and indications. As Acharya Charak in Sutrasthan 1 st chapter verse, 127 says, with a judicious planning deadly poison could be used as an effective medicine, while a misuse of a life-saving drug results in a deadly poison. Hence, if Kuchala is used with mentioned standards for raw material, processing’s and with proper diagnosis in suitable prescribed dose, then it is safe as well as efficacious too.

Table 1: Percentage of strychnine and brucine in crude and purified seeds of Strychnos nux-vomica[18]

<table>
<thead>
<tr>
<th>Strychnos nux-vomica seeds</th>
<th>% of strychnine</th>
<th>% of brucine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude form</td>
<td>1.92%</td>
<td>0.93%</td>
</tr>
<tr>
<td>Seeds after purified with Gomutra</td>
<td>0.96%</td>
<td>0.19%</td>
</tr>
<tr>
<td>Goghrtia fried seeds after purification by Gomutra</td>
<td>0.068%</td>
<td>0.012%</td>
</tr>
</tbody>
</table>
REFERENCES


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The concept of blood circulation in Ayurveda

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Abstract

The knowledge of blood circulation, according to western scholars, came into existence in 1628 AD by William Harvey and was developed by Malphighi in 1661 AD. However, ancient Ayurvedic Acharyas knows very well about the circulation of raktu-rasa (plasma) and rakta (blood) from the samhita period. Bhela is the first ayurvedic acharya to explain the blood circulation in a systemic way. Rasa and rakta are the first two dhatu in the sequence of seven dhatu, and rakta dhatu is produced from the nutrient portion of rasa dhatu. Sushruta described that hrudaya is seat of the rasa, and from the hrudaya, it travels through 24 dhamanis and nourishes the entire body constantly. Bhela has described the systemic circulation explicitly. He said, “The blood (rasa) is first ejected out of the heart, it is then distributed to all parts of the body, and thereafter, is returned to the heart through the blood vessels known as “sira.” The Ayurvedic acharyas said that the site of vyana vayu is hrudaya (in the heart) and the function of vyana vayu is rasa samvahana (circulation of liquid tissues in the whole body). The whole physiology of parivritti or paribhramanam or circulation of rasa and rakta dhatus executes by vyana vayu by its vikshepocita karma or pushing and pumping function through anatomical structures - hrudaya (heart), sira, dhamani (both may include in ten great vessels or sira), and sravana karma of srotas (minutest channels or capillaries) which are prasrata or spread from mulatkhadantara (hrudaya or heart) in a appropriate manner.

Key words: Bhela, circulation, rakta, Rasa, sira

INTRODUCTION

The concept of blood circulation described in Ayurveda is amazingly accurate to the modern concept of blood circulation. Our acharyas are very well known about blood circulation and its purpose, i.e., carrying of prana (oxygen technically) and rasa (nutrients) to the entire body in a cyclical manner with the heart acting as a pump to carry out this function long before William Harvey discovered the circulation of blood in the 17th century.

The literary material related to blood circulation has been collected from different sthanas (parts) of Ayurveda samhitas and modern anatomy books such as Chaurasia general anatomy and Gray’s anatomy critically reviewed and correlated with modern terms.

REVIEW OF LITERATURE

Formation of Rasa and Rakta

Rasa and rakta are the first two dhatu in the sequence of seven dhatu,[1] and rakta dhatu is produced from the nutrient portion of rasa dhatu.[2] The term Rasa is derived from “Gayathrak Rasa Dhatu” depicting its meaning that it moves throughout the day and night.[3] Sushruta described that hrudaya is the seat of the rasa, and from the hrudaya, it travels through 24 dhamanis and nourishes the entire body constantly. The vruddhi and kshya of this rasa cause abnormalities in the body.[4]

The essence of food known as ahara rasa is formed first by the action of jatharagni in the amasaya and is partially digested product. Then, it enters in pacyamanasaya, and there, it undergoes further digestion by the action of bhutagni and formed rasa dhatu.[5] Rakta is formed from the ahara rasa.[6]

According to Sushruta food composed of pancha mahabhutas of four kinds of ahara, which compose of six tastes in combination with two types of virya and eight types of virya and showing the effect of twenty gunas which will undergoing paka and get separated as sara and kitta bhaga, the sukhkma amsa of this sara bhaga which is composed of prasada bhaga is known as rasa.[7]

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Sushruta in sutrasthana 14th chapter Shonita varnaniya adhiyaya said that the apya rasa after reaching yakrut and plilha obtains red color by the tejas and becomes raka dhatu. This raka flows in siras and maintains life activities. [9]

According to Sharangadhara, the essential substance of the food material is formed into rasa. Rasa reaches hrudaya with the help of samana vata. There, it undergoes the process of further digestion with the help of pitta and gets colored to become raka. This raka exists all over the body and is the best supporter of life. [9]

Parvrtti or Paribhramanam of Rasa and Rakta (Blood circulation)

Bhela has described the systemic circulation explicitly. He said, “The blood (rasa) is first ejected out of the heart, it is then distributed to all parts of the body, and thereafter, it is returned to the heart through the blood vessels known as sira.” [10]

Acharya Sharangadhara has mentioned that urah (thorax) is a reservoir of the blood. [11] The sira originates from the heart form a closed circuit. The blood (rasa) ejects away from the heart to the all over the body in the influence of vyana vayu and then returns back through the sira similar as rivers with ultimately drains their water in a sea. [12]

Chakrapani stated that term rasa includes all circulating fluids along with Rakta. [13] Vagbhatta has further clarified that it is not only the Rasa but also “Rasamuk Ojas” that circulates in the whole body through ten great vessels that directly emerge from hrudaya [14] which circulates throughout the entire body ceaselessly for 24 h by vyana vayu and it provides nutrition to other dhatus or body. [15]

Sushruta samhita has given examples to describe the pattern of circulation. Rasa propagates in the body in a pattern that is similar to the movement of shabda, arci, and jala. [16]

DISCUSSION

Blood is a connective tissue which is in fluid form. Rasa and rakta dhatu altogether can be considered as blood, as both are liquid and circulating in intravascular compartment. While describing the circulation of rasa by the action of vyana vayu (a subtype of vata dosha), Chakrapani has explained the term rasa as “Rasateeti raso dravadhatuchayate taenrudhiraadinaamapi dravaanam grahanam bhavati,” where the term rasa stands for intravascular circulating fluid (drava), i.e., plasma including the blood cells. [17] Bhela has also used word rasa while describing the circulation of rasa in heart and blood vessels. Again, the term rasa-rakta has been used for the completely digested essential and minutest material (nutrients absorbed in the blood). [18] Rasa

is clear and colorless, so it refers to plasma; Rakta can be taken as red blood cells, as it is said to be of red color such as Gunjaphala (fruits of Abrus precatorius) and Padma (Nelumbo nucifera). [19] whereas the white blood cells can be considered as shonitarupi oja.

Rasa, in its entirety, is not converted into raka, only that fraction of which is homologous to raka is turned into this dhatu. The remaining portion of rasa is generally spoken as rakta as it assumes red color, while passing through rakta sthanas. The obvious difference between the rasa dhatu and rakta dhatu is like the difference between plasma and erythrocytes on the one hand, and the blood and lymph, on the other hand. It is, in this sense, that plasma (including the interstitial fluid and lymph) would appear to be the analog of the rasa dhatu as described in Ayurveda. It is seen from Sushruta samhita that the term Rasa is derived from the Sanskrit root “Rasa” - to go, and the rasa dhatu of the body is so-called because of the fact that it continuously flows through and permeates every vital principle of an animated organism. In addition, it is the rasa dhatu, the analog of plasma, which is the source of all body secretions. [20]

At the level of hrudaya, dhamanis, and siras, it forms part of the circulating raka, from which latter, it separates, at the level of srotasi, to return back into hrudaya. Hence, in modern, it is related to blood, plasma, interstitial fluid, and lymph.

Blood is a transitory but a vital constituent, dhatu of the body, transitory in the sense that it is always replenished and is ever on the move. Its flow never ceases as long as life exists. Its initial is in the food that we take, for it is nothing but the essence of the food that is transmuted by the rasa kriya or the chemical action of the food. It gets its color in the region of the liver, commences its distribution from the lotus like heart, and courses all over the body through the major and the minor ramifications of the vessels. In this way, it nourishes the whole body. [21]

According to Vagbhatta, the site of vyana vayu is hrudaya (in the heart), [15] and Charaka and Sushruta have stated that the function of vyana vayu is Rasa samvahana (circulation of liquid tissues in the whole body). It is actively involved in the blood circulation, diffusion of blood into the tissue spaces, and perspiration. It also controls the voluntary movements of the skeletal muscles. [22]

In Ayurveda Sutra (a work of 15th century), the circulating raka is a complex substance, being composed of a fluid part, the sthaya rasa dhatu (plasma-serum) and sthaya rakta dhatu (the formed elements of the blood - the erythrocytes), which latter, being relatively more predominant among the circulating formed elements, confers on its vehicle, the characteristic crimson red color. The rasa dhatu transports not only the sthaya or poshya rakta dhatu but also the remaining poshaka or asthaya dhatus to nourish the poshya
sthaya dhatus and the malas cleared from latter. At the level of dhatuvara srotamsi, it is the sthaya rasa dhatu that exudes or permeates through the ayanamukhas (capillary pores), carrying with it the poshaka dhatus (tissue nutrients), and for the nourishment of poshya dhatu, the sthaya rasa dhatu does not permeate through ayanamukhas of the dhatuvara–srotamsi but performs its vital functions jivanan by giving up the oxygen it carries for the use of poshya dhatu.[23]

The whole physiology of circulation of rasa and rakta dhatu executes by vyana vayu by its pushing and pumping function through anatomical structures like hrudaya, sira, dhamani and srotas. These structures are spread from mulatkhadantara (hrudaya) in an appropriate manner.[24]

The circulation of rasa and rakta dhatu contains few peculiarities as described by acharyas, these are listed as follows:

1. One of the chief functions of hrudaya is to pump or circulate rasa sarvatah or everywhere in the entire body, and from there, it ultimately returns to hrudaya, i.e., as a closed circuit.[25]

2. “Rasa” that is pumped from hrudaya is in the form of anu or most minute and essential form of properly digested ahara formed after the proper action of agni. The minutest and the essential fraction of properly digested food are called “sara” in this context. Thus, it is “rasa”. This “sara” includes all completely digested materials absorbed from the alimentary canal that “rasa” is “paramasukshna” meaning that Rasa can follow very minute channels.[7]

3. Paribhramanam or circulation of rasa is in the body in a cyclical order or in a closed circuit. Charaka samhita provides two important adjectives.
   a. One is continuous (samtatya)
   b. and other is cyclical (cakravat).

Commentators explained the meaning of word cakravat as vikshepana and samharana. Further, he explained that the meaning of vikshepana is a process of Rasa pumped out of the heart and samharana is a process of rasa coming toward the heart. Vyana vayu is chief executor of paribhramanam or circulation of rasa. Contraction and relaxation of the muscular tissues are also performed by vyana vayu.[17] Entity, which executes the function of pushing and pumping inappropriate manner, is known as “vikshepa karma” of vyana vayu. This circulation is accomplished in the entire body, simultaneously flown ceaselessly, all the time all the way. This rasa dhatu nourishes all the dhatus.[26]

4. Circulation of rasa rakta happens due to parivrtti. Pari means circulating entire area. Vrtil means Asthitvam and Jivanan means maintenance of health and vitality. The vyana vayu maintains this circulation effectively by its five-fold activities, namely, contraction, relaxation, and ejection of rasa dhatu in upward, downward, and horizontal directions.[27]

Following points indicate microcirculation of body, different velocities of blood at different places, and pumping in all directions.

1. It is a constant and perpetual activity without any obstruction forever (ajasram or avisrantam).[13]
2. It is a life process (sada or ceaselessly or always, continually, without stop for the whole life).[13]
3. It is a cyclic process (cakravat).[13]
4. Sushruta samhita has given examples to describe the pattern of circulation. Rasa propagates in the body in a pattern that is similar to the movement of shabda, arci, and jala. Dalhana quotes that this circulation is reached to anu srotas or microcapillaries. The circulatory process is compared with shabda or sound to indicate that sound reaches to any depth in any direction. It is compared with arci or flames to indicate upward. It is compared with jala or water or liquid to indicate downfall means downward direction. Different kind of velocity is also indicated here. The sound is faster than flames and flames are faster than waterfall. Hence, circulation is in all directions in the body and is maintained at different velocities. Dalhana further adds that these three types of movement of rasa are directly related to the status of agni, i.e., tikshna, sama, and manda and ultimately to the duration of production of dhatu.[28] Gayadasa in his commentary said that arci, sabda, and jala types of Rasa flow are present in dhamani, sira, and srotas, respectively.

6. This concept of Sushruta of rasa movement can be explained on the basis of mean flow velocity. As per the view of different commentators, the velocity with which sound moves is greater than that of fire, whereas the velocity of fire is greater than that of water. The mean flow velocity of blood is maximum in the aorta, as aorta is the smallest cross-sectional area which receives the entire output of the blood from the heart. This mean flow velocity decreases as the blood moves down the cardiovascular system into the arterioles and is lowest in capillaries. Hence, the movement of Rasa is similar to the movement of sabda, arci, and jala.[29]

7. Vagbhatta describes that siradi is mahamula, i.e., they are having the more cross-sectional area at the base and becomes narrower and divides as they move away.[25] Sushruta also in the same view that as dhamani propagates becomes narrower and divided into hundreds to thousands of branches so that looks like gavakshita, i.e., network like.[30]

8. Annarasa, as derived from the food, contains all dhatu poshaka dravyas and circulates along with the rasa-rakta complex to nourish all tissues of the body. This combination of annarasa and rasa dhatu contains a large number of proteins maintaining the colloidal osmotic pressure. The osmotic pressure of the proteins regulates the distribution of fluid between the blood and tissues. The plasma also contains large quantities of both inorganic and organic ions. The intracellular fluid
is very different from the extracellular fluid, which is a combination of intracellular fluid and the fluids of the blood plasma. The extracellular fluid supplies the cells with nutrients and other substances needed for cellular function. Capillaries are the place where the most purposeful function of the circulation, i.e., interchange of nutrients and cellular excreta between the tissues and the circulating blood occurs regularly by the pressure in the capillaries. However, osmotic pressure caused by the plasma proteins tends to cause fluid movement by osmosis from the interstitial spaces into the blood, preventing the continual loss of fluid volume from the blood. The maintenance of an optimum blood volume is essential for the regulation of the cardiac output and the arterial pressure. Decreased blood volume leads to decreased cardiac output. When the cardiac output falls low, the tissues begin to suffer the nutritional deficiency. This movement of the fluid affected by the osmotic pressure maintains not only the fluid volume of the plasma but also the function of the heart.[31]

Now, it is clear that the above descriptions are very much similar to the modern view of circulation.

CONCLUSION

On the basis of above discussion, the rasa and rakta dhatu can be considered as blood because they both are in liquid (drava) state, which gets circulated in the intravascular compartment (heart and blood vessels) and has functional similarities. It is distributed to all throughout the body due to the action of vyana vata on heart and blood vessels (cardiovascular system), quite similar to blood, and there are great similarities at the functional level too. The rasa-rakta dhatu carries all the nutrients along with oja and nourishes and protects all the tissues.

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Collection and residual heavy metal contamination of medicinal plants: Need of cultivation

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Abstract

Collection of herbals from random areas/wild collection causes heavy metals contamination in medicinal plants. This is becoming burning issue of current scenario of Ayurvedic medicine because medicines are producing toxic effects on human body. This is affecting the globalization of Ayurveda. In this regard, it’s our responsibility to prevent herbal medicine contamination. Crude drugs should be collected from ideal land. Causes for residual metal contamination should be avoided and prevented by various procedures of soil purification such as bioremediation, solidification, vitrification, and soil washing cultivation is the only permanent solution for this so in current scenario cultivation must be best practiced with various horticulture and agricultural techniques. This paper emphasizes on a collection of medicinal plants, causes and ill effects of heavy metal contamination and its prevention.

Key words: Heavy metal contamination, Cultivation, Soil purification

INTRODUCTION

Every plant has medicinal properties. From ancient period medicinal plants are widely used as home remedies for various diseases and also as food. In the previous days, people are widely using herbal medicines before inventing synthetic medicines. Global importance to herbal medicines is increasing because of the presumption that herbs are natural and safe and produce no side effects. More than 80% world population depends on herbal medicine. Nowadays heavy metals are detected in most of the medicinal plants beyond the permissible limits. Soil, water, air, and climatic conditions play important role intoxication of plants by heavy metals. Plants take food from the heavy metal contaminated soil and water thus produce adverse effects on human beings such as renal failure, liver damage, and deposition in blood vessels some metals such as copper, zinc, and manganese are vital for formation of enzymes and coenzymes, help in respiration and photosynthesis if their quantity increases they affect growth of plants.[1] Lead, arsenic, cadmium, and mercury have no physiological and biochemical importance. Medicinal plants are raw materials for Ayurvedic formulations for this reason they should be checked for the presence of heavy metals.

Random collection of plants from the wild environment for the purpose of preparation of Ayurvedic medicine exposes more chances for intoxication of heavy metals and impurities in herbal medicine. Thus, cultivation practice sures the purity of Ayurvedic medicine. About 50,000 various species of plants from wild are in use, only a few are cultivated. Biological way of removing heavy metals from soil also provides surety of pure herbal medicine. Acharyas explained prashasta bhumi, desha, kala for proper growth, and collection of crude drugs.

COLLECTION OF DRUGS IN ANCIENT PERIOD

In past days, practitioners have direct contact with pharmaceuticals, and some practitioners have their own pharmacies. They were knowing the identification of plants, they themselves were involved in collecting crude drugs from suitable place, and they were preparing medicine their own. Hence, there was no question of the impure drug. People were using organic fertilizers and were not aware of insecticides or pesticides, so there was less chemical contamination to the soil.

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As per ayurvedic perspective properties of land for the collection of plants is described as:\[2\]
1. Shita (coldness), atapa (temperature), vayu, and jala are according to seasons, not extreme cold not extremely hot.
2. Collected from plane surface (samatala) and Pavitra.
3. Having water supply in its south direction.
4. Free from graveyard, chaitya, sabhagruha (meeting hall), Shvabrama, valmiki, and ushara (type of soil).
5. Having krasha and rohisha (types of grass).
6. Soil should be snigdha (unctuous), Krishna (black color), Suvarna varna (golden color), and madhura rasa.
7. Where plugging has not been carried out.
8. Where there are no big trees.
9. Sadharana or jangala desha.

Medicines collected from this type of place are considered to be ideal.

**Present Scenario**

Pharmaceuticals are prefer wild collection of crude herbs. There is no proper/genotypic identification. Practitioners are not involved in the collection, preparation, or quality of medicine. Cultivation of medicinal plants is not encouraged. Patients are getting ill effects of contamination. Usage of chemical fertilizers and deforestation is increasing. To contour all this cultivation of herbals should be encouraged, proper soil purification methods have to be adopted.

Deleterious effects collection of medicinal herb from wild:
- Loss of genetic diversity
- Habitat destruction
- Misidentification
- Phenotypic variability
- Extract instability
- Presence of toxic components and contaminants
- Extinction of plants.

For this reason, wild collection should be abstained, and cultivation of medicinal crops is encouraged in healthy land. Present cultivation and collection practices cause additional contamination and microbial growth.

**CAUSES OF HEAVY METAL CONTAMINATION OF PLANTS**

The heavy metals that are available for plant uptake are those that are present as soluble components in the soil solution or those that are easily solubilized by root exudates. Most of the growth reduction in plants is due to reduced photosynthetic activity, plant mineral nutrition, and reduced activity of some enzymes.\[3\]

Heavy metals are naturally present in the soil in less amount but are increased by following ways:
- Geologic and anthropogenic activities like using pesticides and insecticides (DDT) presence of chlorinated pesticides is quite common in crude herbal materials, mining, and melting of metals. Sewage and Sludge, burning of fuels, burning and burying of plastics.
- Use of cultivation expedients like cadmium containing dung.
- Less water/improper irrigation supply.
- Supply of sewage water to cultivated crops.
- Industrial wastes are polluting both air and water.
- Change in soil pH, moisture content, and water-holding capacity.
- Hyper- or hypo-climatic conditions have an indirect effect.
- Cultivation near an industrial area.
- Increase in siderophore-producing bacteria which cause heavy metal extraction from soil.

**Harmful Effects**

- Decreased potency of medicines.
- Adverse effects on human body such as carcinogenicity, cadmium causes osteomalacia, and lead causes renal tumors.
- Affects respiration, photosynthesis, and growth of plants.
- Affects nutrient uptake by decreasing the decomposition of organic matter.

**Prevention**

1. Bioremediation/phytoremediation (phytoplant, remedy-to correct or remove an evil) - it is removal of heavy metals from soil using microorganisms (Bacillus subtilis, Pseudomonas putida, Enterobacter cloacae, Mycorrhizal fungi, and bio-precipitation by sulfate-reducing bacteria) or using plants are called phytoremediation. It is a non-disruptive method of soil remediation.\[4\] It is time-consuming and it is affected by climatic and geological conditions.\[5\] By this method, heavy metals cannot be removed completely, but the percentage/ratio of contamination is reduced to become less toxic, easily volatilizable, more water-soluble (can be removed through leaching) or less water-soluble, and less bioavailable.\[4\]
2. Biostimulation - addition of organic manure to soil which serves as C source for microorganisms present in the soil, causes growth and activity of microorganisms responsible for remediation process through alteration of pH.\[6\] Biochar is organic material used nowadays.\[7\]
3. Solidification - it involves the addition of binding agents to a contaminated material to impart physical/dimensional stability to contain contaminants in a solid product and reduce access by external agents through a combination of chemical reaction, encapsulation, and
Need of Cultivation

Encouraging for the cultivation of medicinal plants can diminish soil contamination and thus plant contamination also. Points to be considered before going for large-scale cultivation of medicinal plants: Gardening/growing the particular plant in small area to check suitability of the plant to that soil (applying horticulture methods), detection of presence of mineral content in soil, plantation of seeds of identified plant, organic farming, availability of water supply, etc., benefits of cultivation include:

- Biodiversity conservation.
- Poverty alleviation.
- Safe and efficacious herbal medicines.
- Potent active principles.
- Uniform and high-quality product.
- Prevent extinction of species.

CONCLUSION

As per present trend cultivation practices of medicinal plants should be enhanced and supported. Preventive measures should be undertaken. Organic fertilizers must be used to prevent chemical contamination of soil. Education regarding the importance of herbal medicine is necessary to conserve natural resources. Plants growing in the area of contaminated soil have stunted growth and have less potency. Phytoremediation is a biological method using both plants, and microorganisms percentage of heavy metals in soil is reduced. Other methods such as solidification, vitrification, and soil washing can also be applied but they are cost-effective and are practiced for commercialization purpose. Focusing research on this issue may improve the safety and efficacy of Ayurvedic medicine.

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Doctrine of eugenics, euthenics and euphenics in Ayurveda

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Abstract

Traditional Indian medicine has served humanity since antiquity. Eight branches of Ayurveda have touched all the aspects of human life ranging from intra-uterine to geriatric age group to achieve and maintain “total health.” Ancient science of India laid the foundation of eugenics, euphenics, and euthenics under the discipline of “Garbha Sharir.” Present work is an attempt to explore the knowledge and ideology of traditional Indian medicine to put positive health in future generations.

Key words: Ayurveda, eugenics, fetus, Garbha Sharir, traditional Indian medicine

INTRODUCTION

Traditional Indian medicine has served humanity since antiquity. Ayurveda includes basically eight branches and that have touched all the aspects of human life ranging from intra-uterine to geriatric age group to achieve and maintain “total health.” Ancient science of India laid the foundation of eugenics, euphenics, and euthenics under the discipline of “Garbha Sharir.”

Ayurveda advocates following factors as pre-requisite for the production of Garbha, i.e., fetus-

Ritu, Kshetra, Ambu, and Beeja.

A healthy fetus is the outcome of the union of proper planning of right time for conception (Ritu), healthy uterus (Kshetra), adequacy of nourishment (Ahar rasa), and healthy male and female gametes (Beeja). These all components are very essential and qualitative and quantitative deficit of each of component alone or together will not be able to produce Garbha.

Our ancient scholars were well known to the role of genes and chromosomes for the production of different body parts of a fetus, and also they were enough aware about the genetic inheritance of traits from parents to progeny.

Beeja is known as male and female gametes (shukra and shonita, respectively). Chakrapani states that beejbhaga is a collection of those materials in stri and pumbeeja which is meant to generate different body parts in the course of fetal development.

Despite essential elements of production of fetus, there are several factors which influence progeny which are collectively termed as “Garbha utpattikar bhava,” namely, Matrija, Pitraja, Atmaja, Satmyaja, Rasaja, and Satvaja.

Objective

This work gives emphasis over knowledge and clinical practices of ancient Indian medicine to bring positive health in a future generation.

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LITERATURE REVIEW

Shukra Dhatu

Shukra dhatu (reproductive material of male) is capable of producing garbha and, is composed of Panchabhuta and six types of Rasa namely madhur, amla, lavana etc. According to Ayurveda each and every living entity comprises panchmahabhuta, and all living individuals are the union of various manifestations of panchabhuta viz. tridosha, rasa, and guna, etc.; at structural, functional as well as psychological level. Thus, reproductive material of male individual (Shukra Dhatu) is said to be composed of panchmahabhuta and six rasa as described in Garbha Sharir.[1]

Artava

Artava Raja and Shonita are some terms often used synonymously to represent menstrual blood and ovum. Rajah in female can be defined as a substance produced from Rasa, having the color of Rakta, flowing every month through the female genital tract for the duration of 3–7 days, commencing at the age of 12 years, and completely ceasing at the age of 50 years. Period of 12 days is called as Artavakala which is denoted as that time duration in which Rajah or Artava have capability to produce fetus if fertilized.[2]

Garbha (Fetus): According to the principle of Ayurveda. Developing Garbha in the uterus is the combination of following components:

• Shukra and Sonita (reproductive materials of male and female individuals, respectively).
• Atma (Vitality).
• AshtaPrakriti (union of avyakt, mahan, ahankar, and panchtanmatra, due to which whole substance on earth is manifested).
• Vikar (Panchmahabhuta and ekadash indriya).[3]

Thus each of above factor will certainly influence the basic structural, physiological, and psychological aspect of Garbha Sharir. Among preceding list of factors only sukra and sonita can be attempted to be designed and regulated as par ones requirement. Rest three factors are inherent and depends on previous Karma of the individual as Ayurveda, and other schools of Indian philosophy believes.

EMBRYOLOGICAL DEVELOPMENT AND ORGANONOGENESIS IN GARBHA

After formation of the fetus, embryological development is started under the influence of panchabhuta which were obtained through inherent combinations of parents reproductive material in fetus. Vayumahabhuta is responsible for the division of various body parts along with dosha, dhatu, and mala. Agni mahabhuta is responsible for various transformations inside the fetal body. Jalamahabhuta unites various divisions of the fetal body to make organization between various parts. Prithvimahabhuta gives the final form of the fetal body, and Akashmahabhuta is engaged in total growth and development of fetal body in mother’s womb.[4] In this way, fetus undergoes growth and development in uterus over 9 months of gestational period, and when hand, foot, tongue, and various organs are manifested along with sensory perceptions in the fetus, it is named as “Sharir (body).

PREREQUISITE FOR GOOD PROGENY

Ayurveda Garbha Sharir states following components as a prerequisite for the healthy and fully developed fetus and its delivery.[5]

Shukra sampad - Qualitative and quantitative optimal of male reproductive material.
Shonita sampad - Qualitative and quantitative optimal of female reproductive material.
Atma sampad - Previous Karma and attributes of Atman combining during fertilization in the fetus.
Ashaya sampad - Good health of uterus physiologically and anatomically.
Kala sampad - Optimal season and external environment.
Upachar sampad - Incorporation of basic and essential “garbhiniparicharya” procedure during whole gestational period.
Hita Anna - Intake of wholesome food during pregnancy.
Garbhakala - Delivery of fetus after a complete gestational period.

Above list represents all factors which are essential for obtaining a healthy and fully developed fetus. Good quality sperm and ova will produce a healthy zygote. Various qualitative and quantitative deficits in the reproductive material do not result in a fetal form. The current increase in incidences of infertility owes to improper semen quality and quantity. PCOS, pelvic infection resulting in salpingitis, tubo-ovarian abscess, advanced age, etc., are the leading causes in female infertility. Lack of sex education, lack of cheerfulness, and satisfaction of mind between spouses are also a social and crucial reason.[6] Uterine abnormalities along with infection, hormonal imbalance, and some health problems like diabetes are the causes of miscarriage.[7] A study over pregnant women population of Bangladesh found seasonal fluctuations over birth weight and length. Infants born in colder months were found to be shorter than those born in hot and dry climatic conditions.[8] Antenatal care importantly plays a crucial role in the health of fetus as well as the mother. Identification of health issue in mother and its treatment, nutrition, immunization, personal hygiene, and prevention of birth complication are some basic and necessary intervention done during the whole duration of pregnancy. Carelessness during antenatal care may result in complications during labor, mortality, and morbidity of mother and child.[9] Proper food and regimen practice by the
pregnant lady is an important component because fetus gets nourishment from mother for its growth and development. A study of maternal nutrition over fetal metabolic profile found intake of whole grain increase glucose metabolism and reduce the risk of developing type 2 DM. Delivery of baby at completed 37 weeks of gestation prevent the risk of low birth weight, fetal distress, and neurological disorders, etc., and thus assures fully developed and mature outcome of pregnancy.

**GARBH UTPATTIKARBHAVA AND THEIR IMPACT OVER FETUS**

Ayurveda Garbha Sharir describes following six factors necessary as well as accessory for production of developed and mature fetal outcome and also explores the psychosomatic impact of the same over developing fetus which is as follows:

- **Matruja Bhava** - Maternal component give rise to the development of skin, blood tissue, muscle tissue, heart, liver, kidney, etc., organs in the fetus.
- **Pitru Bhava** - It includes the development of hairs, bones, teeth, veins, and arteries in fetus.
- **Atmajabhava** - It affects form and complexion of body and voice quality etc.
- **SatmyajaBhava** - Health, enthusiasm, and good quality of the reproductive material.
- **Rasajabhava** - Body and organ development with continuity of life.
- **Satvajabhava** - Feeling of happiness or sadness, fear or courage, calmness, or instability of mind.

Beside above concept phenomenon of “Dauhrida” in mother states morbid and mortal effects over fetal growth because of incompletion of maternal desires for particular food and regimen during pregnancy. During whole months of pregnancy maternal practice of quality at mind and bodily level give same effects over mind and body of the fetus.

When Traditional system of India (Ayurveda) is interrogated with the ideology of Eugenics, we find different sets of thoughts. Although there is no terminology like eugenics, is described in Ayurveda, there are scattered links which gives hints of these principles practiced in India. For example, excellency of four factors (ritu, kshetra, ambu, and beeja) for production of fetus has been advocated. Shukra Dhatu is known to have the potential of fetus production and best treatise on internal medicine, Charak Samhita has devoted four different chapters to achieve qualitative and quantitative excellency of shukradhatu. In author’s view, in Ayurveda, Eugenics is not meant to practice selective breeding to have desirable trait in progeny rather it is the science of designing desirable quality of sperm and ova which could give birth to a healthy offspring when combining with other three important factors (ritu, kshetra, and ambu).

Ellen Richards was first to use the term “Euthenics” which derived from the Greek word “eutheneo” which means “well root to cause.” Richard in her book, Euthenics: The science of controllable environment (1910) argue benefits of eugenics principle in following manners:

“Human vitality depends on two primary conditions Heredity and Hygiene - or conditions preceding birth and conditions during life. Eugenics deals with race improvement through heredity, while Euthenics deals with race improvement through the environment. Euthenics precedes eugenics, developing better human now, and thus undoubtedly creating a better race of human in the future.”

Ayurveda exclusively believes and trust over eugenics principles. A pregnant mother is advised to practice controlled environment in terms of diet and regimen because growing fetus lays fully dependent over mother for nourishment and life. Ayurveda describes how mother and child are connected through rasavahanadi (umbilical cord) and further with apara (placenta) and garbhashaya (uterus) and interplay of mother and child activity affect each other physiology at body and mind level. After birth controlled environment in terms of proper sanitation, proper education, prevention of contagious disease could lay the child with good health and sound mind and thus “total health.”

Euphenics refers to phenotypic improvements after birth. This term was coined by Joshua Lederberg in the early 1960s. In 1970 many productive efforts were done to develop euphenics as it was speculated as positive form of genetic engineering. One such success was the use of folic acids containing vitamins during pregnancy to combat neural tube defect (spina bifida) which is a continuing application of euphenics principles till date. In author’s view “Garbhini Paricharya” during the whole gestational period of 9 months might be understood to link with euphenics principle as par modern science which needs extensive research.
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A critical review on therapeutic potential of 
Ashtanga ghrita

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Abstract

The world most ancient documented medical science is Ayurveda, which defines that a healthy body cannot function without a healthy mind. Hence, for a healthy lifestyle a healthy mind is needed, and from this, the concept of psychosomatic disorders and psychiatric disease evolve. The study was done with the aim to review the central nervous system (CNS) protective and learning and memory enhancing activity of Ashtanga Ghrita. The ingredients of Ashtanga Ghrita have been found to be effective against various CNS disorders such as cerebral palsy, Parkinsonism, Alzheimer’s disease, and epilepsy. In the Ayurvedic literature consumption of Ghrita is highly recommended in the management of psychiatric disorders as it is having lipophilic action and it acts on the brain so it is well established that it can cross the blood–brain barrier. The toxicological analysis showed that the drug to be absolutely safe for use. The contents of Ashtanga Ghrita also possess properties of an effective nervine tonic by means of their endeavor in improving memory and intellect. Thus, Ashtanga Ghrita can prove to be a good learning and memory, CNS, depressant activity, anticonvulsant action, antinociceptive, and anti-amnestic action, its effect on depression and in attention-deficit/hyperactivity disorder children.

Key words: Anti-amnestic attention-deficit/hyperactivity disorder, antinociceptive, Ashtanga Ghrita, cerebral palsy

INTRODUCTION

Ayurveda is a traditional approach to treatment practices by ancient Aryans which is based on Atharva veda, one of the oldest scriptures of Hindu. Ayurvedic medicines are attracting global population to treat and prevent various diseases and disease conditions by their holistic approach to heal since antiquity. It had developed itself in all branches and flourished immensely with time and age. This system had got advantage over other medicines in many respects.[3] Nature gifted us a superior gift in the form of medicinal plants to humans to maintain a disease free healthy life.[3] The crucial responsibility herbal medicine play in the treatment of human was identified from the ancient and still in use in the modern era.[3] The world most ancient documented medical science is Ayurveda, which defines that a healthy body cannot be function without a healthy mind. Hence, for a healthy lifestyle a healthy mind is needed, and from this, the concept of psychosomatic disorders and psychiatric disease evolve.[4] Neuropharmacology deals with the study of how drugs affect nervous system functions from molecular, cellular, synaptic, network, and behavioral levels; in turn, treating a variety of neurological diseases. Neuropharmacology is concerned with the interactions of neurotransmitters, neuropeptides, neuromodulators, enzymes, receptor proteins, second messengers, cotransporters and ion channels in the central and peripheral nervous systems. By studying the interactions of drugs with these targets, scientists are developing numerous new drugs to treat many different neurological diseases.[1,5] Ashtanga Ghrita is one of the most potential polyherbal ayurvedic preparations which is mentioned as compound preparations in Ashtanga Hridayam[6] has been use in Ayurveda for Vaka (Speech), Medha (Intellectual), Smruti (Memory), and Buddha (Logical Thinking) enhancement. Ayurveda, the Indian traditional system of medicine can offer much in this regard if thousands of unexplored combinations are brought into limelight.[3,7,8]

To carry out literature review of Ashtanga Ghrita with regard to the textual reference and critical analysis. Ashtanga Ghrita

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literature provided scientific evidence so that the information can be used for studied further clinically or in animal studies and it can be inculcated as major prescribed medication for CNS problems among children and adults both as curative and preventive medication.

**METHODS**

Classical texts of Ayurveda as well as PubMed, Medline database were used for the search of relevant literature and research papers. Papers published on the plants used to formulate *Ashtanga Ghrita* are considered. The keywords used for the search was “Ayurveda,” “Nervous System,” “Nootropic activity,” and “Memory enhancer,” etc. In vitro analysis, experimental trials, as well as clinical studies, were included in the review to search out the reported therapeutic potential of Ayurveda drugs. Only research articles published in the English language were considered.

All contents in equal quantity with Cow ghee 4 times that of content and Cow Milk 4 times that of Cow ghee.

**LITERATURE REVIEW**

*Ashtanga Ghrita* ingredient has eight plants which are *Vacha*, *Indulekha*, *Mandukparni*, *Sankhpuspi*, *Shatavari*, *Brahma soma*, *Amruta*, and *Brahmi* Table 1.[7]

**Bakuchi (Psoralea corylifolia Linn.)**

It belongs to Fabaceae family; it is an endangered and medicinally important plant grows throughout India. It possesses important activities such as antibacterial, anti-inflammatory, antiplatelet, antitumor, immunomodulatory, and antioxidants have also been reported.[8–11] In studies its found that supercritical fluid extracts of *P. corylifolia* at a conc. of 4 μg/ml, 4 μg/ml, 8 μg/ml, and 16 μg/ml show great growth inhibitory effects against *Staphylococcus aureus*.[12] Water Extract of *P. corylifolia* at a dose 20 mg/kg/day shows a good effect for anti-oxidative and anti-inflammatory. Ulcerative colitis was induced using DSS in male mice and the dose of Bakuchi appease hemorrhagic erosion of the colon mucosa.[13] *P. corylifolia* has Hemolytic and Mutagenic potential as in studies its found that antioxidant activity was shown by all extracts (crude and protein extracts) estimated by percentage 1, 1diphenyl-2-picryl hydrazyl radical scavenging activity assay.[14] Bakuchi seed contains various phytoconstituents such as *corylifolia*, *coryllol*, *coryllolin*, bakuchic in, *psoralidin*, *isopsoralidin*, *bavachin*, *isobavachin*, *bavachinin*, *bavachalcone*, *isobavachalcone*, 7-O-methyl *bavachin*, *bavachromanol*, *corylin*, *corylidin*, *corylinal*, 4-O-methyl *bavachalcone*, *neobavaisoflavone*, *bavachromene*, and *neobavachalcone*. These are mainly flavonoids.[15] The fruits of *P. corylifolia* consist of a sticky, oily pericarp (12% of the seed), a hard seed coat and kernel. It had been found that the seeds contain an essential oil (0.05%), nonvolatile terpenoid oil, a dark brown resin (8.6%), essential oil from seed 20.15%, and alkaloid (7.4%) substance.[16] In studies, it found that *P. corylifolia* has a potent cytotoxic action which was studied on two cancer cell lines and their corresponding multidrug-resistant (MDR) cell lines. Analytical and pharmacological data suggest that *P. corylifolia* significantly inhibits proliferation of sensitive and MDR cancer cells in vitro, *psoralen* and *isopsoralen* are responsible for the anticancer activity.[17] Some study demonstrates that aqueous and solvent extracts of *P. corylifolia* were antifungal active against five *Aspergillus* species tested in vitro condition by poisoned technique.[18]

*Brahmi* (Bacopa monniera) belong to the Scrophulariaceae family, is creeping small herb with branches, small oblong leaves, and light purple flowers. Bacopa’s traditional use as an anti-anxiety remedy in Ayurvedic medicine is supported by both animal and clinical research. Brahmi extract did not cause amnesia or side effects related to Lorazepam, instead of that, it has a memory-enhancing effect.[19] *B. monniera* has potent activity in the amelioration of cognitive disorders, as well as prophylactic reduction of oxidative damage, NT modulation, and cognitive enhancement in healthy people.[20] Brahmi has a great role as a neuroprotector. A study was also done on hippocampus of the temporal lobe of epileptic rats which involve cortical GABA receptors in temporal lobe epilepsy, associated mood disorders, spatial learning, and memory deficit.[21] The study concluded that BME treatment potentiates the therapeutic effect by reversing the alterations in glutamate receptor binding and NMDA R1 gene expression that occurs during epilepsy.[22] The triterpenoid saponins and their bacosides are responsible for *Brahmi* s ability to enhance nerve impulse transmission. The bacosides help to repair the damage caused in neurons by enhancing activity of a kinase, synthesis of neurons and restoration of synaptic activity and nerve impulse transmission. The chemical constituent responsible for the facilitatory effect of *Brahmi* on learning schedules was identified as a mixture of two saponins designated as bacosides A and B.[23] A learning memory study on male rats at a dose of 20 mg/kg, 40 mg/kg, and 80 mg/kg was done where animals were subjected to spatial learning (T-maze) and passive avoidance tests. The behavioral study shows that the treatment enhances the memory power of the rats.[24]

*Guduci* (Tinospora cordifolia) has been extensively studied and reported to have potent immunostimulant action.[25,26] In addition, *T. cordifolia* also found to have an antistress effect.[27] Ayurvedic literature recommends a rejuvenating recipe where *T. cordifolia* being an important constituent to enhance the memory function.[28] It can be revealed that the crude ethanolic extract of *T. cordifolia* stem possesses significant antinociceptive as well as antioxidant activities. The potential of the extract of *T. cordifolia* as antinociceptive and antioxidant agents may be due to the presence of...
phytoconstituents such as tannins and phenolics and might be responsible for its activity and justify its use as a traditional folk remedy.\(^{[29]}\) *T. cordifolia* is the best remedy for children suffering from upper respiratory tract infections. The aqueous extract of *T. cordifolia* significantly lowered the serum cholesterol and moves the High-density lipoprotein cholesterol level to a basic value. It also possesses antioxidant, anti-hyperglycemic, and antineoplastic and also it shows hepatoprotective and anthelmintic properties.\(^{[30]}\)\(^{[31]}\) There are various phytocomponents found in *T. cordifolia*, belonging to different groups such as alkaloids, glycosides, diterpenoid lactones, sesquiterpenoids, and steroids and it contains about 11.2% protein and rich in Ca and phosphorus.\(^{[32]}\) A study shows that 50% ethanolic extract of *T. cordifolia* has potent anxiolytic property and also prevent anxiety induced learning and memory impairment.\(^{[33]}\) Antinociceptive study was done on Swiss albino mice using the model of acetic acid at a dose of 25 mg/kg which shows a great effect on it. It also shows good anti-oxidant activity as the stock solution of the plant extract (10 mg/ml) which was prepared in ethanol and its serial dilution used in the study.\(^{[34]}\)

*Mandukparni* (*Centella asiatica*) aqueous extract was reported to have cognitive-enhancing as well as antioxidant effects in rats.\(^{[35]}\) It increases pentobarbitone-induced sleeping time and decreases immobility in rats tested in force swim model.\(^{[36]}\) About 0.1% essential oils and other volatile constituents, *C. asiatica* contains a wide range of other substances.\(^{[37]}\) The most biologically active compounds isolated from *C. asiatica* is the terpenes, for example, asiaticoside, madecassac acid, madecassoside, and asatial acid. In another study, it was found that asiaticoside is possessing wound healing activity by enhancing the stimulation of levels of antioxidant.\(^{[38]}\) *C. asiatica* is a very well-recognized drug, and it’s 3–4 fresh leaves with 1–2 black pepper are given to children to reinforce the memory. This plant is used in blood, skin diseases. The plant has antiseptic property also diuretic and used in leprosy, psoriasis, syphilitic ulcer, fever, dysentery, rheumatism, and bowel complaints. Leaves are rich in ascorbic acid which accelerate nervous activity and also good for increasing memory.\(^{[39]}\) Its parts used for the medicinal purpose are its leaves along with the petioles. The standardized extract at 300 mg/kg and 500 mg/kg shows the effect on analgesic and antinociceptive and anti-inflammatory agent along with its supportive CNS depression effect.\(^{[40]}\) Several animal models of anxiety and thus provides support to the ayurvedic claim that *C. asiatica* has anxiolytic activity. The data reported have an evidence for the anxiolytic activity of the crude plant material and may affect certain mediators to reduce anxiety.\(^{[41]}\) Hydroalcoholic extract of *C. asiatica* at a dose of 2 mg/mL given to 20-month-old female mice and tested on an open field and Morris water maze model which show potential for conferring clinical benefit in Alzheimer Disease and its neuroprotective properties.\(^{[42]}\) Furthermore, in another study *C. asiatica* ethanolic extract was studied on male Sprague Dawley rats at a dose of 100, 200, and 400 mg/kg, (p.o) and tested on open field, elevated plus maze, and hole board and gives a positive result against anxiety.\(^{[43]}\)

**Sankhpushpi** (*Convolvulus pluricaulis*) is used as a brain tonic. The whole herb of *Sankhpushpi* was used medicinally in the form of a decoction with cumin and milk in fever, nervous debility, and loss of memory.\(^{[44]}\) Research into the chemical constituents in *Sankhpushpi* had found the presence carbohydrate-D-glucose, maltose, rhamnose, sucrose and starch, and certain other bio chemicals which include glacial acetic acid, scopoletin, three coumarins, β-sitosterol, tropane alkaloids, kaempferol, convolve, convolvide, convolve, confoline, convosine, palmitic acid (66.8%), linoleic acid (2.3%), and straight chain hydrocarbon hexatriacotane, 20-oxodotriacontanol, tetraatriacontanoic acid, and 29-oxodotriacontanol.\(^{[45]}\) Alcoholic extract of plant yield kaempferol, Di-oh-cinnamic acid and β-stosterolglucos steroid of microphyllic acid.\(^{[46]}^{[51]}\) Ethyl acetate and aqueous fractions of the ethanolic extract of aerial parts of *C. pluricaulis* showed significant anxiolytic effect. The ethyl acetate fractions reduced the neuromuscular coordination indicative

<table>
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<tr>
<th>Name</th>
<th>Rasa</th>
<th>Latin name</th>
<th>Part used</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
<td>Vacha</td>
<td>Katu, Tikta</td>
<td>A. calamus Linn</td>
<td>Rhizome</td>
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<tr>
<td>Indulekha</td>
<td>Kashay, tikta</td>
<td>P. corylifolia Linn</td>
<td>Seed</td>
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<tr>
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<td>C. asiatica (Linn) Urban</td>
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<td>C. pluricaulis Choisy</td>
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<td>Madhur, Tikta</td>
<td>A. racemosus Wild</td>
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<td>A. speciosa Sweet</td>
<td>Heartwood</td>
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<td>Amrunuta</td>
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<td>T. cordifolia (Wild) Miers</td>
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<tr>
<td>Brahmi</td>
<td>Kashay, Tikta</td>
<td>B. monnieri (Linn) Pennell</td>
<td>Whole plant</td>
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</tbody>
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\(^{[10]}\)

\(^{[1]}\) *A. calamus*: *Acorus calamus*, *C. pluricaulis*: *Convolvulus pluricaulis*, *A. racemosus*: *Asparagus racemosus*, *A. speciosa*: *Argyreia speciosa*, *T. cordifolia*: *Tinospora cordifolia*, *C. asiatica*: *Centella asiatica*
of the muscle relaxant activity at a higher dose.[22] Another study showed nootropic and anxiolytic activity of an aqueous methanolic extract of C. pluricaulis[53] Sankhpuspi is a plant use in Medhya, digestive, appetite stimulant, and carminative for the digestive system. It also has cardioprotective property and control hypertension. It is also a good remedy for chronic cough in Ayurveda.[46] This plant has also been reviewed and reported for its potenti anxiolytic, neurodegenerative, and antistress activity by various researchers,[52-55] Alcoholic extracts of Evolvulus Alsinoides and C. pluricaulis at 250 mg/kg body weight given to rats by making a suspension with 2% tween 80 and that gives a good result on learning memory.[56]

Shatavari (Asparagus racemosus) is use mostly in the treatment of stomach ulcers, lung abscess, menopause, herpes, and chronic fevers and as a form of health food ingredients in Ayurvedic formulations[57] A. racemosus root extract has good significant antibacterial activity against S. aureus, Bacillus subtilis, Staphylococcus werneri, Pseudomonas putida, Pseudomonas aeruginosa, and Proteus mirabilis.[58,59] A. racemosus is widely used in Ayurveda for its medicinal properties, and it’s anticancerous property has been implicated in the regulation of cell proliferation and apoptotic gene products. Change in the control of the cell death processes such as apoptosis and autophagy may extend the lifespan of cells and favor neoplastic expansion.[60] The plant has property to the treatment of neurodegenerative disorders. In Ayurveda, Shatavari used as a rasayana herb and has been used as an adaptogen to increase the non-specific resistance of organisms against a variety of stresses.[61] A. racemosus has studied, and its ethanolic extract showed very potent activity against Alzheimer’s Disease, as its dosed at 2.5 mg/kg body weight (b.w.) to albino rats and tested in Elevated Plus Maze and also studied the passive avoidance test.[62]

Vacha (Acorus calamus) belong to Araceae family is a herb which is basically semiaquatic, perennial, aromatic herb with its rhizome being horizontal, rounded, somewhat vertically compressed, spongy and leaves grass like and sword-shaped; grown all over India.[63] Rhizome is a useful part having Medhya quality. It has been used in Indian and Chinese system of medicine for hundreds of years to cure diseases especially the CNS abnormalities.[64-66] A. calamus has a beneficial effect on the learning, memory process in mentally challenged children.[67] The API indicates the use of the dried rhizomes as a brain tonic in weak memory, psychoneurosis, and epilepsy.[68] Vacha is a brain tonic which promotes higher mental functions. It is an ideal herb for meditators, students, and musicians and all who need deep focus and attention in their work. Vacha penetrates deep into the brain tissues and scrapes toxins from the subtle channels in mind and opens the nadi of the higher chakras. Vacha heating qualities stimulate the brain and increase alertness and focus. It significantly aids information absorption and memory recall as it promotes cerebral circulation. It acts as a curative for memory loss, and any attention deficit disorders.[69,70] A. calamus attenuated the chronic constriction injury-induced behavioral, biochemical and histopathological changes in rats. These effects may be attributed to its potential anti-oxidative, anti-inflammatory, neuroprotective, and calcium inhibitory actions.[71] A. calamus may help in stress as in studies. It’s been observed that rhizome extract of the plant was dosed to male rats as 100 mg/kg and 200 mg/kg body weight orally for 21 days and the result show a great impact on the stress reduction with the help of Elevated plus-maze and Hebb-Williams maze models and the data are also collected by tissue processing in which the oxidant anti-oxidant systems were measured in brain.[72]

Vidhara (Argyreia speciosa Linn) belongs to family Convolvulaceae has been used in the different system of traditional medication for the treatment of diseases and ailments of human beings.[73] Vidhara root has potent power to improve the memory. Studies show 100 and 200 mg/kg aqueous extract of root successfully reverse amnesia induced by diazepam, in aged animals.[74] The alcoholic extract of the root exhibited statistically significant anti-inflammatory activity against granuloma formation technique in albino rats which comparable to acetylsalicylic acid.[75] The hydroalcoholic extract of A. speciosa roots was tested for the presence of carbohydrates, proteins, alkaloids, saponins, tannins, and essential oils using standard procedures.[76] Aqueous extract A. speciosa Linn at a dose of 100 mg/kg and 200 mg/kg was studied on mice and tested in Elevated Plus Maze and Passive avoidance model, and the result show a great impact on learning memory.[77]

**CONCLUSION**

Ashtanga Ghrita is a classic Medhya rasayan drug and the plant drug used in it also has nootropic effect individually. The plant drug used in the formulation has some other potent activity individually such as Bakuchi, Brahmi, and Guduchi have antioxidant property. Whereas Bakuchi and Shatavari have antibacterial activity, etc. This type of individual information about the plant may help to modify the formulation or in the further study so the formulation or the modified form may be used in other diseases. Hence, studying the classical formulation and its ingredients individually may help in future for further study and development. The modern concept of medicine and new advanced technology may help in the modification and the theory given here may help to succeed it.

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A review on current trends of ayurvedic medicinal plants having antidiabetic activity and renal disorders

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Abstract

Ayurveda and other Indian literature mentioned the use of plants in treatment of various human ailments. In the last few years, there has been an exponential growth in the field of herbal medicine and gaining popularity both in developing and developed countries because of their natural origin and less side effects. Diabetes mellitus is a chronic heterogeneous disorder affecting the β-cells of endocrinal pancreatic gland nearly 10% of the population worldwide also the number of those affected is increasing day-by-day. Plant showing lowering the elevated glucose level mainly belongs to the family Leguminosae, Lamiaceae, Liliaceae, Cucurbitaceae, Asteraceae, Moraceae, Rosaceae, and Araliaceae. The most active plants have been known to cure and control diabetes without causing any side effects such as Allium sativum, Gymnema sylvestre, Citrullus colocynthis, Trigonella foenum greacum, Momordica charantia, and Ficus bengalensis. Chronic kidney disease is progressive forms of renal disorders associated with reduced renal function having no well-known etiopathogenesis. The available treatment modalities in conventional system of medicine are still evolving but peritoneal and hemodialysis along with nutritional supplements and renal transplant is the final step. In this regard, Ayurveda provides leads through its holistic line of management by incorporating dietary and lifestyle invention and bio-balancing effects of Ayurvedic drugs.

Key words: Chronic kidney disease, glucose ayurvedic drugs, insulin, natural products, β-cells diabetes mellitus

INTRODUCTION

Diabetes is usually a lifelong (chronic) disease, in which there are high levels of sugar in the blood.[1] Diabetes mellitus is a metabolic disorder initially characterized by a glucose level loss homeostasis, due to fat and protein metabolism disturbances of carbohydrate, resulting from defects in insulin production, secretion, insulin action.[2] Complications in some of these organs can lead to death.[3] More than 347 million people are affected by diabetes worldwide.[4] The prevalence of diabetes has risen from 2.5% to 6.5% in the last 14 years.[5] Diabetes-related deaths are more common in the low- and middle-income countries where more than 78% deaths occur.[6] The World Health Organization projects that diabetes will be the 7th leading cause of death in 2030.[7] Traditional and alternative medicines have been used since ancient times. Yet the use of traditional medicine (TM) remains widespread in developing countries, while the use of complementary and alternative medicine is increasing rapidly in developed countries. TM is sometimes also the only affordable source of health care, especially for the world’s poorest patients.[8] Insulin is the most common type of medication used in type 1 diabetes treatment. It is also used in type 2 diabetes treatment. It is given by injection and comes in different types.

Types of Diabetes Mellitus

The World Health Organization (WHO) classification of diabetes introduced in 1980 and revised in 1985 was based on clinical characteristics. The two most common types of diabetes were insulin-dependent diabetes mellitus (IDDM) or (type I) and non-insulin-dependent diabetes mellitus (NIDDM) or (type II). WHO classification also recognized malnutrition-related diabetes mellitus and gestational diabetes Malnutrition-related diabetes was omitted from the
new classification because its etiology is uncertain, and it is unclear whether it is a separate type of diabetes.\textsuperscript{[9,10]}

**Type I Diabetes Mellitus**

The Type- I diabetes is dependent. It is a result of cellular mediated autoimmune destruction of the insulin-producing and secreting β-cells of the pancreas, which results in an absolute deficiency of insulin for the body. Patients are more prone to ketoacidosis. It usually occurs in children and young adults, usually before 40 years of age, although disease onset can occur at any age. The patient with type I diabetes must rely on insulin medication for survival. It may account for 5–10 % of all diagnosed cases of diabetes.\textsuperscript{[11]} Autoimmune, genetic, and environmental factors are the major risk factors for type I diabetes.\textsuperscript{[11-14]}

**Type II Diabetes Mellitus**

The Type- II diabetes is independent. Two key features in the pathogenesis of type II diabetes mellitus are a decreased ability of insulin to stimulate glucose uptake in peripheral tissues, insulin resistance, and the inability of the pancreatic β-cell to secrete insulin adequately, β cell failure. The major sites of insulin resistance in type 2 diabetes are the liver, skeletal muscle, and adipose tissue.\textsuperscript{[15]} Both defects, insulin resistance, and β-cell failure, are caused by a combination of genetic and environmental factors. Environmental factors such as lifestyle habits (i.e., physical inactivity and poor dietary intake), obesity, and toxins may act as initiating factors or progression factors for type II diabetes.\textsuperscript{[9,11,16-18]}

**Factors Precipitating Lactic Acidosis in Patients with Type 2 Diabetes Mellitus**

- Cardiac failure.
- Myocardial infarction.
- Hepatic failure.
- Any hypoxic state.
- Clinical dehydration.
- Shock (especially septic shock).
- Severe sepsis and hemodynamic instability.
- Major surgery.

**Gestational Diabetes Mellitus**

Gestational diabetes, blood glucose elevation during pregnancy, is a significant disorder of carbohydrate metabolism due to hormonal changes during pregnancy, which can lead to elevated blood glucose in genetically predisposed individuals. It is more common among obese women and women with a family history of diabetes. It usually resolves once the baby is born, however, after pregnancy, 5–10% of women with gestational diabetes are found to have type II diabetes, and 20%–50% of women have a chance of developing diabetes in the next 5–10 years.\textsuperscript{[9,11,28,29]} Gestational diabetes is a form of diabetes consisting of high blood glucose levels during pregnancy and goes away after the baby is born. It develops toward the treating diabetes without any complication or any side effects is a challenging problem in the medical community.\textsuperscript{[30]} The medicinal plants used on antidiabetic treatments possess pancreatic β-cells regenerating, insulin-releasing activity, and also fight the problem of insulin resist adipose tissue, and inhibit the glucose absorption from the intestine.\textsuperscript{[31]}

**Testing for Hypoglycemic Activity**

The discovery of the oral synthetic hypoglycemic was a major in the treatment of diabetes. Act by augmenting insulin secretion, and the biguanides only work in the presence of residual insulin.

There are many plant extract with proven hypoglycemic activity jambul, Syzygium cumini; fenugreek, Trigonella foenum-graecum, garlic, A. sativum; onion. No isolated compound from these plants have yet been developed for clinical use which are dietary compound have been tested in human diabetics and found to be hypoglycemic.

The oral sulphonylureas in clinical use are hypoglycemic normal (i.e., non-diabetic) animals, and successful screening programs have been carried out using normal rabbits and rats; however, nowadays diabetic animals are usually employed clinical testing in human non-insulin dependent diabetics involves measurement blood glucose levels after administering the test extract, after overnight fasting or preloading with glucose.

**Measurement of the Blood Insulin Levels**

It may be useful to determine whether there is a rise in circulating insulin levels after glucose loading, and during treatment with plant extract. The usual methods are radio-immunoassay and enzyme-linked immunosorbent assay, available as kits, for example, from Boehringer, Mannheim; Novo Biolabs, Copenhagen; Pharmacia, Brussels, and others, for examples, see “Treatment of Results”

**Clinical Testing in Human Subjects**

Human non-insulin dependent diabetic volunteers can be used to test non-toxic plant extracts. However, the two
examples as shown in “treatment of results” also demonstrate the different mechanisms, there is the true hypoglycemic effect of the opuntia ficus-indica extract and the blunted insulin release and post-prandial glycemic profiles resulting from ingestion of guar gum, Cyamopsis tetragonolobus. In the Opuntia experiment, this was not the case since the patient did not receive a glucose load before the plant extract.

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<table>
<thead>
<tr>
<th>Diagnosis of GDM with 100-g oral glucose load</th>
<th>mg/dl</th>
<th>mmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting</td>
<td>94</td>
<td>5.4</td>
</tr>
<tr>
<td>1-h</td>
<td>181</td>
<td>10.0</td>
</tr>
<tr>
<td>2-h</td>
<td>154</td>
<td>8.5</td>
</tr>
<tr>
<td>3-h</td>
<td>141</td>
<td>7.7</td>
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<table>
<thead>
<tr>
<th>Diagnosis of GDM with 75-g oral glucose load</th>
<th>mg/dl</th>
<th>mmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting</td>
<td>94</td>
<td>5.4</td>
</tr>
<tr>
<td>1-h</td>
<td>181</td>
<td>10.0</td>
</tr>
<tr>
<td>2-h</td>
<td>154</td>
<td>8.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood sugar level chart</th>
<th>Fasting</th>
<th>Just ate</th>
<th>3 h after eating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>80–100</td>
<td>170–200</td>
<td>120–140</td>
</tr>
<tr>
<td>Pre-diabetic</td>
<td>101–125</td>
<td>190–230</td>
<td>200+</td>
</tr>
<tr>
<td>Diabetic</td>
<td>126+</td>
<td>220–300</td>
<td>200+</td>
</tr>
</tbody>
</table>

In normal individuals, the liver acts a storehouse of carbohydrates and releases glucose whenever the need arises. The pancreas produces insulin, which circulates the case of prediabetic patients; the pancreas does not produce enough insulin leading to increased levels of sugar in the blood up to 100–125 mg/dl. Nowadays, dial the number of adults suffering from diabetes is expected to increase in threefold from 19.4 million in 1995 to 57.2 million in 2025.[32] The three main important _cli_ and _polyphagia_ (increased hunger).[33]

**Methodology**

The study aimed to recollect and record, the information on antidiabetic plants from the hyperglycemic condition. In this review, we have collected about 180 plants which
are effective for the reduction of hyperglycemic condition. The plants have about medicinal plants with antidiabetic activity.

**Important Medicinal Plants Explored as Anti-Diabetic [Table 1]**

**Acacia arabica**

Acacia Arabica (babul) is used as home remedy in Indian system of medicine for reducing the complications of diabetes. It is found that this plant extract acts as an antidiabetic agent by acting as secretagogue to release insulin. It induces hypoglycemia in control rats but not in alloxanized animals. Powdered seeds of Acacia arabica when administered (2, 3, and 4 g/kg body weight) to normal rabbits, induced hypoglycemic effect by initiating release of insulin from pancreatic beta cells.\[34\]

**Adansonia digitata**

Leaves bark and fruits of *A. digitata* are traditionally employed in several African regions as food, and for medicinal purposes, and for the letter use, it is also named “the small pharmacy or chemist tree.”\[35\] Hypoglycemic activity of methanolic stem bark extract of *A. digitata* in Wister rats has been investigated in streptozotocin-induced diabetes. Treatment of streptozotocin-induced diabetic Wister rats with the extract caused a significant reduction in the blood glucose levels when compared with control. The dose of 100 mg/kg showed a significant decrease after 1, 3, 5 and 7 h of extract administration, compared to control normal saline. In addition, the dose of 200 mg/kg shown a significant decreased after 3, 5, and 7 h of extract administration. The dose of 400 mg/kg also showed a significant decrease of blood glucose after 5 and 7 h of extract administration, compared to control normal saline. These results suggest that the methanolic stem bark of *A. digitata* possesses antidiabetic effect on streptozotocin-induced diabetic Wistar rats \[35\].

**Adhatoda vasica**

The methanolic extract from the leaves of *A. vasica* Nees (Acanthaceae) showed a sucrase inhibitory activity with sucrase as a substrate. Compounds vasicine and vascinol showed a high sucrase inhibitory activity, and the IC\(_{50}\) values were 125 μM and 250 μM, respectively. Kinetic data revealed that the compounds vasicine and vascinol inhibited sucrase-hydrolysising activity of rat intestinal α-glucosidase competitively with \(K_i\) values of 82 μM and 183 μM, respectively. This is the first report on the mammalian α-glucosidase inhibition of *A. vasica* and the inhibitory effect on sucrase by vasicine and vascinol from this herb species. These results suggest the use of the extract of *A. vasica* as an antidiabetic agent and also show the possibility that the compounds, vasicine, and vascinol could be a useful treatment for metabolic disorders.\[36\]

**Aegle marmelos**

*A. marmelos* leaf extract is being used in Indian system of medicine as an antidiabetic agent. A methanolic extract of *A. marmelos* was found to reduce blood sugar in alloxan-induced diabetic rats. Reduction in blood sugar could be seen from 6th day after continuous administration of the extract and on 12th day sugar levels were found to be reduced by 54%. This result indicates that *A. marmelos* extract effectively reduced the blood glucose in diabetes induced by alloxan and it also showed antioxidant activity.\[37\]

**Aloe Barbadensis**

Aloe, a popular houseplant, has a long history as a multipurpose folk remedy. The plant can be separated into two basic products: gel and latex. *Aloe vera* gel is the leaf pulp or mucilage, Aloe latex, commonly referred to as “aloe juice,” is a bitter yellow exudate from the pericyclic tubules just beneath the outer skin of the leaves. Extracts of aloe gum effectively increase glucose tolerance in both normal and diabetic rats.\[38\] Treatment with prolonged but

**Table 1: Medicinal plants having antidiabetic activity**

<table>
<thead>
<tr>
<th>Plant activity</th>
<th>Family</th>
<th>Parts used</th>
<th>Type of extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alangium lamarckii</td>
<td>Alangiaceae</td>
<td>Leaves</td>
<td>Alcoholic</td>
</tr>
<tr>
<td>Albizia odoratissima</td>
<td>Mimosaceae</td>
<td>Bark</td>
<td>Methanol</td>
</tr>
<tr>
<td>Axonopus compressus</td>
<td>Poaceae</td>
<td>Leaves</td>
<td>Methanol</td>
</tr>
<tr>
<td>Berberis vulgaris</td>
<td>Berberidaceae</td>
<td>Root</td>
<td>Aqueous</td>
</tr>
<tr>
<td>Brassica juncea</td>
<td>Cruciferae</td>
<td>Seed</td>
<td>Aqueous</td>
</tr>
<tr>
<td>Caesalpinia digyna</td>
<td>Fabaceae</td>
<td>Root</td>
<td>Methanol</td>
</tr>
<tr>
<td>Catharanthus roseus</td>
<td>Apocynaceae</td>
<td>Leaf</td>
<td>Methanol</td>
</tr>
<tr>
<td>Centaurium erythrea</td>
<td>Gentianaceae</td>
<td>Leaf</td>
<td>Aqueous</td>
</tr>
<tr>
<td>Chaenomeles sinensis</td>
<td>Rosaceae</td>
<td>Fruits</td>
<td>ethyl acetate</td>
</tr>
<tr>
<td>Costus speciosus</td>
<td>Costaceae</td>
<td>rhizome</td>
<td>Antidiabetic</td>
</tr>
</tbody>
</table>

*A. compressus: Axonopus compressus, C. erythrea: Centaurium erythrea, C. sinensis: Chaenomeles sinensis*
not only a single dose of exudates of aloe barbadensis leaves showed hypoglycemic effect in alloxanized diabetic rats. Single as well as prolonged dose of bitter principle of the same plant also showed hypoglycemic effect in diabetic rats. This action of A. vera and its bitter principle is through stimulation of synthesis and/or release of insulin from pancreatic beta cells.\[39\]

**Andrographis Paniculata**

The chloroform extract of *A. paniculata* roots has been tested for its antihyperglycemic activity in alloxan-induced diabetic rats using chronic and acute studies. Significant reductions in blood glucose levels were observed in both acute and chronic studies. The extract significantly inhibited the induction of albuminuria, proteinemia, and uremia. Activity with the chloroform extract of *A. paniculata* roots and supports the traditional usage of the plant by Ayurvedic physicians for the control of diabetes.\[40\]

**Anthocephalus Indicus**

*A. indicus* (family, Rubiaceae: Hindi name- Kadam) is one such Ayurvedic remedy that has been mentioned in many ancient Indian medical literatures to possess antidiarrheal, detoxification, analgesic, and aphrodisiac properties. A study was carried out to evaluate the hypoglycemic, lipid lowering, and antioxidant activities in root extract of *A. indicus* in alloxan-induced diabetic rats. Oral administration of ethanol extract of root (500 mg/kg body weight) for 21 days resulted in significant decrease in the levels of blood glucose, triglycerides, total cholesterol, phospholipid and free fatty acids. Furthermore, the root extract (100–400 μg/kg) inhibited the generation of superoxide anions and hydroxyl radicals, in both enzymic and non-enzymic systems, in vitro. The result of this study demonstrated hypoglycemic, lipid-lowering, and antioxidant activities in root extract of *A. indicus*, which could help in the prevention of diabetic dyslipidemia and related diseases.\[40\]

**Artanema Sesamoides**

The methanolic extract of *A. sesamoides* was investigated for its antidiabetic activity in streptozotocin-induced diabetic rat models. Administration of this extract significantly reduced the fasting blood glucose level and increased the glycogen level in liver, compared to a control group. The extract also diminished the elevated level of serum glutamic pyruvic transaminase, serum glutamic oxaloacetic transaminase, and serum alkaline phosphatase and also exhibited anti-oxidant activity. This study indicates the antidiabetic potential of Artanema sesamoides and provides the basis for further research to isolate and to identify the active constituents responsible for the reported activities.\[41\]

**Azadirachta indica**

Hydroalcoholic extracts of this plant showed antihyperglycemic activity in streptozotocin-treated rats. The extract caused an increase in glucose uptake and glycogen deposition in isolated rat hemi diaphragm. Apart from having antidiabetic activity, this plant also has antibacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects.\[42\]

**Boerhavia Diffusa**

*B. diffusa* (Nyctaginaceae) is known as punarnava and is used as diuretic, hepatoprotective and for treatment of other diseases in the Indian medicinal system. A study was designed to investigate the effects of daily oral administration of aqueous solution of *B. diffusa* leaf extract (BLEt) (200 mg/kg) for 4 weeks on blood glucose concentration and hepatic enzymes in normal rats and alloxan-induced diabetic rats. A significant decrease in blood glucose and significant increase in plasma insulin levels were observed in the normal and diabetic rats treated with BLEt. An oral glucose tolerance test was also performed in the same groups, and there was a significant improvement in glucose tolerance in rats treated with BLEt. A comparison was made between the action of BLEt and antidiabetic drug - glibenclamide (600 μg/kg). The effect of BLEt was more prominent when compared to glibenclamide, suggesting it was a more potent antidiabetic agent.\[43\]

**Butea Monosperma**

The plant *B. monosperma* belongs to the family Fabaceae. It is also known as Butea frondosa, (Hindi- Dhak, Palas) and is found throughout India. A methanol extract of *B. monosperma* seeds, tested in vitro showed a significant anthelmintic activity, anticonvulsive, and hepatoprotective. In light of the traditional claim on the use of *B. monosperma* in the treatment of diabetes, investigations were carried out to evaluate the effects of extract from the bark of *B. monosperma* on normal mice and alloxan-induced diabetic mice. The studies indicated that the crude aqueous extract exhibited statistically significant hypoglycemic and anti-hyperglycemic activities in normal and alloxan-induced diabetic albino rats, respectively.\[44\]

**Caesalpinia Bondocella**

*C. bondocella* F. (Leguminosae) is a medicinal plant, widely distributed throughout India, and the tropical regions of the world. Four extracts (petroleum ether, ether, ethyl acetate, and aqueous) of the seed kernels were prepared and tested for their hypoglycemic potentials in normal rats as well as alloxan-induced diabetic rats. In diabetic rats, both polar extracts (ethyl acetate and aqueous) similar to glibenclamide, showed significant hypoglycemic effect, besides, reversing the diabetes induced changes in lipid and liver glycogen levels.
As far as the non-polar extracts were concerned, it was only the ether extract that showed a marginal antidiabetic activity. Since both polar extracts were, through phytochemical analysis, found to contain triterpenoid glycosides, it can be presumed that they might be the active principles contributing to the antidiabetic actions.[45]

**Cassia Auriculata**

*C. auriculata* (Family: Cesalpinaceae) is a common plant in Asia, profoundly used in Ayurvedic medicine as a tonic, astringent, and as a remedy for diabetes, conjunctivitis, and ophthalmia. It is one of the principal constituents of “Aavaarai panchaga chooraman”– an Indian herbal formulation used in the treatment of diabetes to control the blood sugar level. The antidiabetic activity of aqueous extract of *C. auriculata* flowers has been documented previously. Therefore, in a study, the antidiabetic potential of aqueous and ethanolic extracts of *C. auriculata* was assessed in alloxan-induced diabetic rats. Both extracts gave significant reduction in blood glucose level because of presence of antidiabetic compounds such as flavonoids and phenolic acids. The antidiabetic potential of ethanolic extract was more than that of aqueous extract. The typical dose was found to be 0.25–0.5 g per kg body weight.[46]

**Medications for Type 1 Diabetes**

Insulin lispro (Humalog), Insulin aspart (NovoLog), Insulin glulisine (Apidra).

**Medications for Type 2 Diabetes**

Sulfonylureas, Glimepiride (Amaryl), Glipizide (Glucotrol), Glyburide (DiaBeta, Micronase, Glynase).

The older sulfonylureas are as follows: Acetohexamide. Chlorpropamide (Diabinese), Tolazamide (Tolinase), Tolbutamide (Orinase).

Chronic kidney disease (CKD) is progressive loss in renal function over a period of months or years. It is also called as chronic kidney failure. Signs and symptoms of kidney disease are often nonspecific, meaning they can also be caused by some other illnesses because kidneys are highly adaptable organ in the body and able to compensate for its lost function. The signs and symptoms may appear at the stage of irreversible damage, which includes nausea, vomiting, loss of appetite, fatigue and weakness, sleep problems, changes in urine output, decreased mental sharpness, muscle twitches and cramps, hiccups, swelling of feet and ankles, persistent itching, shortness of breath, high blood pressure (BP) (hypertension) etc.[47] Often, it is diagnosed as a result of screening of people known to be at risk of kidney problems, such as those with high BP or diabetes and those with a blood relative with renal disorders. It is considered as long-term form of kidney disease and is differentiated from acute kidney disease in that the reduction in kidney function must be present for over 3 months. It is an internationally recognized public health problem affecting 5%–10% of world population.[47] CKD is identified by blood test for creatinine, which is a breakdown product of muscle metabolism. Higher level of creatinine indicate a lower glomerular filtration rate and as a result a decreased capability of the kidneys to excrete waste products. The modern management of CKD is not satisfactory, and the ultimate goal is renal transplant. It seeks attention from nephrologists and researchers to find out suitable remedial measure from other alternative resources, Ayurveda is one of them. The management diseases in Ayurveda are based on its totalistic effect of drugs and measures with minimal unwanted and side effects. Ayurveda proclaims that naming of diseases is not necessary, but the mainstay is to assess the Dosha, dushya, adhishthana along with strength of disease and patient, then incorporate the appropriate therapeutic interventions. The disease CKD is not fairly known in Ayurveda, but on the basis of pathogenetic events we can assess and plan the management. In this regard, we share our clinical experience of a 60 years old female who was suffering from CKD since last 10 months.

CKD, The global burden of noncommunicable diseases is of grave concern and has recently been highlighted by the WHO and a plethora of publications in prominent journals.[48-50] CKD has often been indicated as a major contributing factor to this burden, especially in low- and middle-income countries.[51] Initial figures stated that CKD was present in 10% of the world’s population. Recently, this figure has risen to 14% in the USA, and by 2030, 27% of North Americans >30 years of age are predicted to have CKD.[51] An added burden to the recent number of people with CKD >45 years old will be markedly increased, taking into consideration that the estimated glomerular filtration rate (eGFR) decreases by 0.75–1.00 mL/min and, for example, 50% of UK children born in 2007 will live to the age of 103 years.[52]

**ADVANCES IN IDENTIFYING FACTORS THAT PREDICT DEVELOPMENT OF CKD AND ITS PROGRESSION**

**Hypertension**

Hypertension is one of the modifiable comorbid variables that should be evaluated and managed properly in children with CKD. An increase in BP causes increase intraglomerular pressure and hyperfiltration that leads to progressive deterioration of renal function.[53] The CKiD study has shown that as high as 64% of pediatric CKD patients required antihypertensive medications to control their BP.[54] Furthermore, comparing between the patients with uncontrolled BP and controlled BP, uncontrolled group used significantly less renin-angiotensin antagonists than the
controlled group. Some pediatric CKD patients may have normal BP in the clinic but they have elevated BP over the period of 24 h.

The optimal target of BP in pediatric CKD patient has also been studied in the randomized control study “Effect of strict BP control and ACE inhibition on progression of CKD in pediatric patients” also known as “ESCAPE trial”. It has shown that intensified BP control showed a substantial benefit on slowing CKD progression in pediatric patients [Tables 2 and 3].

**Cardiovascular Disease**

Children with CKD are at an increased risk to develop cardiovascular disease. Parekh et al. has shown that pediatric patient with CKD who were on dialysis had cardiac death rate as high as 20 per 1,000 patient-year. Increase in sympathetic activity has been associated with increase in cardiovascular risk as shown in the adult patient with CKD. The nature of cardiovascular death in children is different than that in adults. In adults, coronary artery disease and congestive heart failure are the leading causes, while in children, cardiomyopathy and arrhythmia are most prevalent. Recently, the CKiD study found that pediatric CKD patients with HT also had decreased heart rate variability and increased BP variability. Both findings are signs of sympathetic nervous system over-activity. Dyslipidemia is also a known risk factor of cardiovascular disease. Salan et al. have shown that 45% of pediatric CKD patients had dyslipidemia.

**CKD-Mineral and Bone Disorder (MBD)**

CKD causes disordered regulation of mineral metabolism with subsequent alterations in skeletal and cardiovascular biology which is now referred to as CKD-MBD. Hyperparathyroidism in advanced CKD is secondary to the deficiency of 1, 25-dihydroxy vitamin D (1,25 (OH)2D) combined with hyperphosphatemia leading to abnormal bone turnover and mineralization. Fibroblast growth factor 23 (FGF23) is a bone-derived circulating hormone that inhibits renal phosphate reabsorption and suppresses the synthesis of 1,25 (OH)2D thereby acting as a phosphaturic hormone. Circulating FGF23 was significantly elevated in patients with CKD and its concentration correlated with renal creatinine clearance. FGF23 normalizes serum phosphate and decreases 1,25 (OH)2D levels in early stage CKD, and suggests a pathological sequence of events for the development of secondary hyperparathyroidism triggered by increased FGF23, followed by a reduction of 1,25 (OH)2D and calcium levels, thereby increasing parathyroid hormone secretion. Portale et al. found that serum FGF23 is the earliest detectable abnormality in mineral metabolism, and levels are highest in glomerular diseases. Serum phosphorus levels, adjusted for age, were significantly lower at GFR of 60–69 ml/min per 1.73 m² than higher GFR, but thereafter they became higher in parallel with FGF23 as GFR declined.

Recent studies have shown that the induction of vascular calcification begins in early normophosphatemic CKD by the reduction of vascular Klotho and increased FGF23 secretion. Studies of the vasculature in CKD indicate the presence of osteoblastic differentiation in the vessel wall suggesting that uremic serum and high phosphate stimulate osteoblastic differentiation of calcifying vascular cells and vascular smooth muscle cells.

**International Society for Peritoneal Dialysis (ISPD)**

ISPD is an International society aimed to advance knowledge of peritoneal dialysis and to promote advancement of such knowledge through scientific meetings and publications. In 2012, ISPD developed practice guideline for the management of peritonitis in pediatric patients with peritoneal dialysis.
Diet

Patient was advised to restrict salty, fried, spicy, heavy, and oily food items. She was restricted for fluid intake and take fluid as per 24 h urine output and protein rich diet. The treatment response was assessed on the basis of clinical symptomatology after a course of medicines for 15 days and significant improvement was found in the associated symptoms. The patient was then discharged and advised to continue the following medicine for 15 days and asked to report.

In first follow-up (after 15 days) it was found that patient got 50% improvement. The improvement in term of the patient’s view in clinical symptoms was as follows:

- Reduction in breathlessness.
- Reduction in facial and pedal edema.
- Improvement in desire of intake of food.
- Improvement in bowel function.
- Improvement in weakness.

Relevant investigations

CBC: Hb-8.0g/dl RFT: Na+ -135.2meq/l
TC-7030/μl K+ -4.1meq/l
DC- N68, L22, E4, M 6 Cl- -108.1meq/l
RBC: 257000/μl Sr. Creat-5.8 mg/dl
HCT: 24.4% Sr. Cal: 10.4 mg/dl
MCV: 94.0fl Blood urea- 202 mg/dl
MCH: 31.0pg Phosphate-3.7mg/dl

After thorough interrogation and physical and systemic examination the following medicines advised for another 15 days:

Treatment advised: Gokshuradi gugglu (125 mg)-2 BD, Punarnavastaka kwath -40 ml BD, Prawal pishti (125 mg) -1TDS, Punarnava mandoor (500 mg) 1TDS & Haritaki Churna- 1tsf/HS with warm water.

Drug Sources

1. Punarnavastaka kwath (Bhaishajyaratnawali).
2. Punarnava mandoor (Bhaishajyaratnawali).
3. Praval pishti tab (Dhutapapeswara).
4. Green punarnava syrup (Dhanwantri pharmaceuticals).
5. Gokshuradi gugglu (Bhaishajyaratnawali).
6. Haritaki Churna (Bhaishajyaratnawali).

The body cannot produce enough insulin, in which the diabetes is a chronic disease that occurs when or cannot use insulin effectively.[68] The diabetes disease by the year 2025, it is projected that 300 million people will have diabetes patient.[69] and it may reach to 366 million diabetes patient in the year 2030.[70] Type 2 diabetes is a common condition and a serious global health problem. In most countries, diabetes has increased alongside rapid cultural and social changes: ageing populations, increasing urbanisation, dietary changes, reduced physical activity, and unhealthy behaviors.[71] A person’s risk of developing Type 2 diabetes mellitus has been shown to be highly linked to obesity and any family history of diabetes.[72] The hyperglycemic condition causes increased glycosylation leading to biochemical and morphological abnormalities due to altered protein structure and develop the neuropathy, retinopathy, neuropathy, and cardiomyopathy.[73]

In 2005, Diabetes patient kills 1.1 million and more than 220 million people worldwide have diabetes mellitus.

It would be right to say that modern system of medicine is capable of offering reasonably effective treatment for so many diseases. The diagnostic tools to find out disease-causing factors are also equally good. However, here, in this case, neither the investigations nor the treatment helped much for considerable period. The patient was not satisfied by modern management. In this case, we observed that the given Ayurvedic drugs were significantly reduced the blood urea, sr. creatinine level and improved the hemoglobin level. This is probably due to renoprotective and nephrogenetic effect of Punarnava,[3-7] which is the major part of current Ayurvedic prescription. The hemoglobin level was also improved from 7.5 g/dl to 9.2 g/dl, without any conventional hemetinic drugs prescription. The hemoglobin level was also improved from 7.5 g/dl to 9.2 g/dl, without any conventional hemetinic drugs and blood transfusion because of using Tablet Abhralauha and punarnava mandoor which provides sufficient nutrition at the level of Saptadhatus and helps in the blood formation by directly or indirectly.

**CONCLUSION**

Among many disease or disorders of carbohydrate, fat and protein metabolism, diabetes is a serious disorder effecting large population of the world. It is associated with decreased insulin production or resistance toward its action. Plants have been traditionally used to treat diabetes patients, both insulin dependent and non insulin dependent diabetes. They have also been reported to be used in associated conditions of diabetes such as diabetic peripheral neuropathy, diabetic retinopathy. Recent scientifically carried out research work has justified the role of herbs in the management of diabetes, however, it would be unwarranted to assure that all these plants can be blindly used in diabetic patients. Authors feel that still there these plants have to go a long way in terms assessment parameters such as toxic effects,
herb-herb; herb-drug interaction and ongoing exploration regarding pharmacological actions and isolation of bioactive compounds should be continued. Although there is an increase in the number of patients suffering from diabetes in every age group during the last decade. Herbs are highly esteemed for millennia as a rich source of therapeutic agents for prevention and treatment of diabetes and its ailments. Although the contribution of modern synthetic medicine for elevating the human sufferings cannot be underestimated, equally true is the fact that most of them leave unwanted harmful side/toxic effects on the human system disturbing the basic physiology. During the last three decades or so, there has been serious realization of these problems associated with synthetic drugs and as a result the world has started looking towards the herbs as agents of therapy which, apart from being comparatively economical and easily available, are relatively free from the problems of side effects, toxicity, and developing resistance toward causative organisms.

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Antioxidant activity of Rajatachandrodaya rasa

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Abstract

Background: Ayurveda is a system of Indigenous Medicine which systematizes and applies the knowledge about health and disease. After the development of Rashasastra Ayurveda made a landmark in the history of medicine by making judicious use of Herbo-Mineral preparations in the treatment of many diseases without any untoward effects with high degree of safety and efficacy. Rajatachandrodaya is a Herbo-mineral preparation. It is being prepared by Kupipakva method. Hence in the present study Experimental evaluation of Antioxidant activity is conducted to interpret its basis of pharmacological properties. Method: Radical Scavenging by DPPH Method and Nitric Oxide Scavenging Activity method were used for evaluation of antioxidant properties with Ascorbic acid as standard. Result: IC50 values were found to be 1256.52 µg/ml and 793.80 µg/ml in Nitric oxide Scavenging Activity and DPPH Method respectively. Conclusion: The current study shows that Rajata Chandrodaya Rasa exhibits antioxidant effects which may be responsible for therapeutic application in sexual problems and low sperm count.

Key words: Rajatachandrodaya Rasa, Ayurveda, Kupipakva, Antioxidant

INTRODUCTION

An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that transfers electrons or hydrogen from a substance to an oxidizing agent. Oxidation reactions can produce free radicals. In turn, these radicals can start chain reactions. When the chain reaction occurs in a cell, it can cause damage or death to the cell. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reactions. They do this by being oxidized themselves, so antioxidants are often reducing agents such as ascorbic acid or polyphenols. In general, free radicals are produced in large amounts during metabolic disease conditions and have been implicated in the causation of several problems such as atherosclerosis, ulcers, asthma, cancer, cataract, liver disease, and other inflammatory process.¹ Reactive oxygen species (ROS) are continuously produced during cell metabolism and under normal conditions; they are scavenged and converted to non-reactive species by different intracellular enzymatic and non-enzymatic antioxidant system. Antioxidants thus play an important role in the protection of the human body against damage by ROS. Antioxidants may act as free radical scavengers, reducing agents, chelating agents for transition metals, quenchers of singlet oxygen molecules, and/or activators of antioxidative defense enzyme system to suppress the radical damages in biological systems.² Therefore, inhibition of free radical-induced oxidative damage by supplementation of antioxidants has become an attractive therapeutic strategy for reducing the risk of these diseases. In recent years, it has been investigated that many plant species are serving as a source of antioxidants and received therapeutic significance. Several antioxidants of plant origin are experimentally proved and used as effective protective agents against oxidative stress. They play an important role in major health problems such as cancer, cardiovascular diseases, rheumatoid arthritis, cataracts, Parkinson’s disease, Alzheimer’s disease, and degenerative diseases associated with aging.³ A great deal of research has been carried out to evaluate scientific basis for the claimed antioxidant activity of herbal agents as in the form of formulation. The aim of the present study is to and to evaluate the antioxidant activity of Rajatachandrodaya Rasa (RCR).

The Rasausadhis are the backbone of the Ayurvedic therapeutics.⁴ These chiefly include metals, minerals,
herbo-mineral and marine products, known for their quick action, tastelessness, and effective in minute dose.\(^5\) In classical age, herbal products were extensively used in all 8 branches of Ayurveda, and later during post-classical age, extensive research was carried out by then Ayurvedic scholars, as a result potent and safe remedies were explored from metals and minerals. RCR is a one of Kupipakwa Rasayanas a unique method of preparation.\(^6\) RCR is one such imperative Kupipakwa Rasayana, used for sexual disorder particularly erectile dysfunction (ED). It is formulated by two fundamental substances of Rasashastra, i.e., Shudha Parada and Shudha Gandhaka and Shudha Rajata. Several reports were published regarding beneficial effects of different antioxidants on ED.\(^7\) Previously, we have reported the beneficial effect of RCR on spermatogenesis.\(^8\) In the present study, we evaluate the RCR for its antioxidant properties.

### MATERIALS AND METHODS

The RCR was obtained from the Department of Postgraduate Studies in Rasashastra, Ayurveda Mahavidyalaya, Hubli, Karnataka.

#### Methods

The antioxidant activity of RCR was evaluated by different *in vitro* methods which are given as follows.

#### Procedure for Nitric Oxide Scavenging Activity

The nitric oxide scavenging activity of RCR was determined according to the method (Green *et al.*, 1982). Aqueous solution of sodium nitroprusside spontaneously generates nitric oxide (NO) at physiological pH, which interacts with oxygen to produce nitrate ions and which was measured colorimetrically. 3 mL of reaction mixture containing 2 mL of sodium nitroprusside (10 mM) in phosphate buffered saline and 1 mL of various concentrations of the RCR were incubated at 37°C for 4 h. Control without test compound was kept in an identical manner. After incubation, 0.5 mL of Griess reagent was added. The absorbance of the chromophore formed was read at 546 nm. The percentage inhibition of nitric oxide generation was measured by comparing the absorbance values of control and those of test compounds. Vitamin E (10, 50, 100, 200, 400, 800, and 1000 µg/mL) was used as standard. The percentage nitric oxide inhibition was calculated from the following formula:

\[
\% \text{ nitric oxide inhibition} = \frac{\text{OD of control} - \text{OD of test}}{\text{OD of control}} \times 100
\]

#### Procedure for free radical scavenging by 2,2-diphenyl-1-picrylhydrazyl (DPPH) method

DPPH scavenging activity was measured by the spectrophotometric method. A stock solution of 25 mg of DPPH (150 µM) was prepared in 100 mL of ethanol. To the 0.2 mL of RCR of different concentrations, 3.8 mL of DPPH was added. Control without test compound was prepared in an identical manner. In case of blank, DPPH was replaced by ethanol. The reaction was allowed to be completed in the dark for about 20 min. Then, the absorbance of test mixtures was read at 517 nm. The percentage inhibition was calculated and

\[
\% \text{ DPPH inhibition} = \frac{\text{OD of control} - \text{OD of test}}{\text{OD of control}} \times 100
\]

### Table 1: *In vitro* antioxidant activity of RCR

<table>
<thead>
<tr>
<th>Tablet</th>
<th>IC(_{50}) value RCR µg/mL</th>
<th>IC(_{50}) value of standard ascorbic acid µg/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitric oxide (% inhibition)</td>
<td>1256.52</td>
<td>865.44</td>
</tr>
<tr>
<td>DPPH (% inhibition)</td>
<td>793.80</td>
<td>511.61</td>
</tr>
</tbody>
</table>

RCR: Rajatachandrodaya Rasa
expressed as percent scavenging of DPPH radical. Vitamin E (10, 50, 100, 200, 400, 800, and 1000 µg/mL) was used as standard. The percentage DPPH inhibition was calculated from the following formula.[9]

\[
% \text{DPPH Inhibition} = \frac{\text{OD of control} - \text{OD of test}}{\text{OD of control}} \times 100
\]

**RESULTS**

Scavenging activity of RCR was enumerated in Table No., Figure 1 and Figure 2. The composition of hydrogen peroxide into water may occur according to the antioxidant property present in the RCR as it may be a good electron donors, they may accelerate the conversion of H2O2 to H2O. IC50 values were found to be 1256.52 µg/ml and 793.80 µg/ml in Nitric oxide Scavenging Activity and DPPH Method respectively.

**DISCUSSION**

RCR is one among the Dhatu sindhura. While mentioning about Chandrodaya with Swarna, there is mentioning that in similar way silver and other metals can also be used instead of gold and we can call it respective Dhatu Chandrodaya. We get reference of RCR in Bhaisajya samhita,[6] he explains the preparation in Sharava. Rajatachandrodaya also has been explained in Rasendra Sambhava along with other Dhatu Sinduras. Bhaishajya Sara Samgraha explains the Anubhuta Yoga of Rajata Sindura, special feature in this reference, quantity of Rajata is 4 times to that of Parada. Other than above, we do not get any classical references for the preparation of Rajata Sindura, and by this, the procedure of Swarna Sindura may be applicable to Rajata also. RCR is used in Jwara (fever), Dhwaj bhang (ED), Rajayaksma (tuberculosis), Rasayana (rejuvenating agent), and Vajikarana (aphrodisiac).

Oxidative stress plays an important role ED and sperm generation. This affected more than about 150 million individuals worldwide.[10] Modern drugs used to cure ED and low sperm count have major systemic effects and produced several side effects. Therefore, alternative therapy is required nowadays. RCR shows antioxidant activity in both the assay. Its antioxidant potential may be responsible for therapeutic application of RCR.

**CONCLUSION**

The current study shows that RCR possesses antioxidant effects which may be responsible for therapeutic application in sexual problems and low sperm count.

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Review article on quality and safety of Ayurvedic formulation

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Abstract

Ayurveda, the divine science of healing has always for the well-being of the people and society. Classical formulations are amended from time to time according to the need of the sufferers. This flexibility has ensured its existence until today. Inclusion of Agadtantra in therapeutics further strengthened Ayurveda. Agadtantra deals with Ayurvedic pharmaceutics, with the safety, efficacy, and quality preparation of drugs from metals and poisonous herbal drugs. According to WHO guideline, government of India prepared separate monograph of herbal drugs along with standard method of preparation of drug and guidelines in “Ayurvedic Pharmacopoeia of India,” everyone concerned to herbal drugs should compulsory have to follow these monographs of herbal drugs ensuring quality, safety, and efficacy nothing but quality control while preparation and identification and use of medicinal plants. WHO has given guidelines for general limits of contaminants of herbal drugs such as percentage of foreign matter, heavy metals, microbial load for crude drug, specific for internal or external use. Each drug not crosses these limits. If any drug reported similar character or values accordingly, then the drug is supposed to be a standard or quality drug. The prime objective of the pharmaceutical research is to produce a safe, effective, and quality drug. Worldwide the hazards of the drugs are monitored stringently to reduce the patient’s mortality or the untoward, adverse effects or unwanted effects of the drugs or therapeutic procedures. For the regulation of safety, and efficacy issue the control and check on the ASU drugs through the pharmacovigilance programmed was essential.

Key words: Agadtantra, Ayurveda, Ayurvedic formulation, drugs, herbal formulation, pharmacovigilance, safety

INTRODUCTION

The WHO defines an herb as being fresh or dried, fragmented or powdered plant material, which can be used in this crude state or further processed and formulated to become the final herbal product. Ayurveda is a medical system primarily practiced in India that has been known for nearly 5000 years. It includes diet and herbal remedies while emphasizing the body, mind, and spirit in disease prevention and treatment (Morgan, 2002). WHO has also issued Guidelines for the Assessment of Herbal Medicines (WHO, 1996). These guidelines defined the basic criteria for the evaluation of quality, safety, and efficacy of herbal medicines with the goal of assisting national regulatory authorities, scientific organizations and manufacturers in assessing documentation, submissions, and dossiers in respect of such products. Herbal medicine is abundantly available in India due to its various climatic zones. India has many species of plants, of which 20,000–25,000 plants proven as medicinal values when taken in formulation form using the traditional system to made formulations. In developed or undeveloped countries found more use of Ayurvedic drugs over last few decades. Quality of Ayurvedic and herbal medicine is practiced on their experiences for proper identification of plants; gradually regulation was put into force and the first organization. Regulation of this product first organized regulatory publication on herbal drug quality was the drugs and cosmetic acts 1940 and drugs and cosmetic rules 1945. Several reports are documental proven that herbal drugs are not saved when not to be taken on the proper formulation and purification procedures. Some are quite toxic in nature these drugs not to be purified properly it may cause harmful effects to the person. As a result, to find the quality, safety, and efficacy of Ayurvedic, as well as herbal formulations, is important for both consumers and health authority throughout the world.

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Objectives

The objectives are as follows:

1) Importance of the drug quality, safety, and efficacy of Ayurvedic and herbal formulations.
2) To describe the pharmacovigilance in form of drug adverse effects.
3) To describe the shelf life of the drugs.

According to the WHO guideline, government of India prepared separate monograph of herbal drugs along with standard method of preparation and guidelines in “Ayurvedic Pharmacopoeia of India,” everyone concerned to herbal drugs should compulsory have to follow these monographs of herbal drugs ensuring quality, safety, and efficacy nothing but quality control while preparation and identification and use of medicinal plants.

WHO has given guidelines for general limits of contaminants of herbal drugs such as percentage of foreign matter, heavy metals, microbial load for crude drug, specific for internal or external use. Each drug not crosses these limits. If any drug reported similar character or values accordingly, then the drug is supposed to be a standard or quality drug.

Good Manufacturing Practices (GMP)

It is a production and testing practices that help to ensure a quality product. Manufacturing processes are clearly defined and controlled. All critical processes are validated to ensure consisting and compliance with the specification. Manufacturing processes are controlled; any changes to the process are evaluated. Changes that have an impact on the quality of the drugs are validated as necessary. It ensured that consistently produced and control safety standard and minimizes the risks involved in any pharmaceutical production. It also ensured the aspect of production from the starting materials, equipments and training and hygiene of the staff present in the pharmaceutical company.

Safety

Safety is a fundamental principle in the provision of herbal medicines and herbal products for health care and a critical component of quality control. These guidelines provide practical technical guidance for monitoring the safety of herbal medicines within pharmacovigilance systems. A recent study indicated that more than 70% of the German population reported using “natural medicines” and that, for most of them, herbal medicinal products were the first choice in the treatment of minor diseases or disorders.

Among consumers, there is a widespread misconception that “natural” always means “safe,” and a common belief that remedies from natural origin are harmless and carry no risk. However, some medicinal plants are inherently toxic.

Some adverse events reported in association with herbal products are attributable to problems of quality. Major causes of such events are an adulteration of herbal products with undeclared other medicines and potent pharmaceutical substances, such as corticosteroids and nonsteroidal anti-inflammatory agents. Adverse events may also arise from the mistaken use of the wrong species of medicinal plants, incorrect dosing, errors in the use of herbal medicines both by health-care providers and consumers, interactions with other medicines, and use of products contaminated with potentially hazardous substances, such as toxic metals, pathogenic microorganisms, and agrochemical residues. Misidentification of the medicinal plant species, plant materials were used for manufacturing herbal products, which caused severe kidney failure in patients in several countries.

Side Effect

Any unintended effect of a pharmaceutical product occurs at doses normally used in humans that are related to the pharmacological properties of the drug. Herbal formulation which contains heavy metals is cause kidney failure and liver damage in some consumers because they contain toxic chemicals or react harmfully with other drugs. This is due to the lack of systematic observation has meant that even serious adverse reaction, such as the kidney damages.

Adverse Event/Experience

Any untoward medical occurrence that may present during treatment with a pharmaceutical product but that does not necessarily have a causal relationship with this treatment. Serious adverse event of any untoward medical occurrence that, at any dose such as results in death, requires inpatient hospitalization or prolongation of existing, hospitalization, results in persistent or significant disability/ incapacity.

Adverse Reaction

Drug which has noxious and unintended was taken in the doses form used in human for the prophylaxis, diagnosis, therapy of diseases for the modification of physiological function. These are causes adverse drug reaction i.e. harmful to human. An adverse reaction, the nature or severity of which is not consistent with domestic labeling or market authorization, or expected from the characteristics of the drug.

Quality Assurance and Control

Quality assurance and control measures, such as national quality specification and standards for herbal materials, GMP for herbal medicines, labeling, and licensing schemes for manufacturing, imports, and marketing, should be in place in every country where herbal medicines are regulated. These measures are vital for ensuring the safety and efficacy of herbal formulations.
WHO guidelines are provided for safety and monitoring of herbal medicines under the pharmacovigilance system. Weak regulation and quality control may result in a high incidence of adverse reactions attributable to the poor quality of herbal medicines, in particular resulting from adulteration with undeclared potent substances and/or contamination with potentially hazardous substances and residues.

The quality control and standardization of raw drugs in process drugs and to worldwide acceptance of herbal drugs, World Health Organization, have done compulsion of use of the standard drug to ensure, quality, safety, and efficacy of the drug which is long lasting and need of the time. The quality control and standardization of raw drugs, in process drugs and finished products, are necessary. It can be done with the help of modern scientific techniques for that purpose; different countries prepared the pharmacopeias which include “monograph” of drugs indicating quality parameters and high standard for most of the herbal drugs and their products.[v]

**CENTRAL GOVERNMENT ACTS RELATED TO DRUG**

**Drug and Cosmetic Act 1940**

It is an act of parliament of India which regulates the import, manufacture, and distribution of drugs in India. The primary objective of an act is to ensure that the drugs and cosmetics sold in India are safe, effective, and confirm to state quality standards. The related drugs and cosmetic rules 1945 contain a provision for classification of drugs under given schedules, and there are guidelines for the storage, sale, display, and prescription of each schedule.[v]

All medicines for internal and external use of human being or animals and all substances intended to be used for or in the diagnosis, treatment, mitigation, or prevention of any disease or disorder in human being or animals, including preparation applied on the human body for the purpose of repelling insects and mosquitoes.

**Section 157 in the Drugs and Cosmetic Rules, 1945**

The manufacture of be Ayurvedic and herbal drugs should be carried out in such premise and under such hygiene conditions as are specified in schedule T(1A) for getting certificate of GMP of Ayurvedic drugs.[v] A graduate in pharmacy or pharmaceutical chemistry or chemistry or botany or a university recognized by the central government with experience of at least 2 years in the manufacture of drugs pertaining to the Ayurvedic medicines. A qualified pharmacist in Ayurvedic system of the medicine possesses experience of not <8 years in the manufacture of Ayurvedic drugs as may recognized by the central government.

**The Prevention of Food Adulteration Act, 1954**

Laws existed in a number of states in India for the prevention of adulteration of foodstuffs, but they lacked uniformity having been passed at different times without mutual consultation between states. The need for central legislation for the whole country in this matter has been felt 1937 when a committee appointed by the central advisory board of health recommended “Adulteration of foodstuff and other goods” is now included in the constitution of India. This act related when contains any poisonous and other ingredient which renders it injurious to health, if any colorings matter other than prescribed in respect thereof is present in the article, or if the amount of the prescribed colorings matters which present in the article are not within the limit of variability. The quality or purity of the article in standard or its constituents are presents in quantities not within the limit of variability, which renders it injurious to health.[v]

**Food Safety and Standard Authority of India**

It is an autonomous body established under the ministry of health and family welfare, government of India. The FSSAI has been established under the food safety and standard act, 2006. Which is a consolidating statute related to food safety and regulation in India. It contains the guideline for food safety research such as generate new knowledge that would help in continuously updating and upgrading food safety standard which is compatible with international organizations. To carried out evidence-based studies for improving or building policies. They described the different standard for the different product such as dairy products and analogs, fats, oils and fat emulsions, fruits and vegetables products, fish and fish products, salt, and spices.

**Pharmacovigilance**

WHO defines pharmacovigilance as “the science and activities related to the detection, assessment, understanding, and prevention of adverse effects or any other medicine-related problems” (WHO 2004, 1).[v]

Pharmacovigilance is the science and activities relating to the detection, assessment, understanding, and prevention of adverse effects of drugs or any other possible drug-related problems such as Lack of efficacy reports and use of medicines for indications that are not approved and for which there is the inadequate scientific basis. Somethings are related to the pharmacovigilance like Case report of acute and chronic poisoning, assessment of drug related mortality, Drug abuse and misuse of medicine etc.[v]

Since 2003, national pharmacovigilance is functioning in India and it is under the central drug standard organization. They published the guidelines for the safety monitoring of herbal drugs in 2004. Worldwide the hazards of the drugs and medical therapies are monitored stringently to reduce the patient’s mortality or the
untoward, adverse or unwanted effects of the drugs or the drugs or therapeutic procedures. Due to the popularity of the ASU drugs and due to increase in demand for these drugs from the community, the chances of adulteration and malpractice in the manufacturing and distribution are increased. Commercialization in ASU drugs put forward the issue of safety and efficacy. The need to develop the national pharmacovigilance center for ASU drugs was addressed in the monitoring of the programmed centrally. This program aims to keep the data of adverse drugs reaction of herbal, mineral and metallic product.[11]

**EXPIRY DATE OF AYURVEDIC DRUGS**

The Expiration Described in Ancient *Ayurvedic* Text Like

1. *Churn* (powder) - 2–4 months
   - *Lepa* (Ointments) - 2 years
   - *Danta manjana* (tooth powder) - 2 years
2. *Gutika/tablet* 5 years (herbal and mineral preparation)
   - *Gutika* (herbal preparation) - 3 years
   - *Gutika* (mineral preparation) - 10 years
3. *Guggulu* tablets - 5 years
4. *Aveleha/Leham/Herbal jam/Paka* - 3 years
   - *Khanda paka* (haridra khand) - 3 years
5. *Lauha* preparation - 10 years
6. *Ghrita* (herbal ingredient) - 2 years
7. *Taila* (herbal oil) - 3 years
8. *Arka* (distilled herbal extract) - 1 year 12.[12]

**FINISHED PRODUCT STANDARDIZATION**[13]

- *Ayurvedic* method - organoleptic features (*panchbhautika*)
- *Shabda* - short/long/even or uneven
- *Sparsh* - internal/external
- *Roop* - color
- *Ras* - taste
- *Gandha* - odor.

Modern perspective - juice percentage, specific gravity, ph., viscosity in form of property of liquid, time required to flow from specific distance to specific distance.

**CONCLUSION**

*Ayurveda*, the divine science of healing has always for the well-being of the people and society. Classical formulations are amended from time to time according to the need of the sufferers. This flexibility has ensured its existence until today. Inclusion of *Agadatantra* in therapeutics further strengthened *Ayurveda*. *Agadatantra*, the unique *Ayurvedic* pharmacutes, deals with the safety, efficacy, and quality preparation of drugs from metals, minerals, animal products, and poisonous herbal drugs. For quality drug and drug product, quality control techniques or standardization according to *Ayurveda* and modern is very necessary. However, practically due to the large diversity in nature as well as the physical and mental buildup of human being different standard are applicable for a different condition which is very difficult. The solution or a need of time is that the ultimate objective of any herbal drugs is to perform a specific function according to its nature. Guidelines defined the basic criteria for the evaluation of quality, safety, and efficacy of herbal medicines with the goal of assisting national regulatory authorities, scientific organizations and manufacturers in assessing documentation, submissions, and dossiers in respect of such products. Herbal medicine is abundantly available in India due to its various climatic zones.

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Treatment of migraine with indigenous medicinal plants: A review

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Abstract

Migraine is one of the most severe types of neurological disorder. Common symptoms of migraine are blurred vision and vibration in sound. Some symptoms appear before the attack of migraine such as allergic reactions. The prevention of migraine involves mediation, yoga, use of herbal formulas, lifestyle modification, panchakarma, and other holistic modalities to create a balanced physiology. This state of complete balanced in healing the body and mind can allow the illness to resolve and disappear the symptoms of migraine. Attack of migraine occurs due to the disbalance in Vata, Pitta, and Kapha (Tridosha) condition, but it can also be triggered by any one of the individual Doshas. Several indigenous medicinal plants are used for the treatment of migraine such as Mentha piperita, Brassica nigra, Calotropis procera, Cassia tora, Helianthus annuus, Moringa oleifera, Ocimum basilicum, and Piper longum.

Key words: Migraine, Menthapiperita, Surajmukhi

INTRODUCTION

Migraine is a neurological disorder which originated half side severe pain in head with various symptoms.[1] The symptoms of migraine are feeling of blurred vision, vibration sounds, colds of hands, mental confusion, nausea, vomiting, and dizziness. These symptoms may occur before the attack of the migraine. There are various factors such as allergic reactions, bright lights, loud noises and certain odors or perfumes, physical or emotional stress, changes in sleep patterns, smoking or exposure to smoke, skipping meals, alcohol or caffeine, fluctuations in menstrual cycle, birth control pills, and headaches.[2] These are mainly two types of migraine. Most common type is “migraine without aura.” Pain will be one side (or) both side of head with symptoms of mood slowing, nausea, photophobia, vomiting, and fatigue. The second type of migraine with aura and this type of migraine symptoms raised before 10–30 min of attack. This is a neurological phenomenon and it effects mainly on locomotors. The second type of migraine is depend on optic stress and stages of migraine.[3] The prevention of migraine is learn to relax and reduces stress – try progressive muscles relaxation (contracting and releasing muscles throughout your body), meditation, biofeedback, or joining a support group, avoid smoking, caffeine, alcohol, exercise regularly, and enough sleep each night. Different

Chrysanthemum indicum

C. indicum belongs to the family Compositae have several vernacular names as Chrysanthemum (English), Shatapatri (Sanskrit), and Chandramallika, Sphaeranthus indicus. Leaves of this plant showed antimigraine property.[5, 6]

Areca catechu

A. catechu belongs to the family Arecaceae have several vernacular name as Betel Nut (English), Puuga (Sanskrit), and Supari (Hindi). Its useful part is dried seed. The seed’s mainly contains tannin, alkaloids, terpenoids, flavonoids, amino acids, peptides, and phenols. Ethanol and aqueous extract of the seeds of A. catechu showed antimigraine property.[7]

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Mentha piperita

*M. piperita* belongs to the family Lamiaceae have several vernacular names as Peppermint (English), Vilayati (Sanskrit), and Pudina (Hindi). The volatile contains of menthol, menthone, and cineole showed migraine property. The oil is used dhumpam. Mint essential oils are generally used externally for antipruritic, astringent, antiseptic, and antimicrobial purposes, and for treating neuralgia, headaches, and migraines. Topical (-)-menthol induces a sensation of coldness by which itching (urticaria and pruritus) and pain is reduced. This effect is mediated by the activation of TRPM8 receptors topically applied peppermint oil is also used against migraine and tension headache.

Achyrantes aspera

*A. aspera* belongs to the family Amaranthaceae have several vernacular names as Prickly chaff flower (English), Apaamaarga (Sanskrit), and Chichcha (Hindi). Seed of this plants contained phytochemicals, achyranthes oleanolic acid glycosides, and amino acids. It is inhaled for relief to headache of migraine as well as stiffness. *Amaparga Navanita*, a preparation of *Achyrantes aspera* is used for the treatment of migraine (*Suryavarta*).

Brassica nigra

*B. nigra* belongs to the family Brassicaceae have several vernacular names as Black mustard (English), Banarasi Raai (Sanskrit), and Raee (Hindi). Seeds of this plant contained major chemical constituent gallic acid and quercetin. Pigeon’s and seed’s droppings, after grinding, are applied on forehead relief for migraine. The leaves, seeds, and stems have been shown to reduce the severity of asthma and high blood pressure, restore normal sleep attacks and prevent heart attack in patients suffering from atherosclerosis or patterns in women experiencing symptoms of menopause, and reduce the frequency of migraine.

Calotropis procera

*C. procera* belongs to the family Asclepiadaceae have several vernacular names as Swallow wort (English), Tapana (Sanskrit), and Madar (Hindi). Yellowish dried leaves of this plant mainly contain of ursane, triterpenoids. Mix few drops of latex in ash of cow dung; inhale the smoke to reduce the pain it is used as “nasya” for migraine.

Citrullus colocynthis

*C. colocynthis* belongs to the family Brassicaceae have several vernacular name as Bitter apple (English), Chitraa (Sanskrit), and Indrayan (Hindi). They are main chemical constituent for Cucubitacins colosynthosides. Oil cooked root bark fruit juice, leaves applied on head to cure for migraine.

Cassia tora

*C. tora* belongs to the family Caesalpiniaceae have several vernacular name as Ringworm plant (English), Chakramarda (Sanskrit), and Panvad (Hindi). Seeds of this plant contained phytochemical Cassiside, toralactone. 25 g seeds are made into paste with the help of water seeds are ground in “kanji” (gruel of beans) and applied on forehead to get relief from migraine. It plays a powerful role in the internal absorption of electrolyte in the body. Its defect in man includes severe diarrhea and migraines.

Helianthus annuus

*H. annuus* belongs to the family Asteraceae have several vernacular name as Sunflower (English), Surajmukhi (Sanskrit), and Hurhul (Hindi). Leaves and seeds of the plant contained diterpenoids, kaurenoic acid. Seed magnesium is important for maintenance of nerve and muscle tone in body. Sunflower seeds contain substantial amounts of magnesium, hence, predicting their potential usefulness in bronchial asthma, muscle cramps, hypertension, and migraine. Leaves juice is grinded together applied on head to relief for migraine.

Sesbania grandiflora

*S. grandiflora* belongs to the family Fabaceae have several vernacular name as Sesbane (English), Munitaru (Sanskrit), and Agastya (Hindi). Flower or leaf of the plant contained leucocyanidin, cyanidin, and triterpenoids. Few drops of leaf or flower extract are put in the opposite nostril of migraine pain giving immediate relief.

Sapindus mukorossi

*S. mukorossi* belongs to the family Sapindaceae have several vernacular name as Soap nut tree (English), Arishataka (Sanskrit), and Reetha (Hindi). Fruits of the plant contained triterpenoid, sesquiterpenoid, saponin, and glycosides. The solution made from the fruits of *Sapindus* species has been found to decrease behaviors associated with migraine in mice. Its fruits are ground with black pepper and few drops are poured in the nostrils to get relief from migraine pain.

Moringa oleifera

*M. oleifera* belongs to the family Moringaceae Drumstick (English), (Sanskrit) Shigru, and Shajan (Hindi) leaves of the plant contained Vitamins A and C, proteins, amino acids, flavonoids, phenolics, glucosinolate, isothiocyanates, and thiocarbamates (niczinin A and B and niczimcin). It is initial trigger of migraine can be due to an increased release of serotonin. This is a neurotransmitter, to cause localized
ischemia. There is also an increase in dopamine levels as implicated by associated symptoms such as yawning, nausea, vomiting, and gastrointestinal disturbances, as a result of which dopamine receptor antagonists are effective therapeutic agents in migraine. It is used in laves juice.[22]

**Ocimum basilicum**

*O. basilicum* belongs to the family Labitate have several vernacular name as Sweet Basil (English), Barbari (Sanskrit), and Tulsi (Hindi). Fruits of the plant contained estragole methyl chavicol, linalool, cineole, and germacrren D. Flower powder is administered with honey.[23,24]

**Daucus carota**

*D. carota* belongs to the family Apiaceae have several vernacular name as Carrot (English), Garjara (Sanskrit), and Gajar (Hindi). Leaves of the plant contained carotenoids, α-Pinene, and sabine. Pure ghee is applied on leaves and warmed over heat and crushed into paste. Two or three drops of its extract are put into nostrils and ear cures headache due to migraine. Leaves extracted with warm “ghee” and given in nose and ears to cure migraine through sneezing.[25]

**Eclipta alba**

*E. alba* belongs to the family Asteraceae have several vernacular name as Trailing eclipta (English), Bhringa (Sanskrit), and Bhangraiya (Hindi). The main chemical constituent for wedelolactone and glycoside mixing black pepper powder in its juice, it is applied on forehead for relief in migraine 5 mL juice of fresh leaves is mixed with 5 mL goat milk. It is Luke warmed and two drops of mixture are put in both nostrils twice a day for 5 days cures migraine.[25]

**Piper longum**

*P. longum* belongs to the family Piperaceae have several vernacular name as Long pepper (English), Maagadhi (Sanskrit), and Peepal (Hindi). Fruits of the plant contained piperine, *P. longum* ine. Piperine is the major alkaloid of peppers. Peppers and “bach” are given in milk to cure migraine pain. Chandramallika, *Sphaeranthus indicus* One teaspoonful juice of flower and fruit is taken and four grinded black pepper are added to it and it is taken twice for 5 days with the help of water; it cures chronic headache as well as migraine.[25]

**Ocimum Canum, Ocimum americanum**

*Ocimum canum* belongs to the family Labitate have several vernacular name as Hoary Basil (English), Kali-Tulsi (Sanskrit), and Vana-Tulsi (Hindi). Leaf grinded with garlic oil, is given topical.[26,27]

**Clitorea ternatea**

*C. ternatea* belongs to the family Papilionaceae have several vernacular name as Butterfly pea (English name), Vishnukranta (Sanskrit), and Aparajita (Hindi). They are main chemical constituent for inositol, hirsutene. In Ayurveda, the juice of root used in migraine the lepa of seed root when take an equal quantity and applied as nasal or recommends the dried leaf. They are showed migraine property.[28]

**Syzygium aromaticum**

*S. aromaticum* belongs to the family Myrtaceae have several vernacular name as Clove (English), Devakusum (Sanskrit), and Lavang (Hindi). Major chemical constituents of clove are carvacrol, thymol, and eugenol. Cloves are grinded in water and the lepa is applied on the earlobes to cure migraine.[23]

**Terminalia chebula**

*T. chebula* belongs to the family Combretaceae have several vernacular name as Chebulic Myrobalan (English), Haritaki (Sanskrit), and Harad (Hindi). Seeds of the plant contained oleanolic acid; glycoside seeds are crushed hot in water and applied for forehead relief for migraine.[29]

**CONCLUSION**

Migraine is a disabling disease. Migraines are frequently prescribed multiple preventive therapy medications to deal with recurrent headaches. The curing Ayurveda opens new doors for the treatment of migraine and other type of headaches. Ayurvedic treatments are holistic therapies that are tailored to the individual since according to Ayurvedic medicine; everyone is a unique combination of five elements and three life source energies (*vata, pitta,* and *kapha*). In Ayurveda, various techniques are used such as nutrition, lifestyle modifications, herbs, panchakarma, yoga, meditation, color therapy, and gem therapy to relief from migraine headaches. These treatment approaches create a balanced physiology. This state of complete balance in healing the body and mind can allow the illness to resolve and symptoms disappears. Synthetic drugs used for the treatment of migraine have several side effects but indigenous medicinal plants are free of all these side effects.

**REFERENCES**


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Botanical pesticides from plants: The sustainable approach to pest management

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ABSTRACT

Plants are attacked by some organisms. Initially, the man attempted to annihilate or eradicate these organisms from the ecosystem itself, but soon we learnt that the task that we are pursuing is impossible to achieve as the organisms have their own means and ways to survive almost any harsh situation they are exposed to. Considering nontarget hazardous effects of chemical pesticides the scientists sought for a safer alternative to this problem and one of them that seems to be promising is the use of pesticidal principles. The use of pesticides prepared from plant extracts and products of biotic origin is not a new thing to India. It dates as back as 4000 years, and this fact makes it quite probable that the knowledge and exploitation of toxicological properties of herbs have even older history. Much before Surpala’s authored “Vrikshayurveda,” which dates back to 1000 AD when fertilizers and pesticides were unknown; there remain Vedas which have ample description of sustainable agriculture and forestry. Botanical pesticides are more popular in developing countries where they are being used in their crude forms, without much refinement of the active principle. The higher cost of synthetic molecules for pest control is one of the major reasons for this. Majority of the farmers of this unorganized sector in developing countries cannot afford these pesticides and hence resort to their botanical alternatives for pest and disease control. Although, it is too early to declare botanical pesticides a replacement of synthetic ones, suitability of these pesticides in integrated pest management strategies is making them popular among people who are aware of the hazards of synthetic pesticides and are keen to pay higher for organic produce. Such economic drive behind botanicals seems to contribute substantially to not only their acceptance but also to make them a popular input for produce of prime quality.

Key words: Botanicals, integrated pest management, pest management, pesticides, plant protection, Sustainable agriculture

INTRODUCTION

Plants face several kinds of stress in their entire lifespan. These may originate from biotic, abiotic, and mesobiotic agents. As much as biotic stress is concerned, plants are attacked by a number of organisms. These harmful organisms come from both, the prokaryotic and the eukaryotic category. Among prokaryotes, bacteria, and mollicutes are the principal organisms that cause diseases in plants. Among eukaryotes, fungi, nematodes, and insects are the major group of organisms that cause considerable loss to the plants and economic parameters thereby. This has compelled the people involved in agriculture to resort to the measures that can mitigate the aggressiveness and reduce the activity of these deleterious agents. Initially, the man attempted to annihilate or eradicate these organisms from the ecosystem itself, but soon we learnt that the task that we are pursuing is impossible to achieve as the organisms have their own means and ways to survive almost any harsh situation they are exposed to. It took almost more than half a century to realize the fact that what we need to do in not eradicate the “organism” responsible for or involved directly or indirectly in the crop loss, but to manage the ‘loss’ itself. As soon as we realized the truth, our focus shifted from the “organism” to the “loss.” But unfortunately, during this period of almost more than five decades, we had synthesized chemical pesticides which were treated as “panaceae” for all kinds of ailments of plants. Owing to its quick and miraculous

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effects this chemical option was so injudiciously exercised that our entire ecosystem had to face its negative repercussions and quite paradoxically, the reports of pest resurgence increased with increasing use of chemical pesticides due to the higher sensitivity of natural enemies to these chemicals. Moreover, is has been a harsh reality that handling of the synthetic pesticidal molecule by private companies was used to fulfill their own vested marketing interests and, therefore, had little to do with ethics and safety of the society. This has been the reason that banning a molecule by the governments always followed its extensive usage and losses to the ecosystem which could never be compensated. Furthermore, incidences of development of resistance in pests to chemical pesticides also increased substantially. The scientists, therefore, sought for a more safe alternative to this problem and one of them that seems to be promising is use of pesticidal principles (also called as botanicals) from plants which not only favor natural enemies of the pest but also have long-term impact on pests negating the chances of development of resistance in pests against them.

**SOURCE OF INFORMATION/ METHODOLOGY**

The information on plants useful in management of crop pests has been collected from exhaustive survey of literature available across books, monographs, research papers, research papers, and review articles. Selective parts of such literature were carefully taken into account for preparation of the manuscript to avoid ambiguity and misinterpretation of any kind.

**Historical Perspective**

Use of pesticides prepared from plant extracts and products of biotic origin is not a new thing to India. It dates as back as 4000 years and this fact makes it quite probable that the knowledge and exploitation of toxicological properties of herbs has even an older history. Much before Surpala’s authored “Vrikshayurveda,” which dates back to 1000 AD[1] when fertilizers and pesticides were unknown, there remain Vedas which have ample description of sustainable agriculture and forestry. Surpala’s recommendation to remove pests (worms-krimi) gathered on a tree, smoking the infested tree with mixture of white mustard, ramantha, vidanga, vaca, usana and water mixed with beef, horn of a buffalo, flesh of a pigeon and the powder of bhilata (bhallataki?) can help. Similarly, creepers eaten away by insects should be sprinkled with water mixed with oilcake. Worms on plant leaves can be destroyed by sprinkling the powder of ashes and brick dust. Like Ayurveda, the oldest system of medicine, the wisdom of ancient India is being welcomed by researchers who have realized the impermanence of the agrochemicals (majority of which are based on petroleum products and are soon to be exhausted) and the trend to test the ancient knowledge of agricultural pest management in modern times has gained momentum. The scientists of the world are cheering up for any measure of pest control which gives some sustenance to agriculture. During the past quarter of a century, the scientific literature has revealed an array of secondary plant metabolites that exhibit promising toxicity to various plant pests and pathogens. Some of them have been isolated and their active principle is characterized across world laboratories. These principles have been formulated into pesticides much like synthetic ones regarding ease of their applicability. Botanical pesticides are more popular in developing countries where they are being used in their crude forms, without much refinement of the active principle. The higher cost of synthetic molecules for pest control is one of the major reasons for this. Majority of the farmers of this unorganized sector in developing countries cannot afford these pesticides and hence resort to their botanical alternatives for pest and disease control. Although it is too early to declare botanical pesticides a replacement of synthetic ones, suitability of these pesticides in IPM strategies is making them popular among people who are aware of the hazards of synthetic pesticides and are keen to pay higher for organic produce. Such economic drive behind botanicals seems to contribute substantially to not only their acceptance but also to make them a popular input for the produce of prime quality.

**Plants and their Roles in Pest and Disease Management**

Plants are being used for pest control since inception of agriculture particularly following identification of potential pests and realization of the losses owing to them. However, scientific studies on this aspect have been intensified since the last 150 years. The number of plant species which can be useful in pest management is as much as 2121 and 1005 of them are known to exhibit insecticidal properties.[2] Further, 384 species have shown promising antifeedant properties for harmful insects and 297 species exhibited repellent properties. However, 31 species possessed growth inhibiting properties and 27 species had exhibited attractant properties. Marigold (Tagetes erecta) is known for its antinemic properties and root extracts of marigold or asparagus has been found nematicidal in nature. Tobacco is credited to be as such the first botanical pesticide and during seventeenth Century and nicotine obtained from its leaves has been shown to kill plum beetles. Vegetable oils have been used since long against stored products pests. Neem and Tulsi/Basil (Ocimum sanctum) had been the plants which are recommended for household cultivation in ancient Indian literature. It is, perhaps, their pesticidal properties that have been the prime reason for such recommendation.

**Neem (Azadirachta indica)**

Neem (A. indica A. Juss. syn. Melia azadirachta L.: Meliaceae) or Indian lilac, has azadirachtin as its principal insecticidal ingredient, which is a tetrarnortriterpenoid limonoid.[3] Although almost all parts of neem contain azadirachtin but
its highest concentration (0.2–0.6%) is found in its seeds,[4] popularly called Nimboli in Northern India. Apart from these principles, some other limonoids including meliantriol, nimbin, nimbidin and salanin are also found in traces[5] and contribute to overall bioactivity. Azadirachtin works against pests in a number of ways and is known to express including insect growth regulatory, antifeedant, repellent, fecundity, and fitness reducing and anti-ovipositional properties[6] against a number of pests. Azadirachtin is effective against more than 500 species of insects[7] and primarily the orders Lepidoptera, Diptera, Homoptera, Coleoptera, and Hemiptera.[8] Apart from its insecticidal properties, azadirachtin has also been found to be antifungal, antibacterial, and antiprotozoan in nature.[9] This is perhaps the most exploited plant product for plant protection and more than 100 commercial formulations of neem are being used worldwide.[9]

**Pyrethrum (Tanacetum cinerariifolium)**

Powder of dry pyrethrum (T. cinerariifolium: Compositae) has been used for delousing children since 400 BC. Rotenone, obtained from the roots of a plant called timbo or jicama vines (Pachyrhizus erosus) was introduced around 1850. It is a broad spectrum insecticide and piscicide. It is an odorless, colorless crystalline isoflavone, and occurs naturally in the stems and seeds of several plants and also in roots of several plants of Fabaceae family. For centuries, it has been used to kill fish by poisoning and had notoriety of strong “fish poison.” However, the first instance of its use as pesticide dates back to 1848 when plants containing rotenone were used to kill leaf-eating caterpillars. Emmanuel Geoffroy, a French botanist, isolated the active principle in 1895 and called it “nicouline.” In 1902, Nagai Nagayoshi, a chemist from Japan isolated the compound in pure crystalline form from *Derris elliptica* (called roten in Japanese), and he named the compound “rotenone.” Later, researchers established that nicouline and rotenone were chemically the same compound.

**Sabadilla (Schoenocaulon officinale)**

Sabadilla being another plant of lily family (*S. officinale* Schldtl. and Cham.), a tropical plant from Central and South America which Indian have been using against various pests for centuries. Its seeds are ground to yield insecticidal dusts. The alkaloids produced in sabadilla are collectively known as “veratrine.”[10] Ripe and aged sabadilla seeds contain alkaloids as much as 0.3% and it is known to affect the membrane of nerve cells, causing a loss of nerve function, paralysis and death.[10] It becomes effective against leafhoppers, caterpillars, thrips, squash bugs and stink bugs either by contact or by ingestion. Although, sabadilla degrades rapidly when exposed to air and sunlight, has little residual toxicity and considered among the least toxic of botanical insecticides with an oral lethal dose$_{50}$ of 4000–5000 mg/kg body weight[11] the major limitation of sabadilla being used as pesticide in agriculture is that it is highly toxic to honeybees.[12]

**Quassia (Quassia amara)**

Quassia or bitterwood tree (*Q. amara* L.: Simaroubaceae), a tropical forest shrub indigenous to Northern Brazil is another plant with pesticidal properties which has been utilized effectively since before the development of synthetic insecticides.[13] Pesticidal sprays are traditionally formulated by boiling quassia wood in water; the wood, depending on the age, containing 0.14–0.28% quassinoids that exhibit insecticidal activity.

**Ryana (Ryana speciosa)**

*R. speciosa* Vahl., a member of Family-Flacourtiaceae is native to South America, the woody stems of which contain alkaloids showing insecticidal activity. These alkaloids are collectively called ryanoids, the most active of them being ryanodine and 9,21-dehydroryanodine.[14] <1% of ryanode is found in ground stem wood.[9] The insecticidal principle is active against a number of insect pests including corn earworm (*Helicoverpa zea*), citrus thrips, and leaf-eating beetles being effective by contact, by ingestion or both.

**Essential oils from plants**

Essential oils chiefly from the Lamiaceae, Apiaceae, Myrtaceae, Laureaceae, Rutaceae, and Asteraceae families have shown great insecticidal potential. These are the secondary plant metabolites being mixtures of volatile organic compounds. They are not only easy to extract but also are broad-spectrum in nature possessing antifungal, antibacterial, and antiviral properties apart from being

<table>
<thead>
<tr>
<th>Action against pests</th>
<th>Number of plant species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticidal</td>
<td>1053</td>
</tr>
<tr>
<td>Antifeedant</td>
<td>384</td>
</tr>
<tr>
<td>Repellent</td>
<td>297</td>
</tr>
<tr>
<td>Growth inhibitor</td>
<td>32</td>
</tr>
<tr>
<td>Attractant</td>
<td>27</td>
</tr>
<tr>
<td>Rodenticidal</td>
<td>29</td>
</tr>
<tr>
<td>Acaricidal</td>
<td>02</td>
</tr>
<tr>
<td>Nematicidal</td>
<td>58</td>
</tr>
<tr>
<td>Fungicidal</td>
<td>100</td>
</tr>
<tr>
<td>Bactericidal</td>
<td>04</td>
</tr>
<tr>
<td>Molluscicidal</td>
<td>06</td>
</tr>
<tr>
<td>Herbicidal</td>
<td>15</td>
</tr>
<tr>
<td>Antiseptic</td>
<td>35</td>
</tr>
<tr>
<td>Piscidal (Fish poison)</td>
<td>147</td>
</tr>
<tr>
<td>Arrow poison</td>
<td>90</td>
</tr>
<tr>
<td>Poisonous</td>
<td>69</td>
</tr>
</tbody>
</table>

Table 1: Number of plant species with properties useful in pest and disease management
### Table 2: Important trees/shrubs and plants showing pesticidal properties

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific name</th>
<th>Family</th>
<th>Plant parts used</th>
<th>Active principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neem</td>
<td><em>A. indica</em> A. Juss.</td>
<td>Meliaceae</td>
<td>Leaves, seeds, oil, bark</td>
<td>Azadirachtin, Meliantriol, Nimbidin, Salanaln, Nimbin</td>
</tr>
<tr>
<td>Dharek</td>
<td><em>Melia azedarach</em> L.</td>
<td>Meliaceae</td>
<td>Leaves, fruits, bark</td>
<td>Nimbolin A, Nimbolin B, Melatoxin A1</td>
</tr>
<tr>
<td>Pongam</td>
<td><em>Pongamia glabra</em> Vent. <em>P. pinnata</em> L.</td>
<td>Leguminosae</td>
<td>Leaves, fruits, seeds, oil, roots and flowers</td>
<td>Pongamol, pongapin, pongaglabrone, pongalanne, pongone</td>
</tr>
<tr>
<td>Custard Apple</td>
<td><em>Annona squamosa</em> L.</td>
<td>Annonaceae</td>
<td>Leaves and bark</td>
<td>Annonin, squamocin</td>
</tr>
<tr>
<td>Mahua</td>
<td><em>Madhuca indica</em> (Koenig) Macbhide <em>M. longifolia</em> Koen</td>
<td>Sapotaceae</td>
<td>Oil and cake</td>
<td>α and β-amyrin, quercetin, saponin-A</td>
</tr>
<tr>
<td>Derris</td>
<td><em>Derris chinensis</em></td>
<td>Leguminosae</td>
<td>Roots</td>
<td>Rotenone</td>
</tr>
<tr>
<td>Quassia</td>
<td><em>Q. amara</em></td>
<td>Simarubaceae</td>
<td>Wood and bark</td>
<td>Quassin, isoquassin, neoquassin and quassinarin</td>
</tr>
<tr>
<td>Aruda</td>
<td><em>Ailanthus excels</em></td>
<td>Rutaceae</td>
<td>Leaves</td>
<td>Ailanthone</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td><em>Eucaluptus globulus</em> Labill</td>
<td>Myrtaceae</td>
<td>Leaves and oil</td>
<td>Camphene, limonene, linalool, α and β-pinenes, α-terpinol</td>
</tr>
<tr>
<td>Moringa</td>
<td><em>Moringa oleifera</em> Lamk</td>
<td>Moringaceae</td>
<td>Flowers and leaves</td>
<td>Moringyne</td>
</tr>
<tr>
<td>Khejri</td>
<td><em>Prosopis juliflora</em> (Sw.) Dc.</td>
<td>Mimosaceae</td>
<td>Leaves and leaves</td>
<td>Juliprosine, julfloridin, julflorilin, prospodione</td>
</tr>
<tr>
<td>Nirgundi</td>
<td><em>Vitex nigundol</em> Linn. <em>V. trifolia</em> Linn.</td>
<td>Verbenaceae</td>
<td>Flowers, leaves and roots</td>
<td>Vitexin, Negundoside</td>
</tr>
<tr>
<td>Pink oleander</td>
<td><em>Nerium oleander</em> L.</td>
<td>Apocynaceae</td>
<td>Leaves, flowers and seeds and whole plants</td>
<td>Oleanderol, oleanderin, oleanderolicacid</td>
</tr>
<tr>
<td>Yellow oleander</td>
<td><em>Thevetia neriifolia</em> Juss. <em>ex Steud</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clerodendron</td>
<td><em>Clerodendron indicum</em> (L. inn.) Kuntze</td>
<td>Verbenaceae</td>
<td>Leaves</td>
<td>Trans-decalin, clerodin</td>
</tr>
<tr>
<td>Ipomoea</td>
<td><em>Ipomoea fistulosa</em> Mart. Ex Choisy I. cornea</td>
<td>Convolvulaceae</td>
<td>Whole plant, leaves, and flowers</td>
<td>Isopomin, ergine, isor/gin, ipalbidinuin</td>
</tr>
<tr>
<td>Murraya</td>
<td><em>Murraya koenigii</em> (L.)</td>
<td>Rutaceae</td>
<td>Leaves and bark</td>
<td>Curryanine, cuyyrangine, murraxonin, murraynone</td>
</tr>
<tr>
<td>Ryania</td>
<td><em>R. speciosa</em></td>
<td>Flacourtaceae</td>
<td>Roots, leaves, and stalks</td>
<td>Ryanodine</td>
</tr>
<tr>
<td>Gliricidia</td>
<td><em>Gliricidia sepium</em> (Jacq.) Kunth</td>
<td>Leguminosae</td>
<td>Leaves and bark</td>
<td>Gliricidin, sepinol, gliricidol</td>
</tr>
<tr>
<td>Jatropha</td>
<td><em>Jatropha curcas</em> L.</td>
<td>Euphorbiaceae</td>
<td>Leaves, seed, seed cake, oil</td>
<td>Curcusone, jatrophol, jatrophin</td>
</tr>
<tr>
<td>Euphorbia</td>
<td><em>Euphorbia tirucallii</em> L.</td>
<td>Euphorbiaceae</td>
<td>Branch</td>
<td>Euphorbosterol, euphorbol</td>
</tr>
<tr>
<td>Bougainvillea</td>
<td><em>Bougainvillea spectabilis</em> Wild B. glabra</td>
<td>Nyctaginaceae</td>
<td>Leaves</td>
<td>Isohamnetin, quercetin</td>
</tr>
<tr>
<td>Datura</td>
<td><em>Datura stramonium</em> Linn.</td>
<td>Solanaceae</td>
<td>Leaves, roots, fruits, dried seeds</td>
<td>Hyoscynamine, atropine, scopalamone (hyoscine)</td>
</tr>
<tr>
<td>Tobacco</td>
<td><em>Nicotiana tabacum</em> L. <em>N. rustica</em> L.</td>
<td>Solanaceae</td>
<td>Leaves, whole plant</td>
<td>Nicotine, nomicotine, anabasine</td>
</tr>
<tr>
<td>Sweet flag</td>
<td><em>Acorus calamus</em> L.</td>
<td>Araceae</td>
<td>Rhizomes</td>
<td>Calamol, β-asarone, α asarone</td>
</tr>
<tr>
<td>Lantana</td>
<td><em>Lantana camera</em> L. <em>L. trifolia</em> L.</td>
<td>Verbenaceae</td>
<td>Leaves, whole plant</td>
<td>Lantalonic acid, lantic acid, ursolic acid, stearoylglucoside (UASG)</td>
</tr>
</tbody>
</table>

*(Contd...)*
Table 2: (Continued)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific name</th>
<th>Family</th>
<th>Plant parts used</th>
<th>Active principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Aloe</td>
<td>Aloe vera (L.)</td>
<td>Liliaceae</td>
<td>Leaves, rhizomes</td>
<td>Aloesin, aloin</td>
</tr>
<tr>
<td>Calotropis</td>
<td>Calotropis gigantean</td>
<td>Asclepiadaceae</td>
<td>Leaves, roots</td>
<td>Calatropin, calatoxin</td>
</tr>
<tr>
<td>Chrysanthemum</td>
<td>Chrysanthemum cinerariifolium (Trev.) Vis.</td>
<td>Asteraceae/Compositae</td>
<td>Flowers, leaves, roots</td>
<td>Pyrethrin I, Pyrethrin II, Cinerin I, Cinerin II, Jasmol I, Jasmol II</td>
</tr>
<tr>
<td>Adhatoda</td>
<td>Adhatoda vasica Ness.</td>
<td>Acanthaceae</td>
<td>Leaves</td>
<td>Vasicine, vasicinone, adhatodin</td>
</tr>
<tr>
<td>Mint</td>
<td>Mentha spicata L. Mentha arvensis DC</td>
<td>Lamiaceae</td>
<td>Leaves, flowers, whole plant, oil</td>
<td>Menthol, limonene, dihydrocarvone, menthone</td>
</tr>
<tr>
<td>Tulsi/basil</td>
<td>Ocimum sanctum L. O. basilicum L.</td>
<td>Lamiaceae</td>
<td>Leaves, flowers, stems, whole plant, oil</td>
<td>Juvocimene-I, juvocimene-II, ocimin</td>
</tr>
<tr>
<td>Parthenium</td>
<td>Parthenium hysterophorus L.</td>
<td>Asteraceae</td>
<td>Leaves, flowers, whole plants</td>
<td>Parthenin</td>
</tr>
<tr>
<td>Onion</td>
<td>Allium cepa L.</td>
<td>Alliaceae</td>
<td>Bulb</td>
<td>Oleic acid, cepocide-D, α and β-tocopherols</td>
</tr>
<tr>
<td>Garlic</td>
<td>Allium sativum L.</td>
<td>Alliaceae</td>
<td>whole plant, bulbs, leaves, flowers</td>
<td>Allicin, diallyl sulfide and diallyl disulfide</td>
</tr>
<tr>
<td>Chillies</td>
<td>Capsicum annum L. C. frutescens L.</td>
<td>Solanaceae</td>
<td>Leaves, fruits</td>
<td>Capsicin</td>
</tr>
<tr>
<td>Sabadilla</td>
<td>Sabadilla officinarum L.</td>
<td>Liliaceae</td>
<td>Seeds</td>
<td>Ceavadine, veratridine</td>
</tr>
<tr>
<td>Tephrosia</td>
<td>Tephrosia vogelii H. T. purpurea L. Pers. T. candida (Roxb.)</td>
<td>Papilionaceae</td>
<td>Roots, pods</td>
<td>Purpurin, pupurenone purpuretenin A and B</td>
</tr>
<tr>
<td>Marigold</td>
<td>Tagetes erecta L. T. minuta L.</td>
<td>Compositae</td>
<td>Flowers, leaves, roots</td>
<td>Mycene, tagetone, alljupatuletin</td>
</tr>
<tr>
<td>Matsyagandhati</td>
<td>Gynandropsis pentaphylla DC</td>
<td>Capparidaceae</td>
<td>Leaves, flowers, whole plants</td>
<td>Kaempferol, α and β-amyris, β-sistosterol</td>
</tr>
<tr>
<td>Bhoiringani</td>
<td>Solarium surrattense Burms. F.</td>
<td>Solanaceae</td>
<td>Roots leaves, flowers, fruits, whole plant</td>
<td>Solasodine, solanolone, solasonine</td>
</tr>
<tr>
<td>Lemon grass</td>
<td>Cymbopogon marginatus, C. nardus (L.) Rendle</td>
<td>Gramineae</td>
<td>Leaves, roots</td>
<td>Cymbopogone, cymbopogonol</td>
</tr>
<tr>
<td>Turmeric</td>
<td>Curcuma longa Linn.</td>
<td>Zingiberaceae</td>
<td>Rhizomes</td>
<td>Curcumol, curcumin</td>
</tr>
<tr>
<td>Ginger</td>
<td>Zingiber officinalis Rosc.</td>
<td>Zingiberaceae</td>
<td>Rhizomes</td>
<td>Gingerols, α-Zingeribe, arcurcumene</td>
</tr>
<tr>
<td>Vinca</td>
<td>Catharanthus roseus (L.) G. Don</td>
<td>Apocynaceae</td>
<td>Leaves, roots whole plants</td>
<td>Vincristine, vinblastine, vindesine</td>
</tr>
<tr>
<td>Vilayati Tulsi</td>
<td>Hyptis suaveolens L.</td>
<td>Lamiaceae</td>
<td>Leaves</td>
<td>Hyptolide</td>
</tr>
<tr>
<td>Sida</td>
<td>Sida acuta Burm. F. S. cordata (Burm. F.) Waalkes</td>
<td>Malvaceae</td>
<td>Leaves, roots shoot</td>
<td>Vasicinol, vasicine, vasicinone</td>
</tr>
<tr>
<td>Kubi</td>
<td>Leucas aspera (Wild) Spreng</td>
<td>Lamiaceae</td>
<td>Whole plant, leaves, flower</td>
<td></td>
</tr>
<tr>
<td>Castor</td>
<td>Ricinus communis L.</td>
<td>Euphorbiaceae</td>
<td>Leaves, oil</td>
<td>Ricin, Ricinnie</td>
</tr>
<tr>
<td>Chirata</td>
<td>Swertia chirata</td>
<td>Gentianaceae</td>
<td>Leaves</td>
<td></td>
</tr>
<tr>
<td>Mahogany</td>
<td>Swietenia mahogoni</td>
<td>Meliaceae</td>
<td>Seeds</td>
<td></td>
</tr>
</tbody>
</table>

A. indica: Azadirachta indica, Q. amara: Quassia amara, R. speciosa: Ryania speciose, T. cinerariifolium: Tanacetum cinerariifolium
insecticidal in nature. Since the compounds quickly biodegrade in the soil, these are considered environmentally friendly\cite{15} and relatively non-toxic to fish and mammals.\cite{16} These compounds have shown various activities including insecticidal, larvicidal, ovicidal, antifeedant, and repellent against a number of insect pests.\cite{17,18}

Thus, we can see that the plant kingdom is the rich storehouse of biologically active compounds and various plant products are in use for over a century in India and other countries to minimize losses in crops and grain storage.\cite{19} A database of plants with various properties that are helpful in pest management [Table 1] has been prepared.\cite{20}

This is a small list as compared to the projections being done after the first decade of twenty-first century. In Table 2, a list of important plants/trees/shrubs is presented which have exhibited promising pesticidal activity.\cite{18,21,22}

**Future Prospects**

As we can see the growing awareness about hazardous effects of synthetic pesticidal molecules on ecology and environment, one can very easily foresee the fact that the future of plant pest control is much more dependent on the plant community itself. Plants have evolved with their respective pests and pathogens and they have developed more or less a mechanism to fight these agents for their survival and in this course of action, they have started biosynthesis of some molecules that have different effects on different kinds of organisms based on their relationship with the host plant. However, this mechanism need to be employed with due knowledge of the active principle, its effects on target organisms and also, on non-target species. Extensive toxicological studies are required to find suitably effective yet safer molecules and plants seem to be a great resource of these agents which have to play a pivotal role in designing the strategy of plant protection in the future.

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Medicinal and nutritional benefits of oyster mushroom

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Abstract

Oyster mushroom is an edible fungus and has been classified as a vegetable in world foods. It belongs to genus Pleurotus. Mushroom fits in very well with sustainable farming systems with huge medicinal and nutritional importance. Oyster mushroom cultivation involves many steps, i.e., selection of substrate and suitable mushroom strain, substrate preparation, its filling in polythene bags, growing the crop, and harvesting. The yield of oyster mushroom can be obtained 1–2 kg per bag from 45 to 60 days of crop duration. Oyster mushroom is the rich source of protein, vitamins, minerals, fiber, and other antioxidants such as selenium protect body cells from damage that might lead to chronic diseases and help to strengthen the immune system. Oyster mushroom is low in calories, fat free, cholesterol free, gluten free, and very low in sodium. Increasing the consumption of oyster mushroom appears to decrease the risk of obesity, diabetes, cancer, and heart disease and increase the immunity system of the body.

Key words: Dhingri, edible fungi, medicinal value, nutritional benefits, oyster mushroom, Pleurotus

INTRODUCTION

Mushrooms are fleshy, spore-bearing reproductive structures of fungi. They are edible fungi of commercial importance, and their cultivation has emerged as a promising agro-based land-independent enterprise.[1] Mushrooms are known to play an important role in human health owing to their nutritional and medicinal properties. They are known to be a good source of protein, vitamins, and minerals. In India, three types of mushrooms are being cultivated, viz., white button mushroom (Agaricus bisporus), paddy straw mushroom (Volvariella volvacea), and the oyster mushroom (Pleurotus spp.). However, white button mushroom being most popular of these three is the most widely grown mushroom on a commercial scale.

Oyster mushrooms are one of the most popular edible mushrooms and belong to the mycological genus Pleurotus of the family Pleurotaceae. These mushrooms are a diverse group of saprotrophic fungi.[2] They were first cultivated in Germany as a means of subsistence during World War I and are now grown commercially around the world as food. Its cultivation is becoming increasingly popular in India with the growing awareness of people about their food and health. Subtropical and tropical climate of India is good for the growth of oyster mushroom as it thrives quite well in a wide variation of temperature and moisture.

In India, oyster mushroom is becoming a unique, non-traditional cash crop under protected cultivation or being grown indoors. Scientifically, oyster mushroom is known as Pleurotus ostreatus. In the local language, it is popularly known as Dhingri. Bihar and UP are the emerging states in oyster mushroom production. Its cultivation has increased tremendously throughout the world during the past few decades. Of total 6,161,000 tonnes edible mushroom produced worldwide, oyster mushroom (875,600 tons) accounted for a good share of 14.2% in 1997.[3,4]

Oyster mushrooms are the third largest cultivated mushrooms. China is the largest producer of oyster mushroom and it alone contributes to nearly 85% of the global production of approximately a million tonnes. The other countries which are known to produce oyster mushrooms include Taiwan, Japan, Korea, Italy, Philippines, and Thailand. Currently,
India produces only around 1500 tonnes of Oyster mushroom owing to low domestic demand. Another inhibiting factor in its production in India is that export demand orders are quite large and cannot be met unless a linkage between producer, cooperatives, and exporters is developed.

Oyster mushroom can be cultivated on any type of lignocellulosic material such as paddy straw, sugarcane leaves, banana leaves, sawdust, and rice hull. It can grow at moderate temperatures, ranging from 20 to 30°C, couples with a relative humidity of 55–70%, on various agricultural waste materials used as substrate. Due to its flexible nature, the *Pleurotus* genus is more cultivated than any other mushroom species.[5]

**Nutritional Value of Oyster mushroom and its Health Benefits**

Mushrooms are a good source of protein, vitamins, and minerals and are known to have a broad range of uses both as food and as medicine. Oyster mushrooms are no exception to this, and they also offer much important nutritive and medicinal benefits to human body and health. A high nutritional value of Oyster mushrooms has been reported with protein (25–50%), fat (2.5%), minerals (potassium, phosphorus, calcium, and sodium) of about 8–12%, and Vitamin D, C, B1, B5, and B6). *P. ostreatus* as a health promoter and environmental restorer is gaining more importance as compared to other medicinal mushrooms, resulting in an upsurge in their research and development activities during the past two decades.[6] The inclusion of mushrooms in a regular diet may help significantly to overcome protein deficiency in the developing countries where good quality proteins from animal sources are either unavailable or unacceptable because of religious beliefs.[7] Mushrooms can be a good supplement to cereals[8] in enriching the human diet. Owing to their good nutritional and high digestibility values, mushrooms are gaining importance in today’s healthy diet.

These mushrooms are a good source of non-starchy carbohydrates, with a high content of dietary fiber and moderate quantity of proteins including most amino acids, minerals, and vitamins.[9] The protein content varies from 1.6 to 2.5%, and the niacin content is about ten times higher than that of any other vegetables.[10] However, oyster mushrooms have been reported to be rich in Vitamin B complex, Vitamin C, and several minerals vital for human health [Table 1].[11]

**Biology of Oyster Mushroom**

Oyster mushroom has a broad, fan, or oyster-shaped cap spanning 5–25 cm. Natural specimens of the mushroom have been found to vary from tan to dark-brown or white to gray in color. When young, the margin is in rolled and is smooth being often somewhat lobed or wavy. The flesh of the mushroom is white in color, firm in texture, and varies in thickness owing to stipe arrangement. The gills of oyster mushroom are white to cream in color and descend on the stalk if present.

**Cultivation of Oyster Mushroom**

Oyster mushroom is being cultivated in India, and with growing awareness of food and nutrition in view of human health, it has been found to be promising in production and consumption across the country in the coming days. A brief summary of its cultivation is being presented below.

**Materials Required**

**Substrate**

‘Straw of wheat, paddy, jowar and bajra can be used as the substrate for cultivation of oyster mushroom.

**Mushroom spawn**

Good quality spawn of suitable strain should be purchased from universities, Government mushroom spawn-producing centers, or other reliable sources.

**Substrate supplementation**

Common supplements are wheat bran, rice bran, soybean cake, groundnut cake, maize meal, etc. Supplements are thoroughly mixed with straw after pasteurization while spawning.

**Polythene bag**

Transparent polythene bags of 80 cm × 40 cm or 60 cm × 40 cm size are used for the purpose.

**Methodology of Mushroom Production[13]**

**Substrate preparation**

Oyster mushroom can be cultivated on a large number of agro-wastes including straw of paddy, wheat, and ragi, etc. Freshly procured good quality substrates are cut into small (2–3 cm) pieces with chaff cutter and are soaked in potable water contained in a drum for about 4–6 h. Afterward, the substrate is dried in the shade for few hours to bring the moisture level down to 50–60%.

**Making the polythene bags ready for filling**

The polythene bags of 80 cm × 40 cm size or 60 cm × 40 cm size are taken and two holes of 10–12 cm diameter are made in the center of the bag on each side. The bottom of the bag is tied with jute thread to make the circular bottom flat for bed when prepared.
Spawning

The substrates such as wheat straw, paddy straw, and banana leaves (cut into small pieces) are filled in the bottom of polythene bags to a height of about 5 cm. For filling a single polythene bag, 1–1.5 kg of dry straw, 200 g of each mushroom spawn, and supplement are used. Spawn is sprinkled uniformly over the surface of the substrate after filling its first layer in the polythene bags. Then, next layer of substrates is spread to a height of approximately 10 cm and an appropriate portion of spawn is sprinkled over it. Thus, four layers of substrate and spawn are filled in each polythene bag. Finally, the fourth layer of spawn is covered with substrates bits to a height of 5 cm and the tip of the bag is tied with jute thread. In a bag 15–20, small holes (0.5 cm diameter) are made on all sides to facilitate gas exchange.

Crop Management

Spawned bags, trays, or boxes are arranged in a dark cropping room on raised platforms or shelves for spawn run (mycelial colonization) of the substrate. The optimum temperature for mushroom production lies between 20 and 25°C and relative humidity is maintained to 70–80%. When the mycelium has fully colonized the substrate, the fungus is ready to form fruiting bodies. Contaminated bags with molds may be discarded while bags with patchy mycelial growth may be left for few more days to complete mycelial growth, and good ventilation should be maintained in the cropping room. Bags are watered twice daily depending on the weather condition.

Harvesting

The right shape for picking can be judged by the shape and size of the fruiting body. Primordia appear within 6–8 days of opening the bag that came to the harvestable stage 5–6 days later. The mushrooms should be harvested when the cap begins to fold inward. Picking is done by twisting the mushroom gently without disturbing the surrounding fruit bodies. Crop should not be watered before harvesting. The second crop appears after 7–10 days. Hence, within 45–60-day crop period, 4–5 crops are expected.

Yield per bag

1 kg - 2.0 kg fresh mushroom can be obtained from 45 to 60 days of crop duration.

Mushrooms and Human Health

Mushrooms are rich source of protein, minerals, and other antioxidants being almost perfect food for everyone. Often grouped with vegetables, mushrooms provide many of the nutritional attributes of produce as well as attribute more commonly found in meat, beans, or grains. A growing number of studies confirm that eating a variety of plant-based foods is linked with reduced risk of lifestyle-related health problems. Mushrooms are low in calories, fat-free, cholesterol-free, gluten-free, and very low in sodium, yet they provide important nutrients including selenium, potassium (8%), riboflavin, niacin, Vitamin D, and more. Mushrooms are among those plant-based foods that help us avoid obesity, cancer, heart disease, and mortality in general.

Mushroom as a source of vitamins

Oyster mushroom is a rich source of vitamin D, B1, B2, B3, B5, B9 and biotin with and as the following:

- Vitamin D: Mushrooms are one of the few natural sources of Vitamin D, which is essential for healthy bones and teeth.
- Vitamin B1 - Thiamin: Vitamin B1 controls the release of energy from carbohydrate, which is needed for the normal functioning of the brain and nervous system.
- Vitamin B2 - Riboflavin: Mushrooms are high in riboflavin that helps to maintain healthy red blood cells and promotes good vision and healthy skin.
- Vitamin B3 - Niacin: Niacin helps to control the release of energy from protein, fat, and carbohydrate, which keeps the body’s digestive and nervous systems in good shape.
- Vitamin B5 - Pantothenic acid: It plays a number of essential metabolic roles in the human body, including providing assistance with the production of hormones, found naturally in mushrooms.
- Vitamin B9 - Folate: Folate is an important factor in healthy growth and development: pregnant women are encouraged to increase their folate to assist with growth.
- Vitamin H – Biotin: Biotin is essential in the metabolism of proteins and carbohydrates and is just another B-vitamin found in mushrooms.

Mushroom as Source of Fiber and Minerals

Mushrooms are a valuable source of dietary fiber: A 100 g serving of mushrooms contains more dietary fiber (2.5 g) than 100 g of celery (1.8 g) or a slice of wholemeal bread.

### Table 1: Proximate composition of fresh and dried mushroom slices (%)[12]

<table>
<thead>
<tr>
<th>Mushroom samples</th>
<th>Moisture content</th>
<th>Crude protein</th>
<th>Crude fat</th>
<th>Crude fiber</th>
<th>Total ash</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh</td>
<td>88.75</td>
<td>28.85</td>
<td>2.47</td>
<td>12.87</td>
<td>9.76</td>
<td>48.16</td>
</tr>
<tr>
<td>Dried</td>
<td>8.45</td>
<td>25.91</td>
<td>2.18</td>
<td>10.41</td>
<td>10.91</td>
<td>42.14</td>
</tr>
</tbody>
</table>
Mushrooms contain virtually no salt. The following minerals are found in mushroom which plays an important role in growth and development of human body:

- **Selenium**: Mushrooms are one of the richest, natural sources of selenium. This mineral works as an antioxidant, protecting body cells from damage that might lead to heart disease and some cancers.
- **Potassium**: This important mineral aids in the maintenance of normal fluid and mineral balance, which helps to control blood pressure. Mushrooms contain more potassium than most other fruit and vegetables.
- **Calcium**: Calcium provides the structure for our teeth and bones. 100g of mushrooms contains 2 mg of calcium.
- **Iron**: Mushrooms are a source of iron, which is essential to most life forms and normal human physiology.
- **Zinc**: Found in almost every cell of your body, zinc stimulates the activity of approximately 100 enzymes, and among other things, supports a healthy immune system. Zinc is found in mushrooms.
- **Magnesium**: Magnesium helps to maintain normal muscle and nerve function, keep heart rhythm steady, and improve healthy immune system; 100 g of raw mushrooms contain 9 mg of magnesium.

**CONCLUSION**

Mushrooms being a rich source of protein, vitamins, and minerals essential for human health are now known as functional foods. Among the major kinds of mushrooms produced in India, oyster mushroom is gradually becoming popular since it can be produced at a small scale without the need of much detailed infrastructure and technical support. The substrate or inputs for its production are usually farm wastes and locally available material which can be turned into good profits by growing oyster mushroom. Oyster mushroom has important nutritive and medicinal properties that can well be utilized in keeping our society healthy and disease free.

**REFERENCES**


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Safety aspects of Ayurvedic formulations

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Abstract

Quality and safety are the most essential aspects and are the denominators in case of the drug. Drug safety is a basic and fundamental concept in medical practice. Ayurveda which is a holistic system of medicine has elaborated the causes and methods of drug-induced consequences along with preventive measures the available data in classical texts are scattered. The drug which is going to be administered into the human body should be standard and should not produce any kind of untoward effects after its administration. Since past decade, few scientists from different corners of the globe started to raise concerns about the safety of these time-tested drugs and opined that there have been numerous reports of clinically significantly. The compilation an analysis along with modern concept drug safety is need of the hour. The present article deals with a review on evidence of different safety aspects of the Ayurvedic formulation.

Key words: Ayurvedic formulation, denominator, drug safety, quality

INTRODUCTION

Safety is the state of being “safe” the condition of being protected from harm or other non-desirable outcomes. Safety of medicines and treatments has always been on high priority in the tradition of Ayurveda. Ayurvedic system of medicine does not require any evidence to substantiate its efficiency since all the fundamentals and principles are well documented in great treatises such as Charak samhita, Sushrutsamhita, Ashtanga granthavali, and Anubhut yog. Although its richness and wholesomeness are unquestionable, yet the issues on the safety of drug should be taken note of so as to ensure the quality, safety, and efficacy of the Ayurvedic formulations and to protect the interests of the consumers. Quality, safety, and benefit are issues which still pose a great challenge to the Ayurvedic pharmaceutical industry. The quality of the product is dependent on the quality of extraction, formulation, and manufacturing processes. The safety of a product is directly related to its quality.¹ Hence, there is a need to modify regulatory guidelines for Ayurvedic formulation, for example, good agricultural practices (good laboratory practices [GLP]), good manufacturing practices (GMP), and GLP. New guidelines should embody the principle for Ayurvedic therapeutics and guidelines to encourage the global acceptance.

Manufacturers need to verify that the correct amounts of an ingredient of the formulation are added, and that of the finished product is of uniform size, weight, and content. Furthermore, the finished product should meet the labeled claim and deliver the expected and promised physiological effect. The safety and benefits of the new formulation, if significantly different from traditional preparation, should be established by appropriate in vitro and or in vivo testing.

Formulation and manufacturing protocols should conduct according to strict GMP standards. At each step, from the acquisition of raw material to packaging finished product, rigorous quality of control processes and standards should be applied to ensure quality, purity, and consistency.

It should be ascertained that unacceptable adulterants, contaminations, and residues are not present in the raw materials as well as extracts.

Development of Ayurvedic formulation was based on wide-ranging experiment and experiences. There was no need to validate the safety of these products but in current times, quality of drugs has been effected due to many factors such as adulteration, contamination, and shortcuts being followed instead of following the recommended methods of manufacturing so there is a need of evidence of safety of Ayurvedic formulations.

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Evidence of Safety of Ayurvedic Medicine[2]

Traditional use
Ayurvedic medicines have been traditionally used for thousands of years in India. About 80% of the population in India depend on traditional medicines. Out of which 70% people do not go to physician and use these traditional medicines in the form of home remedies on their own. It means that they use Ayurvedic medicines on a daily basis in some other form. This is important evidence of safety of Ayurvedic medicine going by their traditional usage pattern.

Method of preparation[3]
The herbo-mineral products are processed in a way that eliminates the toxic properties of the metals. Most of the mineral/metals are used only after they are converted into bhasma by Marana. Before Marana, mineral/metals are thoroughly purified by classical process called Shodhana. By Shodhana process, mineral/metals lose the physical impurities present in them and became available in pure form for further processing.

Objectives of Shodhana[3]
- To convert the inorganic substances into organo-chemical or herbo-mineral so that bhasma process become easy.
- To enhance the existing medicinal properties and reducing harmful properties.
- To reduce toxicity of drugs.
- To make bhasma process easy.
- To remove water of crystallization e.g, alum, borax and making them lighter.
- To remove adulterants e.g kampillak.

Adverse Drug Research Monitoring

ADRs play an important role in assessing patient safety. In fact, the classics emphasize the importance of drug processing in ensuring the safety of the drug. Otherwise, also drug safety is inherently related to its structure and composition may it be a plant, animal, mineral sourced, or a synthetic drug. Structure and composition of the drug, in turn, are a result of the processing through which the drug (final product) has been produced. Deviation is, however, small it may appear it is likely to result in a structural change in the final product which may compromise the safety of the drug. Hence, it is very necessary that the manufacturers must be very much careful in the processing of drug.

Pharmacovigilance is a science related to the detection, assessment, understanding, and prevention of adverse effects or any other drug-related problems. One of its aims is early detection of unknown adverse reactions and detection of an increase in the frequency of (known) adverse reactions. Practice of pharmacovigilance is the need of the hour in Ayurveda. Pharmacovigilance plays an important role in optimizing drug safety and improving treatment outcomes. It describes the possible side effects that can occur with different therapeutically useful drugs.[4]

Toxicity studies[5,6]
The predominant concern of all national and international drug regulation is to ensure the safety of marketed medicinal product during a normal condition of use. The goal of toxicity testing is to identify the hazardous agents, to define the condition (dose, time, route of exposure, the susceptible species, etc.) under which they will exert their toxicity and estimate the potential effect on human health. Standard packages are there for preclinical safety evaluation studies expected to be performed before a candidate drug can be evaluated in humans. Organization for economic cooperation and development (OECD, 1981) and committee on the proprietary medicinal product (Charles worth and Griffin, 1989) have been established to help harmonize the data requirement for different countries with regard to regulation of drugs. OECD member countries have recognized the unique opportunity for international harmonization of test methods. Besides, this since government and industry are increasingly concerned with quality of studies on which hazards assessment are based, several OECD member countries have to establish criteria for the performance of these studies and then with the changing regulatory climate the introduction of “GLP” have a major impact on the modern approach to toxicological investigation.

Ayurvedic formulations do contain toxic substance metals, etc., which if not used according to principles may show symptoms of toxicity.

Manufacturing of Ayurvedic medicine is controlled by drugs and cosmetic act of India. However, there are certain conditions, which a manufacturer has to meet before being granted manufacturing permission. As such there are no guidelines to conduct toxicity studies on Ayurvedic medicines in India. Recently, Department of Ayush has issued draft guidelines for conducting safety studies on Ayush drugs. However, Indian Council of Medical Research has issued preliminary guidelines as below.[7]

Acute and repeated dose toxicity studies for the different dose patterns of different herbo-mineral formulations were carried out on both the sexes of different species of animals as per guidelines of schedule Y of the drug and cosmetic act 1940, in the accredited laboratories by reputed pharmacies of India. Administration of the dose was done through different routes in the animals. The results obtained from these studies show that the aforesaid products are totally safe for human use in the prescribed dosage. In few animals treated with very higher dosage (10 times the prescribed dose) of the formulations, minor changes were observed in hematological
parameter, but these changes were found reversible within a stipulated period.[8,9]

**Factors Responsible for Toxicity of Ayurvedic Medicines**

**Improper manufacturing process**

The Charak Samhita has classified physician into three categories; genuine physicians, feigned physician, and pseudo-physician.[10] Due to socioeconomic reasons quackery in the name of indigenous system of practitioners is also one important factor in certain parts of India.

Ayurvedic products sometimes are adulterated with similar looking cheaper alternatives also. These practices though not common can easily be controlled by strict GMP norms.

**Contaminants**

**Irrational use of Ayurvedic medicine**

Following factors are very important with respect to rational consumption of Ayurvedic medicine.

- The vehicle, for example, honey and water.
- Relationship with food - there are 10 different timing of taking the medicine as per Ayurveda.[11]
  
  a. Abhukta (early morning empty stomach)
  
  b. Pragbhukta (immediately before food)
  
  c. Adhobhukta (immediately after food)
  
  d. Madhya bhukta (midway in the meal)
  
  e. Antara bhukta (between morning meal and evening meal)
  
  f. Sabhukta (with food or mixed in food)
  
  g. Samudag bhuta (before and after intake of light meal)
  
  h. Mahur-Mahur (with food or without food)
  
  i. Sagras (with every bite or with some of the bites)
  
  j. Grasantar (between subsequent bite).

- Improper dose
- Incompatible formulation - though Ayurvedic physicians always take care for any incompatible formulations. This is of particular concern when therapies are used incorrectly, are abused or administered improperly, or are prescribed by unqualified practitioners.

**Quality of Ayurvedic Medicine**

Maintaining quality of Ayurvedic medicine is of prime importance. After almost 30 years of effort, government of India has developed Ayurvedic Pharmacopoeia of India giving the quality standards of certain raw materials. Since Ayurvedic system of medicine covers a large number of ingredients and formulations, generation of quality specifications of all the ingredients and formulations is an uphill task and will take its own time. GMP guidelines for Ayurvedic system of medicines in India have recommended implementation of quality control measure as well.

**Adulteration**

As far as safety issues Rasaushadhi is concerned they are more a result of adulterants/contaminations and improper processing and microbial load. These issues can be definitely tackled successfully if the operating procedures are standardized and monitored carefully.

Ayurvedic products sometimes are adulterated with similar looking cheaper alternatives also. This can easily be controlled by strict GMP norms implementation.

Ayurvedic pharmacology describes the possible side effects that can occur with different therapeutically useful drugs. Further, it also describes ways, including manufacturing techniques, to minimize these side effects.

Ayurvedic literature prescribed various texts for proper preparation of bhasmas such as Varitar, Rekhapoorn, Apunarbhav, Uttam, Niruttha, Nischandra, and Nisswadu. It reflects that our ancient Manishish were fully aware of the toxicity of Rasaushadhvis; hence, they have paid attention to their safety profile. Not only this but also they have described equipments for the manufacture of such preparation. In spite of following all prescribed procedure strictly, there is possibility of toxicity due to use of improper raw material and processing observation. Moreover, one problem arise in the form of toxicity due to drug to drug interaction. It should be sincerely observed and studied accordingly.[12]

**Discussion**

Every system of medicine has efficacy versus toxicity. Charka mentioned that every drug is a poison and every poison is a drug, what matters are a dose hence he has suggested this aspect for the therapeutic use of the drug (C.S 1; 125).

Safety and efficacy of a drug mainly depend on the method of preparation. It is well-known fact that the modernization in the pharmaceutical industry leads to deviation in the classical method of preparation.
To assess the quality of a finished product, there should be some basic standard as well as method of preparation. There are several parameters for testing quality of a chemical drug. A specific method for each and every preparation and some basic standards of finished products are mentioned in Ayurvedic text to maintain their quality. This information may vary from text to text. To overcome this problem, Sharangdhara mentioned detailed information about various formulations with respect to their methods of preparation as well basic standards and are documented in Sharangdhara Samhita.

**CONCLUSION**

To ensure the safety of drugs, it is very important to understand and study the principles of drug safety mentioned in Ayurveda and to follow the does and do not during prescription and consultation. Ayurveda has got vast resources of the medicinal products in the world. Its herbal medicines are quite safe and free from any untoward effects. These drugs can be digested and assimilated in the body more easily due to having similar biomorphic constitution. However, our Rasaushadhis is another treasure of therapeutics, which can be given in smaller doses and having prompt therapeutic efficacy, they can be stored for long time without declining their potency. Our Maharishis had described so many parameters to establish the safety profile of these drugs. If these classical principles were followed strictly in the light of latest technology, the outcome will be worth mentioning.

It is important that all the above factors are integrated and a strategic approach to validate Ayurvedic drugs and ensuring their safety and efficacy.

**REFERENCES**


**Source of Support:** Nil. **Conflict of Interest:** None declared.
A review on quality, safety, and legalization for herbal medicines

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Abstract

With the growing awareness of health care and safety aspects, people are moving toward Herbal products. In the past few decades, market of herbal and traditional medicines (TM) has grown up leap and bound. Till recently Ayurvedic medicines used to be prepared by the practicing physician himself for the use of his patients. In ancient time collection, manufacturing and other processes was done by Vaidya’s in smaller quantity and proper season and used locally. There are 9000 licensed pharmacies in India. Although there is Global interest, there is a concern about Untested medicine Unregulated medicine Quality Standardization Clinical safety and Efficacy. The use of ineffective, poor quality, harmful medicines can result in the therapeutic failure, exacerbation of disease, resistance to medicines, and sometimes to death. Adulteration, substitution, ignorance of dealers creates problems; hence, it has become necessary to standardize the quality and safety assurance measures so as to ensure supply of medicinal plants of good quality. In view of the present trend of commercialization in the preparation and marketing of Ayurvedic medicines and to ensure the interests of the profession and public, the Government of India considered it expedient to utilize the existing law which controls the standards of allopathic drugs, namely, the Drugs and Cosmetics Act, 1940, to also control, in a limited measure, the Ayurvedic, Siddha, and Unani drugs by amending the Act. Govt. needs to establish strong regulatory authorities to ensure the quality, safety, and efficacy of herbal drugs.

Key words: Ayurveda, herbal drugs, quality, standardization

INTRODUCTION

The term “herbal drugs” denoted by means of plant or part of plants that have been converted into phytopharmaceuticals by simply means of processes involving collection or harvesting, drying, and storage.¹ Medicinal plant has play an important role in world health. They are circulated worldwide, but they are most rich in tropical countries. It is noted that about 25% of all modern medicines are indirectly or directly obtained from higher plants. The use of herbal drugs as medicine is the ancient form of health care known to delicacy and it is used in all cultures throughout history. Ancient humans well known their dependence on nature for a good healthy life and since that time humankind depended on the variety of plant resources for food, shelter, clothing, and medicine to cure immensurable of diseases. Led by nature, taste, and experience, primeval men and women cured illness using plant parts, animal parts, and minerals that were not a part of the usual diet. Primeval persons learned by trial and error basis to identified beneficial plants with helpful effects from those that were inactive or toxic, and also which processing methods or mixtures had to be used to meet steady and ideal results. Even in an ancient cultures, ethnic, ancestral, or tribal people collect information related to herbal plant and developed which is defined herbal pharmacopeia.²³

The World Health Organization (WHO) has individual herbal drugs as whole, labeled medicinal products that have robust ingredients, aerial or secret parts of the whole plant or other plant material or mixture of them. WHO has a set of specific Guidelines for the evaluation of the safety, efficacy, and Quality of herbal drugs or herbal medicines. WHO find out that 80% of the world people currently use herbal medicine or drugs for the most important health cares. Herbal drugs are a main constituent in usual medicine and a general ingredient in Homeopathic, Ayurvedic, Naturopathic, and in another medicine system. Herbs are usually measured as safe toxicity, side effects of allopathic drugs have led to more increased in a number of herbal drugs manufacturers. For the past few years, herbal drugs have been

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mostly used by the people with no prescription, leaves, stem, bark, flower, seeds, roots, and extract of all these have been used in herbal drugs over the thousands of their use.\cite{4,5}

**CLASSIFICATION OF HERBAL DRUGS**

- Ayurvedic herbalism: It is derived from the Sanskrit word “Ayurveda” which means “The science of life,” which is originated in India more than 4000 years ago.
- Chinese herbalism: It is a element of traditional related medicine.
- African herbalism: Western herbalism is originated from Rome, Greece and then multiply to North, Europe, and South America.
- Ayurvedic and Chinese herbalism has produced into extremely sophisticated system of diagnosis, identification, and treatment over the centuries. It should have the long-term and effective history of results.

**Advantages of Herbal Drugs**

1. Low cost of production.
2. They may have fewer side effects.
3. Effective with chronic condition.
4. Widespread availability.

**Disadvantages of Herbal Drugs**

1. Lack of dosage instruction.
2. Poison risk associated with wild herbs.
3. Can interact with other drugs.
4. Inappropriate for many conditions.
5. Some are not safe to use.

Herbal drug technology includes all the steps that are involved in converting botanical materials into medicines, where standardization and quality control with proper integration of modern scientific techniques and traditional knowledge will remain important.\cite{6}

**Classification of Herbal Medicines**

The classification of herbal medicines is based on their origin, evolution, and the forms of current usage.

**Category 1: Indigenous Herbal Medicines**

Historically used in a local community or region and is very well known through long usage by the local population in terms of its composition, treatment, and dosage. Detailed information on this category of TM, which also includes folk medicines, may or may not be available. However, if the medicines in this category enter the market or go beyond the local community or region in the country, they have to meet the requirements of safety and efficacy laid down in the national regulations for herbal medicines.

**Category 2: Herbal Medicines In Systems**

In this category medicines such as Ayurveda, Unani, and Siddha medicines which have been used for a long time and are documented with their special theories and concepts are categorised.

**Category 3: Modified Herbal Medicines**

These are herbal medicines as described above in categories 1 and 2, except that they have been modified in some way either shape or form including dose, dosage form, mode of administration, herbal medicinal ingredients, methods of preparation, and medical indications. They have to meet the national regulatory requirements of safety and efficacy of herbal medicines.

**Category 4: Imported Products With A Herbal Medicine Base**

This category covers all imported herbal medicines including raw materials and products. Imported herbal medicines must be registered and marketed in the countries of origin. The safety and efficacy data have to be submitted to the national authority of the importing country and need to meet the requirements of safety and efficacy of regulation of herbal medicines in the recipient country.

**Requirements For Assessment of The Safety of Herbal Medicines**

**Safety category**

A drug is defined as being safe if it causes no known or potential harm to users. There are three categories of safety that need to be considered, as these would dictate the nature of the safety requirements that would have to be ensured.

- Category 1: Safety established by use over long time
- Category 2: Safe under specific conditions of use (such herbal medicines should preferably be covered by well-established documentation)
- Category 3: Herbal medicines of uncertain safety (the safety data required for this class of drugs will be identical to that of any new substance)

**Specific Requirements For Assessment of Safety of Four Categories of Herbal Medicines**

- Category 1: Indigenous herbal medicines - if the medicines in this category are introduced into the market or moved beyond the local community or region, their safety has to be reviewed by the established national drug control agency. If the medicines belong to safety
WHO GUIDELINES ON HERBAL MEDICINES

The WHO has given Guidelines for assessing the quality of botanical materials mainly emphasized the need to ensure the quality of medicinal plant products using the modern techniques and applying suitable standards. In 1997, the WHO developed draft guidelines for methodology on research and evaluation of TM. A typical monograph for herbal drugs as per the WHO guidelines is mentioned in Table 1.[9]

HERBAL DRUG REGULATIONS IN INDIA

Recognizing the global demand, Government of India has realized good manufacturing practices for the pharmacies manufacturing Ayurvedic, Siddha, and Unani (ASU) medicines to improve the quality and standard of drugs. The new rules came into force from June 2000 as an amendment to the Drugs and Cosmetics Act, 1940. Department of Indian Systems of Medicine and Homeopathy is trying to frame safety and efficacy regulations for licensing the new patent and proprietary botanical medicines. Indian Pharmacopoeia covers few Ayurvedic medicines. Monographs have been given for some ayurvedic drugs such as clove, guggul, opium, menthe, and senna. The Ayurvedic Pharmacopoeia of India gives monographs for 258 different ayurvedic drugs. The standards mentioned are quite inadequate to build quality of the botanical materials. Indian Drug Manufacturers Association has published Indian Herbal Pharmacopoeia (2002) with 52 monographs of widely used medicinal plants found in India. The latest available scientific data have been incorporated in these monographs. ASU Drugs Technical Advisory Board mentioned in section 33-C.

The ASU Drugs Consultative Committee-mentioned in section 33-D.

Misbranded drugs-mentioned section 33E.

Adulterated drugs-mentioned in section 33EE.

Spurious drugs-mentioned in section 33EEA.

Regulation of Manufacture of ASU Drugs-Section-33-EEB states the regulations on manufacture and sale of ASU drugs.

A. Requirements of factory premises and hygienic conditions described in schedule 1 (Rule 157)
B. Manufacture on more than one set of premises
C. Prohibition of manufacture and sale of certain Ayurvedic, Siddha, and Unani drugs-mentioned in section-33-EEC
D. Power of Central Government to Prohibit Manufacture, etc., of ASU Drugs in Public Interest-mentioned in section-33-EED

Government analysts-mentioned in section 33F
Inspectors-mentioned in section 33G
Penalty for manufacture, sale, etc., of Ayurvedic, Siddha, or Unani drug in contravention of this Chapter-As prescribed under section 33-I
Penalty for subsequent offences-As mentioned in section 33J
Confiscation-As mentioned under the section 33K
Application of provisions to Government departments - As mentioned in section 33L
Cognizance of offenses - As mentioned in section 33M
Power of Central Government to make rules - As mentioned in section 33N
Power to amend First Schedule - As mentioned in section 33-O.[9]

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botanical</td>
<td>Organoleptic evaluations, foreign matter, microscopic observation</td>
</tr>
<tr>
<td>Physicochemical</td>
<td>TLC, ash, extractable matter, water content, and volatile matter</td>
</tr>
<tr>
<td>Pharmacological</td>
<td>Bitterness value, hemolytic value, astringency, swelling index, foaming index</td>
</tr>
<tr>
<td>Toxicological</td>
<td>Pesticide residues, arsenic, heavy metals</td>
</tr>
<tr>
<td>Microbial contamination</td>
<td>Total viable aerobic compound, pathogens, aflatoxins</td>
</tr>
<tr>
<td>Radioactive contaminations</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: WHO guidelines for standardization of herbal drugs

category 1, safety data are not needed. If the medicines belong to safety category 2, they have to meet the usual requirements for the safety of herbal medicines. Medicines belonging to safety category 3, i.e., “herbal medicines of uncertain safety,” will be identical to that of any new substance.

- Category 2: Herbal medicines in systems - the medicines in this category have been used for a long time and have been officially documented. Review of the safety category is necessary. If the medicines are in safety categories 1 or 2, safety data would not be needed. If the medicines belong to safety category 3, they have to meet the requirements for safety of “herbal medicines of uncertain safety.”

- Category 3: Modified herbal medicines - the medicines have to meet the requirements of safety of herbal medicines or requirements for safety of “herbal medicines of uncertain safety,” depending on the modification.

- Category 4: Imported/exported products with a herbal medicine base - exported products shall require safety data, which have to meet the requirements for the safety of herbal medicines or requirements for safety of “herbal medicines of uncertain safety,” depending on the safety requirement of the importing/recipient countries.[7]
Steps of Standardization of Herbal Drugs

1. Standardization of raw drugs - this includes the Herbal, mineral, and animal origin drugs.
2. Standardization of process procedure to prepare formulations - this includes the purification, etc., procedures to prepare a particular formulation.
3. Standardization of finished products - this includes a quality of finished products.

Parameters For Standardization of Herbal Drugs

The development of parameters for quality control of herbal drugs is a big task involving biological evaluation for a particular disease area, chemical profiling of the raw material and laying down specifications for the finished product. Therefore, the word “standardization” should encompass the entire field of study from birth of a plant to its clinical application. The herbal drug assessment in Ayurveda is about the whole drug rather than concentrating on the active principles or phytoconstituents, thus finer methods of standardization should be developed. General testing parameters for characterization and standardization of herbal medicines are given in Table 2.\cite{10}

CONCLUSION

Herbal drug standardization is very important for the safety and efficacy of the drug. The routine methods of the herbal drug standardization address quality related issue using botanical and organoleptic parameters of crude drugs, and chemo-profiling assisted characterization with spectroscopic techniques, but the new era of herbal drug standardization includes pharmacognostical, chemical, biological, biopharmaceutical, and molecular approaches. Herbal drug standardization should be done through multiple modes as the concentration of the phytochemicals varies according to climate, soil, and environment. Newer aids of research should be used to identify minute variations. Various regulatory authorities and industry are trying to address this issue of quality and efficacy. Regulatory authorities of different countries have contributed in developing guiding principles addressing issues related to these aspects of botanical medicine. This review discusses various regulatory issues related to the quality of herbal drugs. As ayurvedic drugs are also included in the Drugs and Cosmetics Act, 1940 the drugs have to be safe and effective at the same time. This brings about the need for finer standardization of herbal drugs. These guidelines are may be applicable to uplift quality of herbal medicines globally.

<table>
<thead>
<tr>
<th>Testing parameters</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>General data</td>
<td></td>
</tr>
<tr>
<td>Geographical</td>
<td>GAP</td>
</tr>
<tr>
<td>Harvesting time</td>
<td></td>
</tr>
<tr>
<td>Harvesting process</td>
<td>GMP</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
</tr>
<tr>
<td>Identity</td>
<td></td>
</tr>
<tr>
<td>Macroscopic</td>
<td>According to pharmacopeias</td>
</tr>
<tr>
<td>Microscopic</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td></td>
</tr>
<tr>
<td>TLC and DNA fingerprints</td>
<td></td>
</tr>
<tr>
<td>Purity</td>
<td></td>
</tr>
<tr>
<td>Foreign matter</td>
<td>According to pharmacopeias</td>
</tr>
<tr>
<td>Ash/sulfated ash</td>
<td></td>
</tr>
<tr>
<td>Content of extractable matter</td>
<td></td>
</tr>
<tr>
<td>Water content</td>
<td></td>
</tr>
<tr>
<td>Assay</td>
<td></td>
</tr>
<tr>
<td>Constituents with known therapeutic activity (biomarker)</td>
<td>According to pharmacopeias</td>
</tr>
<tr>
<td>Constituents with unknown therapeutic activity (marker substances)</td>
<td></td>
</tr>
<tr>
<td>Titrimetric</td>
<td></td>
</tr>
<tr>
<td>Photometric</td>
<td></td>
</tr>
<tr>
<td>HPLC/GC/TLC</td>
<td></td>
</tr>
<tr>
<td>Contaminants</td>
<td></td>
</tr>
<tr>
<td>Pesticides</td>
<td>Ph. Eur. Recommended limits for herbal drugs (oct. 91)</td>
</tr>
<tr>
<td>Heavy metals</td>
<td>Regulation on aflatoxins (Nov. 90)</td>
</tr>
<tr>
<td>Aflatoxins</td>
<td>Ph. Eur. 1997 Suppl. 1999</td>
</tr>
<tr>
<td>Microbiological purity</td>
<td></td>
</tr>
<tr>
<td>Radioactivity</td>
<td></td>
</tr>
</tbody>
</table>

GMPs: Good manufacturing practices, GAP: Good agricultural practices

Table 2: General testing parameters for characterization and standardization of herbal medicines
REFERENCES


**Source of Support:** Nil. **Conflict of Interest:** None declared.
Market study of *Pushkarmool* (*Inula racemosa* Hook. f.) an important Himalayan herb

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Abstract

Introduction: Due to excessive deforestation and extreme weather conditions adulteration of Himalaya herbs is rampant. There are about 50 medicinal plants from the Himalaya which are extensively used in Ayurvedic formulations, of which 32 plants are scarce and found adulterated in the market study. Moreover, to our misfortune, medical practitioners started depending on the traders for obtaining the raw materials. Hence, the need for identification of these herbs through botanical surveys, pharmacognostic studies, and the assessment of the quality of the material available in a particular area or market is essential. Materials and Methods: The genuine root samples of Pushkarmool, i.e., roots of *Inula racemosa* were collected from Bhadarwa District. Doda State - Jammu and Kashmir along with its mentioned adulterants are collected from its native habitat. Market samples of Pushkarmool from six major markets from all over India were collected and compared with the genuine samples. Results: Samples from five markets of India matches with the Pushkarmool, i.e., roots of *I. racemosa* whereas samples from one market could not be identified. Quality of the market samples along with the price of the drug varies from market to market. Discussion: This exclusive dependence on traders has created serious malpractice of adulteration and selling of substandard medicinal plant raw materials in the market.

Key words: Adulteration, market study, pushkarmool

INTRODUCTION

Alpine range of Himalaya is the source of many valuable herbs used extensively in Ayurvedic, Tibetan and Chinese system of medicine. Major part of the year, these hills are kept under ice, and for the vegetative growth, herbs get only 5–6 months. Furthermore, these herbs are present in the limited pocket which leads to the scarcity of Himalayan herbs. However, due to the globalization demand is increasing and production is decreasing. This decrease in production gives chance to the raw drug traders to adopt unscrupulous trade. Modern-day ayurvedic physician depends on these drug traders for procurement of herbs. Moreover, treatment with adulterated drugs leads to therapeutic unpredictability. Due to excessive deforestation and extreme weather conditions adulteration of Himalaya herbs is rampant. There are about 50 medicinal plants from the Himalaya which are extensively used in Ayurvedic formulations, of which 32 plants are scarce and found adulterated in the market study (Healing Herbs of Himalaya CCRAS Publication). One of the important aspects which have added misery to the identification of some of the important medicinal plants or raw materials are an interruption in the traditional practice of Ayurveda. Moreover, to our misfortune, medical practitioners started depending on the traders for obtaining the raw materials. Hence, the need for identification of these herbs through botanical surveys, pharmacognostic studies, and the assessment of the quality of the material available in a particular area or market is essential.

The botanical source of drug “Pushkarmool” as per the API Part I Vol. IV Page no. 116 is root part of *Inula racemosa* Hook. f., belonging to the family Asteraceae found in alpine Western Himalayas at an altitude ranging from 1800 to 3200 m. The root sample is cylindrical, somewhat angular, obtuse, and unwieldy, grayish brown in color, rough to the touch, and the taste is bitter, astringent, and cold. These roots are typically collected in the month of March and August to September by traditional healers. Market study revealed that the raw drugs were sold at Rs. 45-70/kg in the respective markets.

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Pushkarmool is well known both in the Ayurvedic and Tibetan medicine.

**Aim and objective**

There is a vast document available with regard to the morphology of green drugs. However, for physicians who are totally dependent on the market for the procurement of medicinal plant raw materials, it is not of much relevance even if he has sound knowledge of identification of green drug. Different parts of medicinal plant raw materials, in dry form, show different features most of which are being common to many drugs thus creating a lot of confusion and controversy in the identification of the crude drug. Same is the case with Pushkarmool (*I. racemosa*). Hence, to check the status of Pushkarmool in markets a market study was done by the author in the Department of Dravyaguna, NIA, Jaipur, in the year 2012, which covers six major markets from all over India. Samples of Pushkarmool collected from all the markets were compared with the genuine source collected from its native habitat.

Pushkarmool, i.e., root of *I. racemosa* Hook. f. can be identified organoleptically by following points. Roots are hard, stout, cylindrical, and twisted and having brown or dark khaki color outer surface and inner exposed part is light yellow or khaki in color. After breaking, cutting portion shows outer thin dark brownish colored ring, i.e., periderm, followed by a yellowish colored woody portion with fine radial striation and centrally located pith with numerous small yellowish-white dot-like structures. It is predominantly bitter in taste with a slightly sweet taste at the start. Smell is characteristic and smells such as somewhat camphor and lighter than the smell of kustha.

**Substitutes/adulterants**

The major problem in the field of Indian medicine is confusion and controversy due to certain synonyms used for more than one or two drugs. Similar problem is faced by the plant Pushkarmool in Kerala. Throughout Kerala, the drug *I. racemosa* is widely sold in the name of Pushkarmoolam, and there is another plant by the name Pushkarmulla in Malayalam language, the botanical identity of this as per the botanist is *Coffea travancorensis* Wight and Arn syn. *Psilanthus travancorensis* Wight and Arn. belonging to Rubiaceae family.[1]

In Bhavprakash Kusta is quoted as the substitute for Pushkarmool along with Tagara, Langali, and Sthoneyka[2] whereas Yogaratnakar described Kustha and Erandamool as the substitute for Pushkarmool. Other authors such as Adhamalla, Gangadhara, and Shivdas Sen also indicated Kustha in place of non-availability of Pushkarmool. Vaidya Bapalal is of the opinion that Pushkarmool is a variety of Kustha. Dr. Vaman Ganesh Desai, the author of “Aushadhi Sangraha” considers Pushkarmool to be *Iris germanica* and also consider this as Balvacha (Haimavati vacha and Sweta vacha). He also considered *I. racemosa* as Rasna.

Most researches have described the English name of Pushkarmool as “Orris root.” Infect “Orris root” is the root of *Iris florentiana* Linn. In the local market of Mumbai, Maharashtra, mostly the root of *I. germanica* is sold as Orris root. Considering the pharmacological properties, the root of *I. germanica* has close resemblance with Kustha; thus, it is considered as an appropriate substitute. Some people use the root of “*Nelumbo nucifera*” i.e., kamal as pushkarmool, which is absolutely incorrect.[3]

Dr. Bapalal Vaidya mentioned *I. racemosa* under the name of Rasna.[4] Roots of *Saussurea lappa* of the same family which constitutes the drug Kustha is commonly found mixed with commercial samples. A study done, in 2010, in the Department of Dravyaguna, NIA, Jaipur, scholar found that in the markets of Delhi, Kolkata, and Bengaluru *S. lappa* were being sold under the name of Pushkarmool and in the market of Jaipur Withania ashwagandha, i.e., Nagori Ashwagandha was being sold.

**Collection of genuine sample**

The genuine root samples of Pushkarmool, i.e., roots of *I. racemosa* were collected from Bhadarwa District Doda State - Jammu and Kashmir. An authentic source of roots of *Inula royleana* and Kustha, i.e., *S. lappa* roots were collected from the hills of Shatargala Tehsil - Bhaderwa District Doda State - Jammu and Kashmir. After collection Herbarium was made and authenticated at IIIM Jammu [Table 1].

**Market study**

Exclusive dependence on traders has created serious malpractice of adulteration and selling of substandard medicinal plant raw materials in the market. Hence, it is mandatory to study the market samples to check the adulteration. Six markets from all over India were selected these six markets are Kullu (H.P.), Amritsar, Jaipur, Kolkata, Mumbai, and Kochi. Following points were kept in mind

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Date of collection</th>
<th>Place of collection</th>
<th>Herbarium account no.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Inula racemosa</em></td>
<td>11-09-2012</td>
<td>Dist. Doda J&amp;K</td>
<td>13697</td>
</tr>
<tr>
<td><em>Inula royleana</em></td>
<td>11-09-2012</td>
<td>Dist. Kathua J&amp;K</td>
<td>5989</td>
</tr>
<tr>
<td><em>Saussurea lappa</em></td>
<td>11-09-2012</td>
<td>Dist. Doda J&amp;K</td>
<td>17279</td>
</tr>
</tbody>
</table>
while a collection of market samples. Markets samples were collected as such and not verified on the spot. All the available grades were collected with the simple order method. Sample purchased or received from contacts were properly labeled, stored, and subjected to the investigation [Table 2].

### Kullu market

In the market of Kullu, the drug Pushkarmool is being sold under the name of Manoo and is sold at the rate 150/- rupees per kg.

### Amritsar market

In Amritsar market, the drug Pushkarmool is being sold under the name of Pokarmool and is sold at the rate of 190/- per kg.

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**Table 2: Date and source of market samples**

<table>
<thead>
<tr>
<th>Markets</th>
<th>Date of purchasing or receiving</th>
<th>Collector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kullu</td>
<td>18-04-2012</td>
<td>Scholar</td>
</tr>
<tr>
<td>Amritsar</td>
<td>05-04-2012</td>
<td>Scholar</td>
</tr>
<tr>
<td>Jaipur</td>
<td>05-05-2012</td>
<td>Scholar</td>
</tr>
<tr>
<td>Kolkata</td>
<td>10-04-2012</td>
<td>Contacts</td>
</tr>
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<td>Mumbai</td>
<td>25-04-2012</td>
<td>Contacts</td>
</tr>
<tr>
<td>Kochin</td>
<td>20-07-2012</td>
<td>Contacts</td>
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</tbody>
</table>

**Table 3: Summarized organoleptic features**

<table>
<thead>
<tr>
<th>Source</th>
<th>Appearance</th>
<th>Size</th>
<th>Colour</th>
<th>Odor</th>
<th>Taste</th>
<th>Fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genuine</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>5–14 cm long in length and 2–3 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and uneven</td>
</tr>
<tr>
<td>Kullu</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>4–7 cm long in length and 0.5–1.5 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and uneven</td>
</tr>
<tr>
<td>Amritsar</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>4–9 cm long in length and 1–2 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and even</td>
</tr>
<tr>
<td>Jaipur</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>3–8 cm long in length and 1–2 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and uneven</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>5–10 cm. long in length and 2–5 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and uneven</td>
</tr>
<tr>
<td>Kolkata</td>
<td>Mixture of three or four types of drugs. Small, straight, thin pieces</td>
<td>3–4 cm long in length and 1 cm in thickness</td>
<td>Some pieces were saddle brown, and some were Goldenrod</td>
<td>Peculiar sweet smell</td>
<td></td>
<td>Short and uneven</td>
</tr>
<tr>
<td>Kochin</td>
<td>Stout, hard, cylindrical, carrot-like at the upper end twisted and gradually tapering at the end rough, having some whitish colored lenticels, longitudinally wrinkled</td>
<td>5–11 cm long and 2–3 cm in thickness</td>
<td>Dark Khaki with khaki color longitudinal striations</td>
<td>Characteristic and camphoraceous</td>
<td>Bitter</td>
<td>Short and uneven</td>
</tr>
</tbody>
</table>
Jaipur market
In Jaipur market, the drug Pushkarmool is being sold under the name of Pushkarmool, and it costs 240/- rupees per kg.

Mumbai market
In Mumbai market, the drug Pushkarmool is being sold under the name of Pushkarmool and is cost 800/- rupees per kg.

Kolkata market
In Kolkata market, the drug Pushkarmool is being sold under the name of Mool and is sold in this market at the rate of 200/- per kg.

Kochin market
In Kochin market, the drug Pushkarmool is being sold under the name of Pushkaramoolam and is sold at a cost 210/- rupees per kg.

Summarized organoleptic features of genuine samples, as well as market samples, are given in Table 3.

DISCUSSION AND CONCLUSION
The market samples of Pushkarmool were collected from the markets of Kullu, Amritsar, Jaipur, Kolkata, Mumbai, and Kochin. After studying the samples collected from above-mentioned markets, it had been found that price of Pushkarmool varied from rupees 150 to 800, sample collected from all the above markets except Kolkata, is having the similar characters and resemblance with the characters of root of *I. racemosa* which is an authentic source of Pushkarmool. Hence, the sample collected consisted of an original sample of Pushkarmool. Sample from Kolkata market consisted of unidentified drug material with few pieces of satavari. Sample of Amritsar and Jaipur market was consisted of poor grade material. More than 50% of the material was under matured roots with a thickness <1 cm. Sample from Mumbai market consisted of big chunks of the upper part of roots of Pushkarmool.

In ancient days Vaidyas usually go to the forest to collect medicinal plants and prepare the medicines by themselves. Therefore, there was not much-documented information with regard to morphology and identification of medicinal plants in Ayurvedic texts. However, due to extensive industrialization and urbanization it has become almost unpractical for an Ayurvedic physician to personally procure the authentic drugs and therefore totally dependent on raw drug sellers and the middlemen for procurement of medicinal plant raw materials. This exclusive dependence on traders has created serious malpractice of adulteration and selling of substandard medicinal plant raw materials in the market. Hence, it is mandatory to study the market samples to check the adulteration.

REFERENCES

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Is refined oil safe for health?

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Abstract

In this hurried lifestyle, every individual is working laboriously to refine himself even at the cost of their health, making his life barren. Person is so much occupied in his daily work that he hardly gets time to judge what he is eating. Most of the people depend on the packed and processed food. These food items contain a lot of preservatives, food additives, and added sugars which make these food items slow poisons and can be compared with the garvisha. Garvisha as per Ayurveda is the type of toxin which comes from outside the body which includes environmental toxins such as chemicals, preservatives, air and water pollution, genetically engineered foods, synthetics and chemicals in clothing, synthetic drugs, chemicals in household cleansers etc. In a country like India where we produce more than hundred natural edible oils but these natural oils are hardly seen in modern kitchens and are superseded by refined vegetable oils without understanding the chemical process and hazards of eating these chemically processed refined vegetable oils. Thus, in the present review article author focuses on the process of refining and its hazards.

Key words: Garvisha, hazards, refined oil

INTRODUCTION

Today, we are enclosed by different types of toxins, i.e., Visha, these toxins are present everywhere such as impurities in the air, water, and soil. Visha is the substance which immediately after entering into the body causes the vitiation of the healthy dhatus or killing of the healthy person is defined as Visha. Visha causes sadness to the world.[1] Ayurveda has defined a lot of food items which have Rasayan properties and helps our body to fight against these impurities and toxins. However, nowadays most of the people depend on the packed and processed food. These food items contain a lot of preservatives, food additives, and added sugars which make these food items slow poisons and can be compared with the garvisha. Garvisha as per Ayurveda is the type of toxin which comes from outside the body. Garvisha is the toxic combination of poisonous or non-poisonous substance.[1] Gara is a toxic combination of poisonous or nonpoisonous substance and which exerts toxic effect after interval of some time and as such does not kill the patient instantly.[1] Included are environmental toxins such as chemicals, preservatives, poisons, air and water pollution, genetically engineered foods, synthetics and chemicals in clothing, synthetic drugs, chemicals in household cleansers, and heavy metals such as lead, arsenic and asbestos. Garvisha also includes toxins from spoiled foods. Food is the most important part of our health and presently the most ignored part. Food has been given more importance in Ayurveda than medicines. Charak Samhita, the most authoritative text of Ayurveda says that both human and his/her diseases are outcome of his/her food.[2] Ayurveda states that one must regularly take such foods which help in maintaining and promoting health and which prevent diseases (Charak Sutra: 5/13).[3]

In this hurried lifestyle, every individual is working laboriously to refine himself even at the cost of their health, making his life barren. Person is so much occupied in his daily work that he hardly gets time to judge what he is eating. For choosing his food to eat, he depends on the commercials he saw, and to earn money, these food manufacturers dare to serve toxins and slow poison in the form of refined and processed food. Lot of these packed and processed food are promoted by the major doctor’s associations. Whereas our ancestors choose their food according to the climate of the place, like in northern and eastern India mustard seed oil is the conventionally used...
kitchen oil, in southern India people used coconut oil whereas in central India people mostly use peanut oil. We have also seen in every debate we compare present lifestyle with our grandparents, we talk about how they live their life? What they eat? However, after all these debates, we forget all and start with our present lifestyles.

In a country like India where we produce more than hundred natural edible oils but these natural oils are hardly seen in modern kitchens and are superseded by refined vegetable oils without understanding the chemical process and hazards of eating these chemically processed refined vegetable oils. The chemicals used for the refining of edible oils are hexane, sodium hydroxide, sodium carbonates, and many more. In India, we have thousand’s year’s old history of eating natural edible oils such as mustard oil, peanut oil, coconut oil, and many others. Whereas refined oils such as soy oil, safflower, and linseed oils have a history of using it in paint and varnishes industry 50 years ago. Then, chemists learned how to make paint from petroleum, which was cheaper. As a result, the seed oil industry had loads of crop that was hard to sell. They eventually were given to farmers to make their pigs fatter with less food! The crops that had gone from the paint industry ended up as food on a farm for animals which, in turn, ends up on our plate as well.[4]

Process of Refining Edible Oils

Refined vegetable oil starts from the seeds of various plant sources. The fats from plant seeds are polyunsaturated, meaning they remain in a fluid state at room temperature. There are many different kinds of commercially refined vegetable based oils, including canola or rapeseed oil, soybean oil, canola oil, corn oil, sunflower oil, safflower oil, and peanut oil. The generic cooking term “vegetable oil” refers to a blend of a variety of oils often based on palm, corn, soybean, or sunflower oils. Refined cooking oils are made by highly intensive mechanical and chemical processes to extract the oil from the seeds. This process removes the natural nutrients from the seeds and creates a final product which oxidizes easily. The oxidation factor makes these oils more likely to break down into cancer-causing free radicals within the body.

Oilseeds such as soybean are gathered and cleaned of dirt and dust, then crushed. Crushed seeds are then heated to temperatures between 110 and 180° in a steam bath to start the oil extraction process. The seeds are put through a high volume press which uses high heat and friction to press the oil from the seed pulp. The seed pulp and oil are then put through a hexane solvent bath and steamed again to squeeze out more oil. Now the seed oil mixture is put through a centrifuge and phosphate is added to begin the separation of the oil and seed residues. After solvent extraction, the crude oil is separated, and the solvent evaporated and recovered. The seed pulp residues are conditioned and reprocess to make by-products such as animal feed. The crude vegetable oil is then put through further refining techniques including degumming, neutralization, and bleaching.

Water degumming is the process in which water is added to the oil. After a certain reaction period hydrated phosphatides can be separated either by decantation (settling) or continuously by means of centrifuges. In this process large amount of water-soluble and even a small proportion of the non-water soluble phosphatides are removed. The extracted gums can be processed into lecithin for food, feed or for technical process. Neutralization is the process in which any free fatty acids, phospholipids, pigments, and waxes in the extracted oil promote fat oxidation and leads to undesirable colors and odors in the final product. These impurities are removed by treating the oil with caustic soda (sodium hydroxide, an extremely corrosive base used to clean clogged kitchen sink drains) or soda ash (sodium carbonate). These impurities settle to the bottom and drawn off. The refined oils are light in color, less viscous and more susceptible to oxidation. Bleaching is the removal of colored materials in the oil. The heated oil is treated with various bleaching agents such as fuller’s earth, activated carbon, or activated clays. Many impurities including chlorophyll and carotenoid pigments are absorbed by the process and removed by filtration. However, bleaching also promoted fat oxidation since some natural antioxidants and nutrients are removed along with the impurities. Deodorization is the final step in the refining of vegetable oils. Pressurize steam at extremely high temperature (500° or more) is used to remove volatile compounds which would cause off odors and tastes in the final product. The oil produced is referred to as “refined oil” and is ready to be consumed or for the manufacture of other products. A light solution of citric acid often added during this step to inactivate any metals such as iron or copper present in the final product.[5]

During these processes, some (0.5–1%) of the fatty acids molecules are changed chemically into toxic molecules that interfere with normal biochemical interactions between molecule necessary for normal cell functions, thus interfering with health. Furthermore, the process of refining vegetable oil damages the fats and makes the oil very unstable and prone to going rancid quite easily. Rancid oils in any form are particularly bad for your health because they introduce cancer-causing free radicals into your body, without the benefit of including an antioxidant like Vitamin E. During the process of refining minor ingredients (phytochemicals) that makeup about 2% of most cells but have major benefits on health are removed. It helps in lowering cholesterol and blocks cholesterol absorption from foods, improves cardiovascular function, improves digestion and stimulate pancreatic enzyme production, improves liver and gallbladder function and increase bile flow, acts as anti-oxidants and stabilize essential fatty acids against oxidation (rancidity), acts as anti-inflammatory agents, protect visual function, and improves brain function.

Hazards of Refined Edible oil

In addition, many refined vegetable oils are also hydrogenated. This hydrogenation process makes them solid at room
Ringzin and Lalit: Refined oil a curse

temperature so they can be sold as margarine and shortening. This hydrogenation process further damages the fatty acids in oils, creating trans fatty acids, which are particularly dangerous to human health. Trans fatty acids raise the level of lipoproteins (a), the strongest known risk factor for cardiovascular disease, decrease testosterone, increase abnormal sperm and interfere with pregnancy in animals, correlate with low birth weight human babies, lower the quality of human breast milk, interfere with blood insulin function, interfere with liver enzymes necessary for detoxification (the cytochrome P450 system), change the fluidity of cell membrane making them harder, slow down their reactions, lower cell vitality and make cell membrane more permeable, make platelets more sticky, increase cholesterol, increase low-density lipoprotein cholesterol, and lower high-density lipoprotein cholesterol.[6]

CONCLUSION

Try to avoid any refined oils. They are cheap, they are processed and they are downright dangerous to your health. Instead of it start using natural filtered oils which are unprocessed, raw and does not contain any chemicals. Moreover, these natural oils are time tested on the parameters of environmental and climate changes from thousand years in India.

REFERENCES


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Herbs for textile dye–an eco-friendly approach

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Abstract
Dyes derived from natural materials, such as plant leaves, roots, bark, insect secretions, and minerals, were the only dyes available to mankind for the coloring of textiles until the discovery of the first synthetic dye in 1856. Rapid research strides in synthetic chemistry supported by the industrialization of textile production not only led to the development of synthetic alternatives to popular natural dyes but also to a number of synthetic dyes in various hues and colors that gradually pushed the natural dyes into oblivion. However, environmental issues in the production and application of synthetic dyes once again revived consumer interest in natural dyes during the last decades of the twentieth century. Textiles colored with natural dyes are preferred by environmentally conscious consumers, and today, there is a niche market for such textiles. However, the total share of natural dyes in the textile sector is approximately only 1% due to certain technical and sustainability issues involved in the production and application of these dyes such as non-availability in ready-to-use standard form, unsuitability for machine use, and limited and non-reproducible shades. Natural dyes are sustainable as they are renewable and biodegradable; however, they cannot fulfill the huge demand from the textile sector in view of the preferential use of land for food and feed purposes. In addition, overexploitation of natural resources to obtain dyes may result in deforestation and threaten endangered species. For these reasons, the global organic textiles standard permits the use of safe synthetic dyes and prohibits the use of natural dyes from endangered species. Various research efforts have been undertaken all over the world to address the shortcomings of natural dyes given the tremendous environmental advantage they offer. An aspect of the return to use natural dyes is the search for novel natural dyes from various plant materials. This is because the use of synthetic dye has recently been banned not only due to the carcinogenic nature of the intermediates used in the preparation of these dyes but also the effluent coming from their industries are the major cause of environmental pollution. There are several plants parts that provide natural dyes which might be used in the textile industry.

Key words: Dyes, industrialization, natural, organic, synthetic, textiles

INTRODUCTION
The art of dying is as old as our civilization. Dyed textile remnants found during archaeological excavations at different places worldwide provide evidence to the practice of dying in ancient civilizations. Natural dyes were used only for coloring of textiles from ancient times till the nineteenth century. As the name suggests, natural dyes are derived from natural resources. Coloring materials obtained from natural resources of plant, animal, mineral, and microbial origins were used for coloration of various textile materials. Different regions of the world had their own natural dying traditions utilizing the natural resources available in that region. Use of natural dyes started to decline after the invention of synthetic dyes in the second half of the nineteenth century. Concerted research efforts in the field of synthetic dyes and rapid industrialization of textile production resulted in almost complete replacement of natural dyes by synthetic dyes on account of their easy availability in ready-to-apply form, simple application process, consistency of shades, and better fastness properties. The tradition of using natural dyes could survive only in certain isolated pockets. Recent environmental awareness has again revived interest in natural dyes mainly among environmentally conscious people. Natural dyes are considered eco-friendly as these are renewable and biodegradable; are skin friendly and may also provide health benefits to the wearer. Natural

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dyes can be used for dyeing almost all types of natural fibers. Recent research shows that they can also be used to dye some synthetic fibers. Apart from their application in textiles, natural dyes are also used in the coloration of food, medicines, handicraft items and toys, and in leather processing, and many of the dye-yielding plants are used as medicines in various traditional medicinal systems. There are several challenges and limitations associated with the use of natural dyes. The current dyestuff requirement from the industry is about 3 million tones. Considering this fact, the use of natural dyes in mainstream textile processing is a big challenge. As agricultural land is primarily required to feed an ever-increasing world population and support livestock and biodiversity should not be compromised for the extraction of dyes, sustainability of natural dyes is a major issue. This paper discusses various issues related to the use of natural dyes in textiles such as potential sources, advantages and disadvantages, methods, application methods, and sustainability issues (Table 1).

**DYING**

As for synthetic dyes, the amount of dye to be taken is normally given as % shade. It denotes the amount of dye (in grams) to be taken for dyeing 100 g of textile material. The terminology remains the same for both crude dye material and purified extracts. As the dye content of raw materials is low, it is common to use 10–30% shade whereas the amount can be reduced to 2–5% for the purified dye extracts. The amount of mordants is also selected in relation to the shade dyed. A larger quantity of mordants is needed for higher shades. As is the case with synthetic dyes, the amount of water to be taken in the dye bath is an important parameter. In technical terms, it is given in the recipe as the material-to-liquor ratio (MLR). The MLR denotes the amount of water in ml required per gram of the fabric to be dyed. As natural dyes differ in their chemical constituents, their dying procedures also differ; however, their basic dying process is similar. There may be different optimum temperature, time, and pH of dying; however, the basic steps remain the same. Many natural dyes are dyed at near boiling temperature on cotton. Wool and silk are dyed at a lower temperature although some dyes may dye cotton also at lower temperature. Most dyes require neutral pH but some dyes require acidic pH and some may need alkaline pH. For dying animal fibers wool, *Pashmina*, and silk, generally 1–2% of acetic acid is added during dying. The material to be dyed premordanted or otherwise is introduced into the dying bath at room temperature, and the temperature is then increased slowly to ensure uniformity of dying. The material is usually dyed for at least an hour to allow the dye to penetrate well inside the textile material. The movement of textile material in the dye bath is very essential. If the dying is carried out in dying machines, movement of the material is taken care of but in hand dying, the fabric needs to be continuously stirred in the dye bath, otherwise uneven dying may result. If delicate fabrics such as pashmina are to be dyed, the dye bath should not be stirred continuously as that will damage the fabric structure. In such cases, it is advisable to have a MLR of at least 1:100 so that the fabric is completely immersed in the dye liquor during dying and dying is uniform. If simultaneous mordanting is to be carried out, the required quantity of mordant is also added to the dye bath. After the dying is over, the dyed materials are removed and allowed to cool down a little and then washed with water. Some traditional dyers leave the material in the dye bath itself to cool and then remove the material for washing. The washed dyed material is then soaped with a hot soap or nonionic detergent solution to remove loosely held dye and is again rinsed with water and air-dried in the shade. At industrial scale, hydroextractors are used to remove excess water during washing. If post-mordanting is to be carried out, the washed material is taken up for post-mordanting without soaping and soaping is carried out on the post-mordanted material after washing. When cotton materials are dyed with dyes such as madder which do not have affinity to it without mordants, the premordanted dyed material may be further post-mordanted to get different shades and improvements in fastness properties. Treatment with small amounts of copper mordant improves the fastness to light for many dyes although it also results in slight hue changes. Such treatment with copper to improve lightfastness was also practiced earlier for certain synthetic dyes. A post-dying treatment with tannins and alum can help in improving the fastness to washing.

**Categories of Textile Suitable for Dying with Natural Dyes**

Natural dyes can be used on most types of materials or fibers; however, the level of success regarding fastness and clarity of colors varies considerably. Users of natural dyes; however, tend to also use natural fibers, and so much emphasis will be given to this group. Natural fibers come mainly from two distinct origins, animal origin, or vegetable origin. Fibers from an animal origin include wool, silk, mohair and alpaca, as well as some others which are less well known. All animal fibers are based on protein. Natural dyes have a strong affinity to fibers of animal origin especially wool, silk, and mohair and the result with these fibers are usually good. Fibers of plant origin include cotton flax or linen, ramie, jute hemp, and many others plant fibers have cellulose as their basic ingredient. Natural dying of certain plant-based textile can be less successful than their animal equivalent. Different mordanting techniques are called for with each category. When a blend of fiber of both animal and plant origin is being dyed, then a recipe should be chosen which will accentuate the fibre which is required to be dominant.

**Advantages of Natural Dyes**

**Eco-friendly**

Natural dyes are considered to be eco-friendly as these are obtained from renewable resources as compared to synthetic
dyes which are derived from non-renewable petroleum resources. These are biodegradable and the residual vegetal matter left after extraction of dyes can be easily composted and used as fertilizer. They produce soft colors soothing to the eye which are in harmony with nature.

**Antibacterial and antimicrobial properties**

In addition to these environmental benefits, natural dyes also offer functional benefits to the wearer and users of such textiles. Fabrics dyed with some natural dyes have been reported by the wearers to be free of odor perhaps due to the antibacterial or bacteriostatic properties of natural dye materials. Users of natural dyed fabrics have also found such fabrics to be mosquito repellent and/or moth repellent as perhaps the plant material from which these dyes were derived might also have contained natural repellent substances. In addition, recently, cellulosic textiles treated with natural plant extract have been found to exhibit flame-retardant properties.[2] Many of the natural dye materials possess. Therefore, textiles dyed with such materials are also likely to show antimicrobial properties, and the same has been reported by many researchers.[3-5]

**Ultraviolet (UV) protection**

Many of the natural dyes absorb in the region and therefore fabrics dyed with such dyes should offer good protection from UV light. Improvement in UV characteristics of natural cellulosic fibers after treatment with natural dyes has been reported by various researchers.[6-8] Gupta et al.[4] observed that treatment with tannins during mordanting itself improved the UV protection of fabrics. Saxena et al.[9] also observed that extracts of tannin-rich pomegranate rind showed strong absorption in UV region and cotton fabrics treated with these extracts showed excellent UV protection which was durable to washing. As cotton and other cellulosic are frequently treated with tannins in the mordanting step during dying with natural dyes, it is likely that such dyed fabrics would also show good UV protection. Ibrahim et al.[10] have reported improvements in both UV protection and antibacterial activity for polyamide six fabrics after treatment with natural dyes.

**Curative and medicinal properties**

In the Table no. 1 many natural dyes, such as myrobolon fruits, turmeric, manjistha root, Arjuna (Terminalia arjuna) bark, and safflower florets, among others possess curative properties and have been used in various traditional medicinal systems. Textiles dyed with these materials may also possess healing properties by absorption of medicinal compounds through the skin. Textiles produced in Kerala, India, by dyeing with herbs as per the traditional Ayurvedic system of medicine and known as “Ayurvastra” have become very popular as health and well-being textiles and also as medicinal or curative textiles and are being exported to various countries. Various companies are now marketing naturally dyed textiles as health and well-being textiles.

**Drawbacks of Natural Dyes**

Natural dyes are considered to be an eco-friendly alternative for dyeing of textile materials, especially natural fiber textiles. However, there are many limitations in the usage of natural dyes some of which are listed below.

<table>
<thead>
<tr>
<th>Common name of the plant</th>
<th>Botanical name</th>
<th>Part used</th>
<th>Color obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siam weeds</td>
<td>Eupatorium odoratum</td>
<td>Whole plant</td>
<td>Yellow</td>
</tr>
<tr>
<td>Goat weed</td>
<td>Ageratum conyzoides</td>
<td>Whole plant</td>
<td>Yellow</td>
</tr>
<tr>
<td>Jack fruit tree</td>
<td>Artocarpus heterophyllus</td>
<td>Bark</td>
<td>Yellow</td>
</tr>
<tr>
<td>Gulmohar</td>
<td>Delonix regia</td>
<td>Flower</td>
<td>Olive green</td>
</tr>
<tr>
<td>Teak</td>
<td>Tectona grandis</td>
<td>Leaves</td>
<td>Yellow</td>
</tr>
<tr>
<td>Babool</td>
<td>Acacia nilotica</td>
<td>Leaves, bark</td>
<td>Yellow/brown</td>
</tr>
<tr>
<td>Water lily</td>
<td>Nymphaea alba</td>
<td>Rhizomes</td>
<td>Blue</td>
</tr>
<tr>
<td>Dahlia Dahlia</td>
<td>variabilis</td>
<td>Flowers</td>
<td>Orange</td>
</tr>
<tr>
<td>Amla</td>
<td>Emblica officinalis</td>
<td>Bark, fruit</td>
<td>Grey</td>
</tr>
<tr>
<td>10 Indian Jujube Ber</td>
<td>Ziziphus mauritiana</td>
<td>Leaf</td>
<td>Pink</td>
</tr>
<tr>
<td>Drumstick</td>
<td>Moringa pterygosperma</td>
<td>Leaf</td>
<td>Yellow</td>
</tr>
<tr>
<td>Sausage tree</td>
<td>Kigelia pinnata</td>
<td>Petals, heartwood,</td>
<td>bark Yellow, pink</td>
</tr>
<tr>
<td>African tulip tree</td>
<td>Spathodea comanulata</td>
<td>Flower</td>
<td>Yellow/orange</td>
</tr>
<tr>
<td>Tamarind</td>
<td>Tamarindus indica</td>
<td>Leaves, seeds</td>
<td>Yellow, brown</td>
</tr>
<tr>
<td>Golden dock</td>
<td>Rumex maritimus</td>
<td>Seeds</td>
<td>Brown</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>Eucalyptus camaldulensis</td>
<td>Bark</td>
<td>Yellow and brown</td>
</tr>
<tr>
<td>Red sandalwood</td>
<td>Pterocarpus santalinus</td>
<td>Wood</td>
<td>Red</td>
</tr>
</tbody>
</table>
**Soni: A review on natural herbs used in textile dye**

**Limited shade range**

Shade range of natural dyes is limited. Out of the three primary colors red, yellow, and blue, although there are several sources for red and yellow dyes, there is only one major source of the blue dye: Indigo. As natural dyes differ in their application process, only few dyes can be applied in mixtures and differences in fastness properties further limit the choice. Even a common secondary color such as green needs to be produced by over dying as blue dye indigo being a vat dye has an entirely different application process that increases the dying time and cost.[11]

**Nonreproducible shades**

Difficulty in reproducing the shades is another major drawback of natural dyes which is caused by the inherent variations in the proportion of chemical constituents in the natural material and thus in its crude extract depending on the maturity, variety, and agro-climatic variations such as soil type, region, and so on. Therefore, it is not possible to produce the same shade with a particular natural dye in every dying operation.[12] The production of standardized dye powders is an expensive and complicated exercise as most of the natural dyes contain various chemical constituents. Some of the natural dyes are pH sensitive and tend to change color due to change in pH. As natural dyes tend to form colored complexes with metal ions, the mineral composition of water may also cause shade variations. Hence, even the same standardized powder may give different shades at two different places due to the differences in mineral content and pH of the water which makes it very difficult to reproduce the shades.

**Fastness properties**

Colorfastness to light and washing are most important parameters to evaluate the performance of a textile and deciding about its end use although colorfastness to rubbing and perspiration are also important especially if it is to be used as apparel. A material should have good fastness to light if it is to be used for making curtains although a little lower fastness to washing may be satisfactory for this application. Colorfastness properties of natural dyes are a cause of concern. Only a few natural dyes possess fastness properties conforming to modern textile requirements. Restrictions on the use of certain metal salts for mordanting such as chromium, copper, tin, and so on by eco standards has not only reduced the color gamut of natural dyes but has also made the task of producing shades with good fastness properties difficult. Improper application procedures used by certain practitioners of natural dyes are also sometimes responsible for poor fastness properties. Improvements and optimization of mordanting and dying procedures can help in solving this issue. Exploring the new sources for dyes can increase the number of dyes with better colorfastness properties.

**Safety issues**

Exploration of new sources for dyes can certainly help in increasing the shade range of natural dyes with good fastness properties. However, extensive research on the safety of these materials to humans and the environment would be needed before propagating their usage as everything of natural origin may not be safe. Nature is known to produce poisonous substances also; therefore, thorough toxicological evaluations for the new sources are necessary. Use of metallic mordants also requires caution as not to cause adverse health effects during handling. Precautions should also be taken to prevent pollution problems in the usage of these dyes and it should be ensured that the amount of restricted mordant in the dyed textile is within the limits set by eco regulations.

**Characterization and certification issues**

Although dyeing of textile fabrics with dyes obtained from various natural resources has been extensively investigated, little information is available on the identification and characterization of the natural dyes. Natural dyes, being plant metabolites, are present only in small amounts in dye-bearing materials along with large quantities of other non-dye materials. The dye content may vary according to the age, part of the plant, and agro-climatic conditions, and it is important to know the dye content in order to get reproducible shades. While procuring the dye materials, pricing should match the dye content and when powdered dye materials or extracts are used, these should be authentic. Thus, determination of dye content as well as characterization of dye material is important in the case of natural dyes. Absorption spectroscopy is very successfully used for measuring the dye content of synthetic dyes but has limited applicability for natural dyes as these...
dyes are usually not a single chemical entity but a mixture of closely related compounds, and in many cases, there are no clearly defined absorption maxima. A literature survey shows that the earliest attempts to characterize the natural dyes were made in the context of identifying the dyes present on historical textiles kept in museums or those found in archaeological excavations. Different techniques including high-performance liquid chromatography, thin-layer chromatography (TLC), high-performance TLC (HPTLC), UV visible, and mass spectroscopy have been employed for this purpose. However, there are no certification bodies or any testing agencies that can certify or characterize and identify the commercial natural dyes or the fabrics dyed with natural dyes although such fabrics fetch higher prices. As a result, some unscrupulous elements in the trade tend to mix natural dyes with cheap synthetic dyes or try to pass off the fabrics dyed with synthetic dyes as those dyed with natural dyes. It is quite common to find people trying to market fabrics dyed with synthetic alizarin or indigo as dyed with natural dyes. Therefore, development of process protocols for quick identification and characterization of natural dyes is very important for the sustainability of true natural dyed textiles. TLC and HPTLC techniques can be easily employed for quick identification of natural dyes by comparing with chromatographic fingerprints of authentic natural dye samples.

CONCLUSION

It has been found that lots of natural materials such as leaves, roots, bark, insect secretions, and minerals are used for natural dyeing. There are lots of natural products still untouched. There are lots of unharnessed natural products and required scientific studies and systematic reports on dyeing of textile with eco-friendly natural dyes are still insufficient. Though natural coloration is known from ancient time as artisanal practice for handicrafts, paintings, handloom textiles, the chemistry of interaction of such colorants with textile materials is of relatively recent interest for producing eco-friendly textiles. The present excessive use of synthetic dyes, estimated at around 10,000,000 tons per annum, the production and application of which release vast amount of waste and unfixed colorant causing serious health hazard and disturbing the eco-balance of nature is of great concern. Nowadays, fortunately, there is increasing awareness among people towards the use of eco-friendly natural dyes owing to their better biodegradability and higher compatibility with the environment. They are non-toxic, non-allergic to skin, non-carcinogenic, abundant, and renewable. Thus, there are needs of many more active researches to build knowledge base and database with production of appropriate shades cards for different textiles. It will help to popularize the use of natural dyes by solving some of its problems relative to application methods, reproducibility and colorfastness. Improving the computerized color matching for use of synthetic dyes has now become regular practice in most of the textile industry. It has still not become possible mainly due to the essential two dependent factors (dye & mordant) and color development mechanism of natural colors applied to textiles. In countries such as India, Nigeria, Liberia, and Uganda among others, there is a wealth of plants available for producing natural dyes that could be utilized for commercial dyeing of textiles. Therefore, much more research and developmental efforts should be geared toward producing high quality natural dyes with shades comparable to some of the highly rated synthetic dyes.

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Critical review on the concept of Kajjali: The boon of Ayurvedic Herbomineral preparations (Rasaushadhi)

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Abstract

Rasashastra is the branch of Indian alchemy which manages the scientific utilization of purified and processed metals, minerals, valuable stones, marine, narcotic, and different herbs for curing diseases and rejuvenation. Kajjali Kalpa is a novel concept of ancient Indian drug delivery system. Despite the fact that the specialists of Rasashastra consider Kupipakwa Rasayana and Pottali Rasayana as prominent therapeutic agent, the Kajjali Kalpa - Khalviya Rasayana are likewise similarly effective Rasa yoga helpful in various clinical conditions. Black sulfide of mercury (Kajjali) comprehensively and synergistically acts with the herbal ingredients to bring multitargeted organ effect, in particular, Rasayana effects in its complete sense.

Key words: Gandhaka, Jarana, Kajjali, Kajjali Kalpa, Murchana, Parada, Rasashastra

INTRODUCTION

Ayurveda is a well-documented traditional system of Indian Medicine. Rasa Shastra, a branch of Ayurveda popular from medieval period, with twin aim, the foremost being the therapeutic applicability of metals and minerals, i.e., Dehavaada[1] and another been the conversion of lower metals into higher metals, i.e., Dhatuvaad.[2] Mercury (Parada) is the prime member and considered to be highly auspicious material followed by sulfur (Gandhaka), which is essential to potentiate the therapeutic properties of former in many ways. Kajjali is the name given to a compound obtained by either combination of mercury and sulfur in different ratios[3] or even combination of these two along with some other metals.[4] In fact, Kajjali is considered to be first Murchana of Parada.[5,6] Hundreds of formulations are explained in classical texts with the permutation combination of Kajjali[7] in different proportion of sulfur and mercury along with herbal ingredients. Kajjali kalpa is found effective in diseases of all Srotasa. The impact might be multidimensional, free radicals scavenging, antioxidant, antimicrobial, reactant, proenzymatic, or immunomodulator. Kajjali complex is additionally more effective in light of its longer stay and coordinated and sustain release, GI adsorption/stimulant, and even neurochemical irritability.[8] It also suppresses autoimmune reaction, drug reactions, and hepatic abnormal metabolism. For formulations containing pure mercury and pure sulfur in equal proportion, Sama guna Kajjali (Mercury:sulfur 1:1) may be used. Similarly, in formulation where only mercury is prescribed, Rasasindoora may be added in place of mercury. Formulation in which sulfur is more in comparison to mercury, Kajjali is to be prepared with additional sulfur and if mercury is more vice versa may be used.[9] The information available in different databases on Kajjali have been gathered and critically reviewed. The compiled information has been efficiently studied and classified in different headings and commented.

Murchana and Jarana

Jarana and Murchana are two independent procedures followed in Parada Sanskar (potentiation of mercury). Murchana involves change in physical state of mercury from liquid to powder state. Murchana is a process in

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which mercurial compounds develop *Ayabhicarita Vyadhighatakavata* (disease curing ) property or potency.[10] The basic concept behind is that mercury with or without sulfur converts in such a suitable compound form which could be used internally in the body for curing diseases even without being reduced/converted to ashes. *Murchana*, which means to introduce disease-curing properties in *Parada*,[11,12] Through this process, mercury and mercurial compounds should develop a definite diseases curing capacity and after *Murchana* mercury may not return to its original form (*purvavastha*). One specific type of *Murchana* in which without heat treatment mercury is processed with sulfur is *Kajjali* (*Sagandha Niragni Murchana*).[13] Here, continues and vigorous grinding is done until black-colored powder like compound is prepared that fulfills some typical tests such as absence of shininess and floating over water surface. [14] As it is first *Murchana* of *Parada*, it is being used as a primary component of even processing of mercury with sulfur with heat treatment (*Sagandha Agni Murchana*) such as *Kupipakwa Rasayana*, *Parpati Kalpa*, and *Pottali kalpa*.

Whereas such a change is not expected in *Jarana* Sanskar with the help of *Vida* and through various pharmaceutical procedures carried out using variety of instruments such as *Baluka yantra*, *Kacchapa yantra*, and *Jarana yantra*, the process of digesting other metals and minerals in mercury is called as *Jarana*.[15] percent of therapeutic strength in mercury can be obtained only after digestion (*Jarana*) of purified sulfur (*Suddha Gandhaka*) in and it is different ratios. The digestion (*Jarana*) of mercury in sulfur (*Gandhaka* in *Parada*) ranges from 1:1 ratio to 1:6 ratio; i.e., one part of mercury with either 1, 2, 3, 4, 5, or 6 times of purified sulfur. As per *Ayurveda prakash* in certain context, both the terms are used as synonyms[16] also otherwise both are different from each other, only in the context of *Gandhaka Jarana* both are used as synonyms and for same objective. Even though mercury is a toxic element, the forms of mercury play an important role in converting it to toxic metal. In *Jarana*, mercury does not convert in any form rather remain in its original (mercury) form. It consumes and digests some metal contents of some minerals (*Satva*) and gold silver, etc., metals (*Bija*) in specified amount and returns to its original form (*Purva avastha*).[17] In *Jarana*, mercury does not essentially acquire disease-curing property rather it is done to prepare mercury suitable for further *Samskara* means for transformation purposes (*Dhatuvada*).[18] The process *Jarana* is also aimed at improving the appetite of mercury through various pharmaceutical procedures. By addition of *Vida*,[19] the hunger of mercury increases to many folds. Only then, it becomes efficient enough to digest the metals such as gold (*Swarna*), silver (*Rajata*), and mica (*Abhraka*). More the ratio of sulfur digested in mercury better will be its therapeutic strength and wider will be its therapeutic application. The mercury digested with 6 times of purified sulfur (*Shuddha Gandhaka*) not only gains therapeutic potency but also exhibits the rejuvenation properties.[20] The term *Jarana* is used which means whatever is added to *Rasa* (*Rasa* is synonym for mercury) that should completely be digested in *Rasa*, just like a food in human beings immediately after ingestion of food the weight may be found increased, but after the digestion, the weight is not found increase. The chemistry of mercury shows that it has affinity to assimilate most of the metals to form amalgam. Perhaps, the text *Ayurveda prakash* describes it in a non-scientific language as the capacity of mercury (*Parada*) to dissolves all metals.[21] The word *Jarana* denotes the textual meaning of digestion of sulfur in mercury as well as the digestion of different metals in mercury. The former *Jarana* includes *Bali* (synonym for *Gandhaka*) *Jarana* (*Samguno to Shadguna*, i.e. 1:1 to 1:6) while the later includes 13th *Samskara* of *Parada*. The term *Jarana* is also included for incineration in the context of *Puti louha*. In the context of *Parada*, *Gandhaka Jarana* process ultimately converts *Parada* into a compound which is useful for therapeutic purposes, whereas *Jarana* as 13th *Samskara* takes *Parada* a potent *Rasayana* in respect of therapeutics and thermostable (*Pukhkshachchhina*) for therapeutic as well as alchemical purposes. In *Jarana*, it may be that some changes in atomic structure which cannot be explained scientifically. Among *Astagasha Parada Samskara*, i.e., processes for potentiation of mercury, the *Grasamana*, *Charana*, *Garbha druti*, and *Bahya druti* are meant only for *Jarana* of mercury, i.e., to assimilate extra appetite in mercury.

**Kajjali**

*Kajjali* (black sulfide of mercury) is a preparation which is made either triturating *Parada* (mercury) with *Gandhaka* (sulfur) alone in different proportions[3] or *Parada* (Mercury) with *Gandhaka* (Sulphur) along with other metals and minerals[4] without using any liquid and is converted into very soft powder, just like collyrium. The *Kajjali* when used properly along with other metals or herbs can cure all the diseases, pacify all the three humors (*Tridodhahara*), increases *Shukradhatu* (*Vrishya*), immediately spreads in the body when consumed, clears the obstructed channels at the diseased organ, and enhances the properties of other metallic or herbal medication when taken along with proper Anupana.[22,23]

**The Effects of Gandhaka Jarana in Different Proportions**

Sulfur can be added to mercury either in equal quantity, i.e., 1:1 or half quantity (1:1/2) or even in* ratio as 2, 3, 4, 5, 6 parts, and so on, i.e., in various proportions. *Samaguna Gandhaka Jarana* (equal part), *Dviguna* (double), *Shadaguna* (6 times), *Ashtaguna* (8 times), *dwadasha guna* (12 times), *Shataguna* (100 times), and *Sahasraguna* (1000 times) are therapeutically superior in increasing order of *Jarana*.[24]

Hence, according to *Ayurveda*, more the sulfur content safer and effective is the mercurial medicine.


<table>
<thead>
<tr>
<th>Samaguna</th>
<th>Dwiguna</th>
<th>Triguna</th>
<th>Chaturguna</th>
<th>Panchaguna</th>
<th>Shadaguna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of sulfur</td>
<td>Effects produced as per Rasendra Chintamanī[^25]</td>
<td>Effects produced as per Rasa Tarangini[^26]</td>
<td>100 times more potent than purified Mercury (Shodhita Parada)</td>
<td>Cures all types of skin diseases (Kustahāra)</td>
<td>Cures all types of sharira jadata (Śarva Jādyā Vinashanā)</td>
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<td></td>
<td>Cures only the common ailments</td>
<td></td>
<td>Cures all types of skin diseases (Kustahāra)</td>
<td>Cures phthisis (Kshaya roga), Enhances potency (Purusatva prakashana)</td>
<td>Cures all types of chronic ailments</td>
</tr>
<tr>
<td></td>
<td>Cures Maha roga</td>
<td></td>
<td>Improves enthusiasm (Utsaha), Intellect (Medha), and Memory power (Smriti)</td>
<td>Cures all types of chronic ailments</td>
<td>Sarvarogahara (cures all types of diseases)</td>
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<td>Brings extraordinary powers</td>
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**DISCUSSION**

*Kajjali* is the base material and is used in maximum formulations of Indian system of medicine. It is more common and popular in day-to-day practice as it is very easy to prepare and very safe to use. When used internally, it does not produce any toxic effects in the body. Organic mercury such as methyl mercury and ethyl mercury is found to be 5000 times more toxic than inorganic mercury like sulfides of mercury.[^27] Only minimum amount of mercury is absorbed from inorganic mercury.[^21]

Mercury is widely used in Ayurvedic drugs in the form of mercuric sulfide (HgS), an inorganic compound of mercury. Rarely, other inorganic compounds of mercury such as mercuric chloride are used. Such use is restricted and always advocated with a specific caution regarding its toxicity. It is a well-known fact that negligible amount of sulfide compounds of mercury is absorbed through gastrointestinal (GI) tract and hence is non-toxic in nature. The ancients brilliantly overcame the problem of mercury toxicity by severely reducing its bioavailability through the use of sulfur. Intimate mixing of purified mercury and sulfur to prepare the *Kajjali* is the first step in the preparation of any herbomineral preparations (Rasaushadhi). As mentioned before, the compound of mercury and sulfur is prepared in many ways, but one always finds the use of excess sulfur in the preparation of a form called *Kajjali*, more than required for the stoichiometric preparation of HgS (approximately sulfur at 1/6 of the weight of mercury). The idea behind use of higher ratios of sulfur in the preparation of *Kajjali* could be to prevent oxidation as well as to make available more sulfur.[^28] Thus, chances of toxicity from *Kajjali* formulations are very negligible or nil since long time these medicines are being used in traditional systems of medicine. Moreover, the methodology adopted in processing of mercury is so unique that it is treated with materials that reduce toxicity of the same. For example, in *Ayurveda* for purification (Shodhana) of mercury, *Allium sativum* (Rasona) is used. For almost all procedures of mercurial processing, sour gruel (*Kanjī*) is used, such as heating, boiling in liquid bath, grinding, sublimation, and distillation.[^29] *Rasasindura* and *Kajjali* both contain sulfur that reduces toxicity of mercury.[^30] Mercury whether it is purified extracted from Cinnabar (Hingulotha) or subjected for 8-fold of process/Samskar (Ashtha samaskritita), it is not going to have the complete therapeutic potency in it without undergoing *Muruchana*.[^31] Standardized the administered form of mercury as HgS, one of the least soluble substances. The KSP of HgS is 1 × 10⁻⁵⁴. Thus, the quantum of mercury ions that would be available on the administration of mercury as sulfide can be much below the threshold of toxic limit. However, HgS may be more soluble in the GI tract due to the action of digestive enzymes, changing pH conditions, and complexation with other biomolecules present in the food.[^28] In another study related to immobilization and disposal of mercury, detailed observations on the process of mixing mercury and sulfur have been reported, using X-ray diffraction and electron microscopy, as a function of grinding time. The grinding process slowly forms metacinnabar (black HgS) and up to 60 min of grinding, globules of mercury could be found to be present, using electron microscopy. After 90 min, free mercury could not be found, but the most important observation is the formation of particles containing 2–15 weight% of mercuric oxide after 120 min of grinding. It is also found that the HgS particles are surrounded by sulfur particles.[^31] *Rasasindura* that contains *Kajjali* has been trialed and was found to be non-toxic under therapeutic doses.[^32] *Yogavaahitva* an unique attribute of mercury[^33] substances possessing “*Yogavaahit*” characteristics when combined with others besides maintaining their own activity, increase the therapeutic activity of the other substance many folds. This is one of the reasons why the dose of the drug and time required for the onset of action is considerably reduced by mercurial compound.[^34] Thus, mercury enhanced the bioavailability of the drug. *Kajjali* has excess sulfur and is reported to contain free sulfur, trapped in the crystal lattice of HgS. Sulfur is a very important nutrient and many biomolecules such as methionine, cysteine, cystine, taurine, and antioxidant enzymes such as glutathione and many more, contain sulfur. *Kajjali* containing medicines may induce the (excess) synthesis of these sulfur-containing biomolecules in human systems. Antioxidants are the cell protectors against free radical-induced cell damage, and it is quite possible that the rejuvenating effects and the reversal of aging effects. The antioxidants themselves could be the curative agents while mercury could serve as a transient catalyst.[^35,36] According to *Rasa tarangini*, *Kajjali* can be used with different herbs to get optimum result. The paste prepared in milk of *Calotropis procera* (Arka) using equal proportion of *Kajjali* and

[^25]: Joshi, et al.: Critical review on the concept of Kajjali
[^26]: Joshi, et al.: Critical review on the concept of Kajjali
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[^36]: Joshi, et al.: Critical review on the concept of Kajjali
Saindhava lavana, is useful for cervical lymphadenitis/Scrofula or (Gandamala).[37] For Malaria (Sannipatika Jwara), Kajjali mixed with purified As2S3 (Shuddha Haratala) along with Piper nigrum (Maricha) and Aconitum ferox (Vatsanabhâ) or with Tamra bhasma triturated in juice of Azadirachta indica (Nimba swarasâ) may be used. With cuttlefish bone (Samudraphena),[40] it is prescribed in Pitta kapha jwara. For Krimijanya hridroga, Kajjali along with Abhraka bhasma levigated in decoction of Terminalia arjuna (Arjuna kwath)[41] is beneficial while for Kapha prakopaka, Kajjali, Lauha bhasma, and Pippali churna in honey (Madhu)[42] are prescribed. For various skin troubles including itching (Kandu) and scabies (Pama), Kajjali may be given with liquid extract of Datura metel leaves (Datura patra swarasâ) or with liquid extract of Phalambago zeleynicum (Chitraka Swarasâ).[43] For Syphilis (Upadansha), Dwigna Gandhaka jariya Kajjali is given with clarified butter.[44] For testicular swelling (Muska soshâ) Kajjali with Swarna bhasma and powder of Boerhavia diffusa (Punarnava churna) may be given.[45] For blood dyscrasias (Rakta pitta), Kajjali is advocated either with Emblica officinalis (Amalaki), Piper longum (Pippali), and juice of Adhatoda vasica (Vasa swarasâ)[46] or with Swarnamakshika bhasma and honey (Madhu).[46] For respiratory trouble such as breathlessness and cough (Swasa/Kasa), Dwigna Gandhaka jariya Kajjali is given with Ocimum sanctum (Tulasî), Glycyrrhiza glabra (Mulethî), Adhatoda vasica (Vasa), Piper longum (Pippali), Terminalia chebula (Haritaki), and Terminalia bellerica (Bibhitaka).[47] For night discharge (Swapnâmeha), Kajjali is prescribed together with seeds of Elettaria cardamomum (Elâ Beej), Papaver somniferum (Aphîhena), Cinnamomum camphora (Kapoor), Myristica fragrans (Jaïphal), and Syzygium aromaticum (lavanga).[48] For Vata roga, Kajjali is given with (Triphala churna), purified Conipharra mukul (Shuddha Guggulu) triturated in oil of Ricinus communis (Eranda taila).[49] For Vanama, Kajjali in combination of Elettaria cardamomum (Elâ), Piper nigrum (Maricha), Syzygium aromaticum (Lavanga), Cinnamomum camphora (Kapoor), Cyperus rotundus (Mustaka), and Ziziphus mauritiana (Bidara) along with honey (Madhu)[46] is prescribed. For erysipelas (Visarpâ), Dwigna Gandhaka jariya Kajjali is given with leaf extract of Momordica charantia (Karavellaka patria swarasâ).[50] For abscess (Vidradhi), Kajjali is either given with Varunadi kashaya or given with liquid extract of Moringa oleifera (Sahajana swarasâ) mixed with honey (Madhu).[51] Henceforth in clinical practice, it is watched that “timed release and sustained release” speculations of drugs triturated with Kajjali are more than the drugs without Kajjali. Trituration of herbal powders with Kajjali draws out the structure of the compound as different layers of herbal therapeutic standards with inert molecular layer of Kajjali, and this formation of chemically organized alternate layers of Kajjali and herbal compounds continues proportionally with that of continued Mardana. Sustained release of Kajjali compounds in GI tract undergoes the process of adsorption and hence also acts as GI stimulant. Pharmacological activity of such a compound can be still better observed. Effective dose of active drug when consumed will be gradually released, adsorbed, and later on acts as per the requirement at target cell. At the point when the plasma concentration of effective drug decreases, quickening of active drug happens through biofeed system. In between these two phases, the inert drug - Kajjali will be slowly stimulating the local membrane enzymatic axis, means, and effective drug dose decline is followed by inert drug release which when declines, again active drug is biochemically signaled for release.[51]

CONCLUSION

Ayurveda encompasses the use of multiple compound formulations known as Rasa kalpas to provide a near immediate relief. However, a detailed study is need of hour to check the pharmacodynamic as well as pharmacokinetics of these Rasa kalpas and, in particular, the Kajjali, i.e., the mercury-sulphur compound to understand its role on the organs and genetic susceptibility.

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Safety of Ayurvedic medicine

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Abstract

Ayurvedic medicine is one of the world oldest medicine systems. With the increasing use of herbal medicines, its efficacy and safety has become a major concern for health authorities. The WHO estimates that 4 billion people about 80% of world population use Ayurvedic medicine for some kind of primary healthcare. One of the major objectives was to promote safety, efficacy, and quality of Ayurvedic medicine. Research and evaluation of herbal medicines without a long history of use or which have not been previously researched should follow the WHO research guidelines for evaluating the safety and efficacy of herbal medicines. In this melee to show efficacy, several positive results related to safety and other purported advantages with Ayurvedic drugs, including improved quality of life, easy drug availability, and less cost, get drowned. To increase the quality of raw herbal drug results in highly safe and effective and quality herbal products, this would accelerate the global acceptance of Indian system of medicine.

Key words: Efficacy, herbal medicine, safety, WHO

INTRODUCTION

Herbal medicine is the oldest form of healthcare known to the humanity. For this reason, herbal medicine has been used therapeutically all around the world and began an important aspect of various traditional medicine system.[1]

The WHO research guidelines for evaluating the safety and efficacy of herbal medicines can also be consulted for these as well as for other appropriate toxicity tests. Only when there is no documentation of long historical use of an herbal medicine, or when doubts exist about its safety, should additional toxicity studies be performed. Where possible, such studies should be carried out in vitro. Using in vitro tests can be reducing the number of in vivo experiments. If in vivo studies are needed, they are to be conducted humanely, with respect for the animals’ welfare and rights. Toxicity studies should be conducted in accordance with generally accepted principles, such as those described in WHO research guidelines for evaluating the safety and efficacy of herbal medicines.[2]

Currently, an issue is raised with respect to increasing reports of adverse drug reaction related to herbal medicines labeled as alternative medicine and Ayurveda.[1,4]

Today, a need to establish the safety of Ayurvedic medicines has been a challenge posed to the Ayurvedic fraternity. A Bheshaja (drug) forms the prime limb among the Chikitsa Chatushpada (four-fold treatment). Bheshaja includes drugs of herbal, mineral, and animal origin. Each drug (medicine) is procured after proper identification and authentication and is processed in view of its purification thus enhancing the therapeutic properties.[5]

Although safety is supreme, drug trials in real life are highlighting efficacy more than safety. Hence, this study was envisaged, keeping in view, the safety of Ayurvedic medicines as it is equally important in the treatment of disorders requiring long-term management.[6]

MATERIALS AND METHODS

In general, the traditional procedure-based therapies are relatively safe, if they are performed properly by well-trained practitioners. Reported and documented side effects of a herb or herb mixture, its closely related species, constituent of the herb and its preparation/finished herbal products should be taken into account when decisions are made about the need for new pharmacological or toxicological studies. The absence of any reported or documented side effects is not an absolute assurance of safety for herbal medicines. Tests which examine effects that are difficult or even impossible to detect clinically should be

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encouraged. The WHO research guidelines for evaluating the safety and efficacy of herbal medicines can also be consulted for these as well as for other appropriate toxicity tests.[7]

Herbal medicines are generally regarded as safe based on their long-standing use in various cultures. However, there are case reports of serious adverse events after administration of herbal products. In a lot of cases, the toxicity has been traced to contaminants and adulteration. However, some of the plants used in herbal medicines can also be highly toxic. As a whole, herbal medicine can have a risk of adverse effects and drug-drug and drug-food interactions if not properly assessed. Assessment of the safety of herbal products, therefore, is the priority in herbal research. There are various approaches to the evaluation of the safety of herbal medicines. The toxic effects of herbal preparation may be attributed mainly to the following:

- Inherent toxicity of plant constituents and ingredients
- Manufacturing malpractice and contamination.
- Requirements for pharmaceutical assessment that cover the safety assessment of herbal products are as follows:
  - Experience of safety
  - Toxicological studies, where vindicated.[2]

For herbal products, analysis of the active pharmaceutical ingredients may be best approached by analysis of one or more hypothesized active ingredients, analysis of a chemical constituent that constitutes a sizeable percentage of total ingredients, and chemical fingerprinting of ingredients.

Assessment of Safety

This should cover all the relevant aspects of the safety assessment of a medicinal product.

- Specifications of safety parameters.
- Methods and periodicity for assessing and recording safety parameters.
- Procedures for eliciting reports of and for recording and reporting adverse drug reactions and/or adverse events and intercurrent illnesses.
- Type and duration of the follow-up of the participants after adverse events.
- Information on establishment of the study code, where it will be kept and when, how and by whom it can break in the event of an emergency.[9]

DISCUSSION

Most of the Ayurvedic medicine contained metallic/mineral components; there were no changes in the safety profile as they complied with good manufacturing practice standards. However, the toxicity of the metallic preparations as mentioned in the other contexts could be due to the following reasons:

- Drug interaction (viruddha dravya prayoga)
- Iatrogenic (Vaidhya kruta)
- Overdose (At imatra dravya prayoga)
- Admiration of unwholesome drugs (Ahitam dravya)
- Therapeutic procedural complications (Panchakarmavyapad)
- Improper use of Rasaushadhi (medicines of mineral origin).[9]

According to Ayurveda, the formulations contain heavy metals for producing a different effect such as enhancement of bioavailability of herbs, as a carrier for active principle, and as a catalyst. The metals which have been transformed to non-toxic forms are safe for internal use. After performing the desired action, these metals are eliminated from the body through the excretory system.[10]

CONCLUSION

To sum up, herbomineral preparation is safer for both short term and long term, if each drug (medicine) is procured after proper identification, authentication, and prepared under proper guidance of wise physicians. Further exploration with larger samples appears necessary to seal the issue.

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A review on *Yusha Kalpana*

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**Abstract**

In recent decades, there is a sharp increase in lifestyle disorders such as diabetes, obesity, and cardiovascular diseases due to changing dietary habits and increasing sedentary lifestyle. Therefore, we need to be more careful about diet and habits. Since thousands of years, Ayurveda practices Ahara Kalpana for maintaining health and also for prevention and cure many diseases. A set of Ahara Dravya such as Shuka Dhanya and Shimbi Dhanya mentioned in the ancient text. Several pharmaceutical procedures (sanskar) applied on Ahara Dravya to form Ahara Kalpana which are manda, peya, vilepi, yusha, yavagu, etc. Yusha being one of them is broadly discussed in every Ayurvedic literature in almost all the diseases. Yusha is prepared by cooking one part of grain other than rice in 16 parts of water. It can be adopted easily as a routine diet for a prolonged time and prevents the progress of diseases in individuals of any age group. This paper is an effort to provide benefits of *Yusha Kalpana* and explore its therapeutic uses in day to day practice.

**Key words:** Ahara Kalpana, Ayurvedic pharmaceutics, Yusha

**INTRODUCTION**

According to *Charaka Samhita*, the distinction between health and disease arises as the result of the difference between *Pathya* (wholesome) and *Apathya* (unwholesome diet) *Ahara*. Even hundreds of medicines cannot cure a disease in the absence of wholesome regimen. *Ahara* is one of the factors among the three *Upastambha* (*Ahara, Nidra* and *Brahmacharya*) essential for smooth running of life. *Ahara Dravya* are classified by Acharya *Charaka* into 12 subdivisions such as a set of cereals, legumes, fruits, and milk and milk product. *Kritanna Varga* is one of them. *Kritanna Varga* is nothing but a list and properties of different kalpanas made from different *Ahara Varga*. *Ahara Varga* such as *Shuka Dhanya, Shami Dhanya, Mansa Varga*, and *Shaka Varga* cannot be used without applying *Kritanna Varga*. Hence, *Acharyas* have mentioned *Kritanna Varga* to explain the different *kalpana*. It is the group consisting of food preparations such as *manda, peya, vilepi, saktu, odana, yavagu, yusha, veshavara, rasala, roga*, and *shadava*. *Yusha* preparation is one among them. According to *Acharya Kashyapa*, so many substances such as *legume, pulses, vegetables, and meats* are cooked with water except rice is called *Yusha*. All types of *Yusha* are liquid in nature. It is the preparation with a large portion of water and with the ingredients specific to the diseases condition, making it easily available to the system. *Yusha* can also enhance palatability and absorption of drugs added to it. Thus, *Yusha* makes treatment more effective. Thus, this article emphasizes a different type of *Yusha* described in different texts along with their therapeutic effect.

**AIM AND OBJECTIVE**

The aim of this study is to explore a different type of *Yusha* mentioned in various texts, which could be beneficial for a patient suffering from different diseases and also for healthy individuals.

**LITERARY REVIEW**

The word *Yusha* signifies liquefaction and metabolization. The cooked *Yusha* liquefies the diet what we take and digest it. According to Monier William dictionary, *Yusha* means soup, broth or the water in which pulse of various kinds has been boiled. *Soopa* is also a preparation described in many ancient texts which is slightly different from *Yusha*. According to *Acharya Sushruta, Soopa* which has been well cooked and prepared from dehusked and slightly fried grains. It is light and beneficial.

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METHOD OF PREPARATION OF YUSHA

One pala of dravya (such as kulathya and maduga) mixed with half karsha of sunthi and Pippali Churna and boiled in one prashta or 16 parts of water. According to Kairdev Nighantu, Yusha is prepared by cooking one part of grain in 18 parts of water. Acharya Gangadhhar makes a difference between Yusha and Soopa, on the basis of their method of preparation. According to him, slightly fried pulse which is boiled by adding 14 or 18 times of water till half of the liquid remains is called Yusha. When it is cooked till ¼ of liquid remains, it is called Soopa.

CLASSIFICATION OF YUSHA

All types of Yusha can be classified into two, namely, Kashaya with Madhura and Kashaya with Amla. On the basis of addition of Sneha Dravya, Yusha can be classified into three types, namely, Krita yusha for Vata roga, Akritayusha for Kaphajroga, and Akrita - Kritayusha for Pitta roga. On the basis of Veerya of drugs added in it, Yusha is of three types, namely, drug with sheetaveerya causes brihana, drugs with ushnaveerya causes karshana, and drugs with mishra veerya causes pachana. As per classification of doshas, Yusha is 75 in number. Depending on rasa, Yusha is 50 in number. On the basis of ingredients, Yusha is 25 in number which are described in detail in Kashyapa Samhita.

PROPERTIES OF YUSHA

Yusha cooked with various drugs capable of suppressing different diseases. Yusha can be taste enhancer, appetizer, aphrodisiac, improve voice, complexion, strength, and agni, diaphoretic; it brings satisfaction, nourishment, and pleasure. It can bring proper nourishment both mentally and physically giving a sense of comfort. Yusha can suppress all three dosha on the basis of drug added in it. It suppresses Vata Dosha due to snigdha and usna properties, suppresses pittadosha due to sneha and kashaya nature, and sesuppresses kaphadosha due to ushna and katu properties.

Yusha described in Table 1 below with their ingredients and therapeutic properties and uses.

OTHER USES OF YUSHA

Acharya Charaka mentioned in ritucharya that Yusha mixed with jangalamsarasa should be taken in rainy season. Yusha is said to be taken as Anupan in tailapanda and while takin Gamalaka Rasayana and Haritakyadi Yoga. Bhallataka Rsayana can be taken in the form of Yusha to reduce its toxic effects on the body. For the alleviation of jwara, if kapha is dominant, then Yusha should be used as a meal for 10 days.

Yusha is widely used for administration of unpalatable drugs for purification therapies and also indicated as a diet before and after purification therapies:

- Oleation therapy: Yusha is one among 24 kinds of snehana methods.
- Emesis therapy: Madanaphala can be used in the form of Yusha for Yamana therapy.
- Snigdha, amala, lavana, and Hridhya Yusha are advised in hyperemesis complication.
- Purgation therapy: Sudha can be used in the form of Yusha for purgation therapy. Masha and Kulattha Yusha is indicated in over purgation. As a diet while taking purgative medicines such as Trivrutadi Virechana Yoga Churna and Danti Dravanti Mula Kwatha.

Medicated enema: Yusha with amala and Lavana Dravya is indicated in the conditions of Udararoga during their treatment through Vasti therapy.

For Sansarjan karma: After the body is cleansed by panchkarma therapies, the patient should be provided with the food such as manda, peya, vilepi, akrita - krita yusha, and akrita - krita mansa rasa. Yusha of husk free maduga, virasika (Yusha of maduga and takramla), Dadima Yusha, and Dhatri Yusha can be used after purification. Yusha mixed with dadhi, kanjika, sukta, and Deepan Dravya is contraindicated for this purpose.

Miner surgical procedures - Yusha is suggested during Agnikarma in Pleehodararoga.

DISCUSSION

There is a large number of Yusha found in every classic and in almost all the disorders. Most of the Acharya described Yusha under Kritanna Varga, but Acharya Kashyapa describes it as separate chapter. Yusha Kalpana has been described in Kashyapa Samhita with a specific aim. Yusha is more liquid in nature. Due to liquid consistency, Yusha can be used widely in pediatric age group patient. Yusha and Soopa are two preparations given by Acharya Charaka which looks similar, but there is the difference between them. Acharya Charaka has not mentioned their method of preparations. The method of preparation of Yusha is described in Sharngadhara Samhita and Kairdev Nighantu. Acharya Gangadhhar makes a difference between Yusha and Soopa, on the basis of the method of preparation. The property of Yusha is greater than that of Soopa because it is formed by the combination of various substances. In the present scenario, Yusha is compared with soup formed by the combination of different vegetables, etc.

Ayurveda gives more importance to digestion of food in comparison to nutrition. It is believed that only properly
## Table 1: Ingredients, therapeutic properties and uses of different Yusha

<table>
<thead>
<tr>
<th>Name of Yusha</th>
<th>Ingredients</th>
<th>Therapeutic property and uses</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chitraka Yusha</td>
<td>Chitraka</td>
<td>Pacify kapha and Vata Dosha. Enhance agni in disease such as Grahani Dosha, Pleeha Roga, arsha, guima, kushtha, and hridrog</td>
<td>Kashyapa Samhita Khi. 4/38-40</td>
</tr>
<tr>
<td>Panchkolaka Yusha</td>
<td>Sati, karkataki, bilva, ajashringi, Pushkar Dhataki, dadhitth, dadima, changeri, and samanga</td>
<td>Grahi Cures atisara, grahani, pravahika in niarama condition.</td>
<td>Kashyapa Samhita Khi. 4/40-42</td>
</tr>
<tr>
<td>Dadhimanda and Takra Siddha Yusha</td>
<td>Any Shimi Dhany+Dadhimanda and takra</td>
<td>Pathya in Shira, chakshu, kama and hridroga, and ardhavahbedaka. Cures aruchi and atisara if taken with tila and masha</td>
<td>Kashyapa Samhita Khi. 4/44-45</td>
</tr>
<tr>
<td>Phala Yusha</td>
<td>Unripe fruits of kapittha, bilva, badara, dadima, and aamra</td>
<td>Cures chronic atisara</td>
<td>Kashyapa Samhita Khi. 4/46-47</td>
</tr>
<tr>
<td>Pushpa Yusha</td>
<td>Decoction of flower of sana, shalami, dhataki, padma, saugandhika, kovidara, and karbudara</td>
<td>If cooked with dadima without sneha and amala dravya, cures Asrigdara, Raktapitta, and daah</td>
<td>Kashyapa Samhita Khi. 4/47-49</td>
</tr>
<tr>
<td>Patra Yusha</td>
<td>Decoction of leaves of bilva, sobhanjana, eranda, bala, raasna, and aamra</td>
<td>Eradicates Vata Dosha</td>
<td>Kashyapa Samhita Khi. 4/49-50</td>
</tr>
<tr>
<td>Valka Yusha</td>
<td>Decoction of bark of dadima, aamra, jambu, and chirabilva with dadhimanda</td>
<td>Cures atisara</td>
<td>Kashyapa Samhita Khi. 4/50-51</td>
</tr>
<tr>
<td>Pallava Yusha</td>
<td>Decoction of tender leaves of nyagrodha, udumbara, plaksha, palasa, and kamal</td>
<td>If cooked with ghrita and dadima, Cures garbhapatia, and daah</td>
<td>Kashyapa Samhita Khi. 4/51-53</td>
</tr>
<tr>
<td>Vatahara Yusha</td>
<td>Yusha of punarnava, raasna, changeri, and bala prepared separately with dadhi and ghrita</td>
<td>Eradicate vata dosha</td>
<td>Kashyapa Samhita Khi. 4/53-54</td>
</tr>
<tr>
<td>Kambalika</td>
<td>Rohita fish cooked decoction cooked with 1 kudava of supta, kanji, Dadhi Mastu, and 5 Pala Guda (jaggery).</td>
<td>Brighana, balya in nature and pacify vata dosha. If cooked with tila tail, enhance rati (sexual pleasure), nidra, and ruchi (appetite)</td>
<td>Kashyapa Samhita Khi. 4/54-57</td>
</tr>
<tr>
<td>Maha Yusha</td>
<td>Decoction of Deepaneeya Panchmoola, fruits of Madhura Gana Dravya, all dhanya, dhanyaka, maricha, and kakoli etc. + dadhi, kanji + tail, ghrita + Moolaka + trikatu</td>
<td>Pacify all three doshas. Cures atyagni, anidra, stabdhita, atisara</td>
<td>Kashyapa Samhita Khi. 4/57-63</td>
</tr>
<tr>
<td>Lasuna Yusha</td>
<td>Lasuna</td>
<td>Cures Bhagna, all Vataj Roga, kaas, kushtha, kilasa, krimiroga, gulama, and Jeerna Jwara</td>
<td>Kashyapa Samhita Kalg. 2/26-27</td>
</tr>
<tr>
<td>Moolaka Yusha</td>
<td>Kulattha and moolaka</td>
<td>Can cure all the diseases. Specially Ajeerna and rajyakshma</td>
<td>Kashyapa Samhita Khi. 4/65-66 and Ch. Chi. 8/68</td>
</tr>
<tr>
<td>Mansa Yusha</td>
<td>Meat of laavaka (quail)</td>
<td>Mixed with ghrita, without Amla Dravya pacify pitta dosha and with Sneha Dravya pacify Vata Dosha</td>
<td>Kashyapa Samhita Khi. 4/66-67</td>
</tr>
</tbody>
</table>

(contd...)
<table>
<thead>
<tr>
<th>Name of Yusha</th>
<th>Ingredients</th>
<th>Therapeutic property and uses</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudga Yusha</td>
<td>Mudga, saidhava lavana, sunthi, dhanyaka, pippali, and jeeraka</td>
<td>Pacify kapha and Pitta Dosha. Pathya in hridroga, raktapitta, trishna, daah, jwara, vrina, Urdha Jatragata Roga, and increases agni</td>
<td>Kaiyadeva Nighantu 5/65-66</td>
</tr>
<tr>
<td>Masooradi Yusha</td>
<td>Masoora, mudga, godhuma, kulattha, and lavana</td>
<td>Pacify Vata Dosha. Does not increases pitta and Kapha Dosha</td>
<td>Kaiyadeva Nighantu 5/69</td>
</tr>
<tr>
<td>Mridwikadi Yusha</td>
<td>Mridwika, Dadima, and 5 lavana</td>
<td>Pathya for aruchi, hridroga, and vataroga</td>
<td>Kaiyadeva Nighantu 5/70</td>
</tr>
<tr>
<td>Kulattha Yusha</td>
<td>Kulattha</td>
<td>Pacify tridosha and causes rukshana. Cures gulma, arsha, prameha, medaroga, ashmar, sharkara, kaasa, shwasa, and tuni-pratuni.</td>
<td>Kashyapa Samhita Khi. 4/4546 Kaiyadeva Nighantu 5/76-77</td>
</tr>
<tr>
<td>Adhaki Yusha</td>
<td>Adhaki</td>
<td>Pacify all three dosha. Cures jwara, kaasa, shwasa, raktagata vyadhi, peenasa, and krimiroga.</td>
<td>Kaiyadeva Nighantu 5/78</td>
</tr>
<tr>
<td>Chanaka Yusha</td>
<td>Chanaka</td>
<td>Pacify all three dosha. Cures kaas, shwasa, pratisyaya, and raktapitta.</td>
<td>Kaiyadeva Nighantu 5/79</td>
</tr>
<tr>
<td>Masoora Yusha</td>
<td>Masoora</td>
<td>Grahi and brihana in nature and cures prameha</td>
<td>Kaiyadeva Nighantu 5/80</td>
</tr>
<tr>
<td>Maasha Yusha</td>
<td>Maasha</td>
<td>Vitiate all three dosha. Increases Sukra Dhatu and increases mala in koshtha</td>
<td>Kaiyadeva Nighantu 5/80-81</td>
</tr>
<tr>
<td>Nishpaav Yusha</td>
<td>Nishpaav</td>
<td>Pacify Kapha Dosha. stanyajanana</td>
<td>Kaiyadeva Nighantu 5/81</td>
</tr>
<tr>
<td>Panchmushthika Yusha</td>
<td>Yava, kola, kulattha, mudga, and moolaka</td>
<td>Pacify all three dosha. Cures shoula, kaasa, shwasa, gulma, kshaya, and jwara</td>
<td>Kaiyadeva Nighantu 5/82-83</td>
</tr>
<tr>
<td>Navanga Yusha</td>
<td>Mudga, kola, pippali, shunthi, amalaki, moolaka, kulattha, and tandula</td>
<td>Pacify pitta and Kapha Dosha</td>
<td>Kaiyadeva Nighantu 5/84</td>
</tr>
<tr>
<td>Mudga Amlaka Yusha</td>
<td>Mudga and amalaka</td>
<td>Pacify pitta and Kapha Dosha and cures constipation and pathya for Visha Rogi</td>
<td>Kaiyadeva Nighantu 5/86 and Ch. Chi. 23/226</td>
</tr>
</tbody>
</table>

(Contd...)
digested food can provide proper nutrition to the body. *Yusha* being liquid in nature, can be easily digested and also enhance *agni* for digestion of other substance as well. It can also enhance the palatability of medicine and make *katu, Tikta Dravya* more acceptable for the patient. This preparation is a better option for patient of pediatric age group or mental patient to administered drugs. It also excludes harmful and poisonous effect of drug. It also checks irritation and burning that occurs after administration of *ushna* and *teeksha* drugs.

Acharya Charaka classify *Yusha* into two types, i.e., *Krita Yusha* and *Akrita Yusha*, on the basis of addition of *Lavana Katu* and *sneha* substances in it. *Akrita Yusha* should be used in those patients who have very poor digestive power or weak due to chronic disease. *Acharya Kashyapa* gives a very detailed description of *Yusha*. He made several classifications of *Yusha*. First one is of two types, i.e., *Kashaya-madhura* and *Kashaya-amala*. *Kashaya-madhura Yusha* can be prescribed in weak patient or inpatient of *Rakta Pitta, Rakta Atisara, rakta aruchi, visharpa, etc.*, and *Kashaya-amala Yusha* prescribed in patient of *aruchi, chhardi, atisara, etc.* These classification mentioned in *Kashyapa Samhita*, helps us in deciding type of *Yusha* for particular disease or individual.

*Khada* and *kambalika* are types of *Yusha* described by many Acharyas. *Acharya Chakrapani* and *Dalhana* considered *khada* as a preparation of *Yusha* mixed with vegetables and pulses, but *Acharya Vagabhata* considered *Khada* as *Yusha* prepared from fruits. *Kambalika* is the type of *Yusha* which is soured with curd water.

There are a number of *Yusha* described in Ayurvedic texts. *Dravya* which is used in the time of *Samhitas* is different, and their preparation methods are also changed. Many classical *dravya* is not in practice today. Therefore, it is intellect of physician to choose the type of *Yusha*, their ingredients, and methods of preparation for the benefit of healthy individuals as well as patients suffering from different diseases.

### CONCLUSION

Description of *Yusha Kalpana* is found in *Brihat-trayi*, but there is a lack in their method of preparations, which is later described by other *Acharya*. Detailed description of *Yusha Kalpana* is found in *Kashyapa Samhita* and *Kaidev Nighantu*. *Yusha* being easy to prepare can be adopted easily by patients of many acute and chronic diseases. *Yusha* is indicated as diet therapy during and after purification therapy, for a person under medication, as an *Anupaan* with many food articles and medicine. *Yusha* being liquid in nature and tasty in taste, it can be very good diet for children. Moreover, it can also be used to enhance the palatability of many drugs. The food we take should be incorporated with *Yusha Kalpana*. It would be more congenial and is advised for both healthy and diseased and is also said as health promotive.

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A phytochemical study of medicinal plant extract

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Abstract

Aim of Study: The aim of this study was the phytochemical evaluation of extract of the Musta, Pippali, Ativisha, and Karkatshringi. All these drugs have been described to have antidiarrheal properties and antimicrobial properties in different texts. Materials and Methods: The dried samples were resuspended in high-performance liquid chromatography (HPLC)-grade methanol for HPLC analysis. Shimadzu LC-10A (Japan) was used that was equipped with dual pump LC-10A binary system. Shimadzu Class VP series software was used to integrate the data separation of phenolics was achieved with acetonitrile/water (1:1 v/v) containing 1% acetic acid in a linear gradient program. The solvent flow rate was 1.0 ml min\(^{-1}\). Results: In phytochemical study, six phenolic acids were detected in the four plant samples. Of the six phenolic standards used, Ativisha contained only one phenolic compound, whereas Musta and Pippali contained five compounds. Only two phenolic compounds were detected in Karkatshringi. Of the seven phenolic standards used, Draksha contained four compounds, whereas Vasa and Haritaki contains five compounds while Pippali contains six phenolic compounds. Conclusion: It means Balchaturbhadra yoga having high antioxidant property.

Key words: Balchaturbhadra yoga, high-performance liquid chromatography, medicinal plant, phytochemical

INTRODUCTION

Bacterial pathogens were identified in majority of patients in developing countries. Etiological spectrum varies during different seasons and different geographic settings. In the developed countries, it is estimated that over 50% of acute diarrhea are caused by viruses including Rotavirus, Norwalk virus, and coronavirus. Human Rotavirus is the most important etiological agents of acquired diarrhea in infants and young children worldwide.[1] The bacterial agent that is known to cause diarrhea is Escherichia coli (20% of all cases of acute diarrhea are due to E. coli, V. cholerae (cholera accounts for 5–10% cases), Clostridium difficile, Shigella, Salmonella (3–7% of childhood diarrhea), Campylobacter; and Yersinia enterocolitica.[2]

Diarrhea is the third most common cause of death in under-five children, responsible for 13% of deaths in this age group, killing an estimated 300,000 children in India each year.[3] Infectious diarrhea is considered the second most common cause of morbidity and mortality worldwide.[4] Global annual burden of diarrhea is huge affecting 3–5 billion cases and causing approximately 2 million deaths a year.[5] Overall, the prevalence being significantly higher in children <2 years as compared to those 2–5 years.[6] Mostly, acute diarrhea is infectious in origin in childhood. Bacterial pathogens were identified in the majority of patients in developing countries. Etiological spectrum varies during different seasons and different geographic settings. Diarrheal disease remains an important cause of death and morbidity in developing countries with an estimated 1.5 million episodes and 1.5 million–2.5 million deaths each year among children younger than 5 years.[7] It still continues to be a major cause of hospitalization and death in <5-year-old children and has severe economic consequences.[8]

The present study was conducted to investigate phytochemical study of extract of the Musta, Pippali, Ativisha, and Karkatshringi. All these drugs have been described to have antidiarrheal properties and antimicrobial properties in different texts. The present in vitro study was initiated to evaluate the efficacy of these drugs, which may help in ascertaining the mode of action as well as further specific use of the present combination in future in vivo studies.

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Phone: +91-9415624827. E-mail: psupadhyay08@gmail.com
MATERIALS AND METHODS

Plant Materials

For this study, fruits of *Piper longum* L., rhizome of *Cyperus rotundus* L., root of *Aconitum heterophyllum*, and galls of *Pistacia integerrima* were collected from Haridwar, Uttarakhand. The plant was identified and authenticated by the Professor N. K. Dubey, Department of Botany, Banaras Hindu University, Varanasi, with the voucher specimen no:


Preparation of Extracts

For the study, dry extract of each drug was prepared in the laboratory of the Department of Medicinal Chemistry, IMS, BHU. Aqueous extract of drugs was prepared by water decoction method and alcoholic extract was prepared by Soxhlet method of extraction. Both the extracts were collected in separate sterile vials and preserved at 4°C temperature.

The phytochemical study was carried out in the Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, BHU, Varanasi. The dried samples were resuspended in high-performance liquid chromatography (HPLC)-grade methanol for HPLC analysis. Shimadzu LC-10A (Japan) was used that was equipped with dual pump LC-10A binary system, UV detector SPD-10A, and Phenomenex (Torrance, USA) C18 column (RP-Hydro, 4 μm, 250 mm × 4.6 mm). Shimadzu Class VP series software was used to integrate the data. Separation of phenolics was achieved with acetonitrile/water (1:1 v/v) containing 1% acetic acid in a linear gradient program (Singh *et al.*, 2009). The solvent flow rate was 1.0 ml min⁻¹.

OBSERVATIONS AND RESULTS

Concentration of the phenolic compounds in the four plants is as follows:

Table 1 shows that six phenolic acids were detected in the four plant samples. Of the six phenolic standards used, *Ativisha* contained only one phenolic compound, i.e. shikimic acid, whereas *Musta* and *Pippali* contained five compounds as shown in the table. Syringic acid was not detected in *Musta* and quercetin was not detected in *Pippali*. Only two phenolic compounds, i.e., syringic and cinnamic acids were detected in *Karkatshringi*.

DISCUSSION AND CONCLUSION

In phytochemical study, of the six phenolic standards used, *Ativisha* contained only one phenolic compound, i.e., shikimic acid, whereas *Musta* and *Pippali* contained five compounds as shown in Table 1. Syringic acid was not detected in *Musta* and quercetin was not detected in *Pippali*. Only two phenolic compounds, i.e., syringic and cinnamic acids were detected in *Karkatshringi*. The beneficial effects derived from phenolics compounds have been attributed to their antioxidant activity.[⁹] It means *Balchaturbhada yoga* has high antioxidant property.

REFERENCES


Source of Support: Nil. Conflict of Interest: None declared.
Biological activity and medicinal uses of neem

Renu Srivastav, Vandna Pathak
Department of Physical Sciences, Mahatma Gandhi Chitrakoot Gramoday Vishwavidyalaya (Behind of Mission Hospital Karwi), Satna, Madhya Pradesh, India

Abstract
Neem has become valuable tree in the world which shows the solution for many problems. Neem is an evergreen tree which is native of India, Africa, and Bangladesh. Neem shows various biological activities such as antibacterial, antimalarial, antiulcer, and anticancerous activities. This review article focuses on antifungal and antibacterial activity.

Key words: Antibacterial, biological activities, evergreen tree, neem

INTRODUCTION
In human society from immemorial medicinal plant has played an important role in prevention and control of diseases (Chibber S and Sharma N). Neem is very common tree in India. It is large evergreen dense tree some 10–15 m tall (Shrivastava et al.). Azadirachta indica is rapidly growing evergreen plant found in America, Africa, and India (Pingale Sirish et al.).[1] A. indica has been used for their healing powers since ancient time (Pratibha Prasharar). Neem tree has attracted worldwide prominence showing to its wide range of medicinal properties.

Taxonomy
Kingdome - Plantae
Division - Magnoliophyta
Class - Magnoliopsida
Order - Sapindales
Family - Meliaceae
Genus - Azadirachta
Species - A. indica.

MEDICINAL USES
1. Cough, fever, loss of appetite, and worm infections.
2. Used in vomiting, skin diseases, and reduces high blood pressure.
3. Used to treat arthritis, malaria, diabetes liver disease, and cancer.
4. Remove toxins, purify blood, and prevent damage caused by free radical in the body neutralizing them.

ANTIBACTERIAL ACTIVITY
The in vitro effect of crude extract of leaves of A. indica in ethanol hexane and ethyl acetate gave varied result for various microbes such as Escherichia coli, Pseudomonas, Bacillus subtilis, and Staphylococcus aureus. Ethanol extract found most effective for all microbes, whereas ethyl acetate extract showed minimum antimicrobial activity.[2] Neem extract of methanol, hexane, and chloroform was compared with penicillin. Hexane extract of neem found effective against Proteus vulgaris and Micrococcus leuteus, and Streptococcus showed maximum inhibition zone 18.33 mm. The maximum inhibition zone showed by chloroform against Proteus vulgaris is 31 mm and maximum inhibition zone showed by methanol extract is 33 mm.[3] Leaf and bark aqueous and alcohol extract of A. indica were tested against E. coli and Staphylococcus, and it was reported that ethanol extract effective than aqueous extract against microbes.[4] Leaf, bark, and seed aqueous extract were tested against various bacteria and reported that the aqueous extract of neem leaf exhibited highly antibacterial.[5]

ANTIFUNGAL ACTIVITY
Methanol extract of neem showed recorded mycelium growth again three species of fungi are Aspergillus viridae,

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Penicillium digitatum, and Rhizopus which separated by tomatoes. The maximum inhibition zone showed in all fungi at 20% concentration and minimum inhibition zone in 60% of concentration. The study shows that the effectiveness of extract on the fungi is decreases with increasing the concentration.[6] The extract of methanol and water was compared against Aspergillus and Rhizopus and found that methanol extract shows maximum effectiveness against fungi as compared to water extract.[7] Leaf bark and seed extract were tested against various fungi and reported that the aqueous extract of neem leaf exhibited highly antifungal.[5]

CONCLUSION

A. indica (neem) is a medicinal tree that has been found effective in the treatment of bacterial and fungal disease and revealed antibacterial and antifungal activities. Due to increasing of antibiotics resistant to bacteria and fungus and side effect, neem trees are the best option for medicine. The present study determines that neem has real potential for the treatment of fungal and bacterial infection.

REFERENCES


Source of Support: Nil. Conflict of Interest: None declared.
State of the art toward the management of prameha (diabetes) ascribed by Dhanvantari Nighantu

Roli Sarjuprasad Mishra¹, Anil Kumar Singh¹, Sudheer Kumar Kushwaha², Sapna Chaudhary¹

¹Department of Dravyaguna, Faculty of Ayurveda, I.M.S., B.H.U., Varanasi, Uttar Pradesh, India, ²Department of Shalakya Tantra, Faculty of Ayurveda, I.M.S., B.H.U., Varanasi, Uttar Pradesh, India

Abstract

At the present time a major population of the world, as well as our country, is suffering from a serious metabolic syndrome - diabetes. Allopathic drugs are having a limitation on the management of diabetes (Prameha) because there are so many adverse effects, so we cannot use these medicines for a long time. We found that there is a need of some search for herbal remedies in ayurvedic scripture like Dhanvantari Nighantu for the treatment of this life-threatening disease. Dhanvantari Nighantu contains total 703 drugs, out of these total 17 drugs having Pramehaghna (anti-diabetic) property which belongs to different Vargas. The result shows that out of 17 drugs 11 drugs are belonging from Guduchyadi varga (8.5%), 3 drugs are from Suvarnadi varga (1.42%), 2 drugs are from Chandanadi varga (2.53%), and 1 drug from Mishrakadi varga (1.21%). Some of them are useful for pittaj prameha as they are having shita virya and tikta rasa. Some are useful for kaphaj prameha because of their ushna virya. Drugs can be selected on the basis of symptoms or do shik predominance of Prameha vyadhi.

Key words: Ayurveda, Dhanvantari Nighantu, diabetes, Prameha

INTRODUCTION

Dhanvantari Nighantu is one of the important collections of herbs with their properties and synonyms in Ayurveda. This must have been before the 11th century A.D., but some authors said that it might be between 10th and 13th century A.D.⁹ This nighantu is written by Mahendra Bhaugika. In this nighantu, for the first time, the drugs are classified as Aushadhi dravya or on the basis of medicinal property. During this period the numbers of aushadhi dravya were many. It was necessary to have a systematic study of these drugs.⁹ Therefore in this nighantu, the drugs are divided into seven varga on the basis of their action. They are as: Guduchyadi varga, Shatpushadi varga, Chandanadi varga, Karviradi varga, Amradi varga, Suvarnadi varga, and Mishrakadi varga.⁹ In Rajnighantu, Narhari Pandit uttered that a physician without the knowledge of Nighantu, a scholar without the knowledge of Vyakaran and a soldier without Aayadha all these three being laughed at in this world.⁷⁷

According to Acharya Charaka sedentary lifestyle, excessive sleep, meat soup of domestic, aquatic and marshy animals, curd, and other milk products or any other food material which aggravates the kapha dosha are responsible for produce Prameha vyadhi.¹⁻³ According to Laghu Vagbhatta foods, drinks or any other activities which aggravates meda, mutra, and kapha are the main cause for the genesis of Prameha.⁴ Diabetes mellitus is not a single disease, but it is a syndrome which is characterized by hyperglycemia caused by an absolute or relative deficiency of insulin. It is also associated with a disturbance in carbohydrate, fat, and protein metabolism, which leads to disturbance of water and electrolyte homeostasis. Long-term metabolic derangement is associated with structural and functional changes in many organs, especially with those which are the part of the vascular system, which leads to the complications of the diabetes mellitus. These characteristically affect the kidney (diabetic nephropathy), eyes (diabetic retinopathy), and nervous system (diabetic neuropathy).¹⁰

We have done a study and find that 17 drugs from 7 vargas of Dhanvantari nighantu having Pramehaghna (anti-diabetic)

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Table 1: Useful drugs for diabetes according to their varga

<table>
<thead>
<tr>
<th>Name of the Varga</th>
<th>Total number of drugs</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandanadi Varga</td>
<td>Ushira, Jatiphalah</td>
<td>2/79=2.53</td>
</tr>
<tr>
<td>Suvarnadi Varga</td>
<td>Loham, Mandura, Vaikranta</td>
<td>3/211=1.42</td>
</tr>
<tr>
<td>Mishrakadi Varga</td>
<td>Triphala</td>
<td>1/82=1.21</td>
</tr>
</tbody>
</table>

Table 2: Useful drugs for diabetes with special reference

<table>
<thead>
<tr>
<th>Drug name</th>
<th>Family</th>
<th>Action of drug</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guduchi (Tinospora cordifolia Wild.)</td>
<td>Menispermaceae</td>
<td>Mehajita</td>
<td>Dh. Ni. Guduchyadi Varga 6, Page no. 17</td>
</tr>
<tr>
<td>Murva (Marsdenia tenacissima W. &amp; A.)</td>
<td>Asclepiadaceae</td>
<td>Mehnashini</td>
<td>Dh. Ni. Guduchyadi Varga 13, Page no. 18</td>
</tr>
<tr>
<td>Dhanvyas (Fagonia arabica Linn.)</td>
<td>Zygophyllaceae</td>
<td>Mehannahini</td>
<td>Dh. Ni. Guduchyadi Varga 20 Page no. 19</td>
</tr>
<tr>
<td>Haridra (Curcuma longa Linn.)</td>
<td>Zingiberaceae</td>
<td>Mehanuta</td>
<td>Dh. Ni. Guduchyadi Varga 55 Page no. 26</td>
</tr>
<tr>
<td>Daruharidra (Berberis aristata DC.)</td>
<td>Berberidaceae</td>
<td>Mehajita</td>
<td>Dh. Ni. Guduchyadi Varga 59, Page no. 26</td>
</tr>
<tr>
<td>Shalaparni (Desmodium gangeticum. DC.)</td>
<td>Fabaceae</td>
<td>Mehanashini</td>
<td>Dh. Ni. Guduchyadi Varga 88, Page no. 32</td>
</tr>
<tr>
<td>Gokshura (Tribulus terrestris Linn.)</td>
<td>Zygophyllaceae</td>
<td>Pramehanivartaka</td>
<td>Dh. Ni. Guduchyadi Varga 103, Page no. 34</td>
</tr>
<tr>
<td>Sariva (Hemidesmus indicus R. Br.)</td>
<td>Asclepiadaceae</td>
<td>Mehanashana</td>
<td>Dh. Ni. Guduchyadi Varga 160, Page no. 46</td>
</tr>
<tr>
<td>Ashmantaka (Ficus lacor Roxb.)</td>
<td>Moraceae</td>
<td>Pramehajita</td>
<td>Dh. Ni. Guduchyadi Varga193 Page no. 51</td>
</tr>
<tr>
<td>Haritaki (Terminalia chebula Retz.)</td>
<td>Combretaceae</td>
<td>Mehajita</td>
<td>Dh. Ni. Guduchyadi Varga 205, Page no. 54</td>
</tr>
<tr>
<td>Aragvadh (Cassia fistula Linn.)</td>
<td>Fabaceae</td>
<td>Pramehaghna</td>
<td>Dh. Ni. Guduchyadi Varga 216, Page no. 56</td>
</tr>
<tr>
<td>Ushira (Vetiveria zizaniodes Linn.)</td>
<td>Gramineae</td>
<td>Mehanuta</td>
<td>Dh. Ni. Chandanadi Varga 14, Page no. 93</td>
</tr>
<tr>
<td>Jatiphalah (Myristica fragrans Houtt)</td>
<td>Myristiceae</td>
<td>Mehaghna</td>
<td>Dh. Ni. Chandanadi Varga 34, Page no. 97</td>
</tr>
<tr>
<td>Loha</td>
<td></td>
<td>Pramehajita</td>
<td>Dh. Ni. Suvarnadi Varga 28, Page no. 183</td>
</tr>
<tr>
<td>Mandura</td>
<td></td>
<td>Mehanashana</td>
<td>Dh. Ni. Suvarnadi Varga 33, Page no. 184</td>
</tr>
<tr>
<td>Vaikranta</td>
<td></td>
<td>Mehajita</td>
<td>Dh. Ni. Suvarnadi Varga 42, Page no. 186</td>
</tr>
<tr>
<td>Triphala</td>
<td></td>
<td>Meahara</td>
<td>Dh. Ni. Mishrakadi Varga 2, Page no. 260</td>
</tr>
</tbody>
</table>

property [Tables 1 and 2]. Out of seven vargas, anti-diabetic drugs are present in four vargas.\[5,6\]

Some of the above-mentioned drugs are shita in virya, and some of them are ushna in virya. All drugs have different Rasa, Guna, Virya, and Vipaka Table 3. Drugs having ushna virya enhance the digestive power and block the generation of kleda and aam. Characters produced by piita dosha such as burning micturition and burning sensation in palm and sole are subsided by shita virya drugs. Drugs which are tikta in rasa and shita in virya have a predominance of vayu and akash mahabhuta, so
Table 3: Useful drugs for diabetes with their Guna-Karma

<table>
<thead>
<tr>
<th>Name of drug</th>
<th>Rasa</th>
<th>Guna</th>
<th>Virya</th>
<th>Vipaka</th>
<th>Doshaghnata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guduchi (Tinospora cordifolia Wild.)</td>
<td>Tikta, kashaya</td>
<td>Guru</td>
<td>Ushna</td>
<td>Tridosahar</td>
<td></td>
</tr>
<tr>
<td>Murva (Marsdenia tenacissima W. &amp; A.)</td>
<td>Madhura</td>
<td>Ushna</td>
<td>Shita</td>
<td>Kapha vatashamak</td>
<td></td>
</tr>
<tr>
<td>Dhanvyasa (Fagonia arabica Linn.)</td>
<td>Madhura</td>
<td>Ushna</td>
<td>Tridosahar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haridra (Curcuma longa Linn.)</td>
<td>Tikta</td>
<td>Ruksha</td>
<td>Ushna</td>
<td>Tridosahar</td>
<td></td>
</tr>
<tr>
<td>Daruharidra (Berberis aristata DC.)</td>
<td>Tikta</td>
<td>Ruksha</td>
<td>Ushna</td>
<td>Tridosahar</td>
<td></td>
</tr>
<tr>
<td>Shalaparni (Desmodium gangeticum. DC.)</td>
<td>Tikta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gokshura (Tribulus terrestris Linn.)</td>
<td>Tikta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sariva (Hemidesmus indicus R. Br.)</td>
<td>Madhura</td>
<td>Shita</td>
<td></td>
<td>Kapha vatashamak</td>
<td></td>
</tr>
<tr>
<td>Ashmantaka (Ficus laco Roxb.)</td>
<td>Madhura, Kashaya</td>
<td>Shita</td>
<td></td>
<td>Pitta kaphashamaka</td>
<td></td>
</tr>
<tr>
<td>Jatipala (Myristica fragrans Houtt.)</td>
<td>Kashaya, Katu</td>
<td>Ushna</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haritaki (Terminalia chebula Retz.)</td>
<td>Panchrasa (Lavanavarjita, Kashayaradhana)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aragvadh (Cassia fistula Linn.)</td>
<td>Tikta</td>
<td>Guru</td>
<td>Ushna</td>
<td>Tridosahar</td>
<td></td>
</tr>
<tr>
<td>Ushira (Vetiveria zizaniodes Linn.)</td>
<td>Tikta</td>
<td>Shita</td>
<td></td>
<td>Pittshamaka</td>
<td></td>
</tr>
<tr>
<td>Loha</td>
<td>Tikta</td>
<td>Ruksha</td>
<td>Ushna</td>
<td>Kapha Pittasamak</td>
<td></td>
</tr>
<tr>
<td>Mandura</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaikranta</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triphala</td>
<td></td>
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</tbody>
</table>

Table 4: Some previously done research works which prove the anti-diabetic effect of drugs of Dhanvantari Nighantu

<table>
<thead>
<tr>
<th>Name of drug</th>
<th>Physiological activity of drug</th>
<th>References</th>
</tr>
</thead>
</table>

(contd...)
they absorb the kleda of the body by these properties. Tikta rasa has also property of sukshmasrotogamitva so they can purify the srotas or microchannels. Because of these properties above mention drugs can break the samprapti (pathogenesis) of Prameha.

**Samprapti[2,3,9]**

<table>
<thead>
<tr>
<th>Name of drug</th>
<th>Physiological activity of drug</th>
<th>References</th>
</tr>
</thead>
</table>

*Dhanvantari nighantu* describes seven Vargas. Drugs of *Dhanvantari nighantu* are studied for their Pramehaghna property. A total of 17 drugs are having anti-diabetic property which belongs to different Vargas. The result shows that out of 17 drugs 11 drugs are belonging from *Guduchyadi varga* (8.5%), 3 drugs are from *Suvrana varga* (1.42%), 2 drugs are from *Chandanadi varga* (2.53%), and 1 drug from *Mishrakadi varga* (1.21%). We have mentioned some previously done research works which prove the anti-diabetic effect of drugs of Dhanvantari Nighantu in Table 4.

Hetu, Linga (symptoms), and Aushadh are the three important pillars for treatment of any disease among them. *Aushadh dravyas* are the key element of *Dhanvantary nighantu*. *Aushadh dravyas* are 1st time accepted in *Dhanvantari nighantu* by Mahendra Bhaugika. Out of 7 Vargas, four Vargas and from 703 drugs only 17 drugs having *Pramehaghina* (anti-diabetic) property. The result of this study is very beneficial to treat *Prameha* as we can achieve the best result in treating *Prameha* only when we know about the different types of *Prameha*. From that point of view in *Dhanvantari nighantu*, the drugs have described in very systematic manner. Hence, our study can give a great help to treat *Prameha* in respect to different types. By these drugs, we can make a formulation for the treatment of *Prameha* (diabetes) either it may be *pittaj prameha* or *kaphaj prameha*. Some drugs are shita in virya, and some
drugs are *ushna* in *virya*. Drugs can be chosen on the basis of symptoms and *doshik* predominance.

**REFERENCES**


**Source of Support:** Nil. **Conflict of Interest:** None declared.
Evaluation of tongue W.R.T agni

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Abstract

Jivha pariksha (tongue examination) is one of the means for diagnosis of disease and assessment of Agni. Aasthasthana Neerikshan (eight folds of examinations) is mentioned by Yogaratnakara for rogi pariksha in the late 17th century, which includes nadi, mala, mutra, jivha, shabdha, Sparsha, Drik, and Aakriti, it is also mentioned in Yoga-tarangini. It is said that different areas of the tongue are allocated for different organs of the body and tongue coating extension and thickness reveals the pathology in the digestive systems. It is said in Ayurvedic texts that every disease is formed due to mandagni and that mandagni leads to the formation of excess kitta bhag reflected on the tongue. Our aim is to assess the Agni as per the Ayurvedic Criteria and to study jihva pariksha in healthy volunteers to fulfill our hypothesis whether tongue characteristics have any relationship with Agni. For the study, 25 healthy volunteers were registered (BAMS and BNYS) from Ayurvedic wing, Faculty of Ayurveda, Institute of Medical Sciences, BHU. We have used HTC one M8, IMEI-SV 01, 16 megapixel cameras to capture the image of the tongue under natural light to see color, coating, fissure on tongue, pH paper to assess pH of the tongue, and filter paper to assess wetness of tongue. Assessment of Agni on the basis of questionnaire prepared for the study.

Key words: Agni, fissure, Jivha, pH, tongue

INTRODUCTION

Various folds of examinations are mentioned in Ayurveda texts for the diagnosis of diseases, i.e., Trividha pariksa, Chaturvidha pariksa, Panchvidha Pariksa-Nidana, Purvarupa, Rupa, Upasaya, Samprapti, Saptavidha Pariksha-Prashna +Panchindriya Pariksha, Aasthasthana neerikshan, Dashavidha pariksha, and Dwadasha pariksa. Among these Aasthasthana Neerikshan is one mentioned in Yogaratnakara for rogi pariksha which includes nadi, mala, mutra, jivha, shabdha, sparsha, Drik, and Aakriti. The tongue is one of the ways to see the changes taking place in the basic constituents of the body and to monitor the progress of the disease. It also reveals the prakriti and vikruti of the tongue through its color, size, shape, coating, fissure, and moisture. Acharya Yogaratnakar has explained that in vata Dosha prakopa, jivha become sheeta, Khara, and sphutita; in pitta Dosha prakopa, jivha become rakta and shyama varma; in Kapha Dosha prakopa, swheta and pichhila; in Sannipataj Dosha, jivha become Krishna, sakantak, shushka, and mixed lakshana of all doshas are found in dwandaja Dosha prakopa. It is also mentioned in Yoga-tarangini, Sharangdhar Samhita, Lifespan, complexion, strength, health, enthusiasm, immunity, etc., depend on Agni (body fire). One dies if this fire is extinguished, lives long if it functions properly; hence, Agni is the root cause of all. It has been stated that Agni cooks the food. It is of four kinds, namely, one physiological (not vitiated with the doshas) and three other are pathological. Prakriti (physiological) is assessed based on three factors, namely, Jarana Shakti (Digestion power), Ruchi (Appetite), and Abhyavaharana shakti (Hunger), and pathological Agni assessed on the basis of questionnaire for Agni assessment. Prakriti - the body constitution is assessed on the basis of questionnaire.

Aims and Objectives

We hypothesized whether the tongue characteristics (color, size, shape, coating, fissure, and moisture) are influenced by the effect of Agni and relation of prakriti with jivha.

Our Purpose

1. To assess the prakriti of the individuals as per the Ayurvedic criteria.
2. To assess the Agni of the individuals as per the Ayurvedic criteria.
3. To study Jihva pariksha in healthy individuals.

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Phone: +91-9453494143. E-mail: rbysingh86@gmail.com
MATERIALS AND METHODS

For this study, 25 healthy individuals were registered (BAMS and BNYS students) from Faculty of Ayurveda, IMS, BHU. We have used HTC one M8, 16 megapixel cameras to capture the image of the tongue, and also to see the size, shape, coating, fissure, and moisture of the tongue. We have used filter paper to assess the moisture of the tongue; pH paper to check pH of the tongue.\(^{[17]}\)

Methods

After proper rinsing of the mouth, the tongue was examined in natural light. In sitting position, individual was asked to protrude out the tongue and image captured within a minute before scrapping of the tongue.\(^{[18]}\)

We had examined the dorsal, ventral and lateral surface of tongue for colour, coating, fissure, vein engorgement of the tongue.

OBSERVATIONS AND RESULTS

The study was conducted in Ayurvedic wings of S.S.H, IMS, BHU.

<table>
<thead>
<tr>
<th>Table 1: According to sex of the individuals, (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
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CONCLUSION

- We have registered 25 healthy individuals, out of which 13 are male and 12 are female.
- Of 13 male candidates, 16% were of PK prakriti followed by 12% of VP prakriti. Of 12 female candidates, 28% were of PK prakriti followed by 12% of KP prakriti.
- Of 25 cases, maximum number, i.e., 16% were found to have samagni followed by 12% with mandagni and tikshnagni.
- On examination of the tongue, 20 cases have normal pattern of tongue, 2 have small tongue, and 3 have large tongue.
- In Table 3: According to sex of the individuals, (n=25)
- In Table 2: According to Prakriti of the individuals, (n=25)
- In Table 3: Status of Agni among healthy individuals, (n=25)
- In Table 4: Tongue examination in healthy individuals, (n=25)
- In Table 5: Type of tongue according to dosha, (n=25)
color, 48% have pink color tongue. In coating, 68% have no coating on tongue. In pH, 80% cases have alkaline range of pH.

- Of 25 cases, 56% individuals have dwandaja jihva, of which 50% have pittaj-kaphaja jihva.

• All the above finding, may give a conclusion that, dwandaja prakriti person can have samagni and dwandaja dosha prakopak jihva.

REFERENCES


Singh, et al.: Evaluation of tongue features with relation to agni status


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Medicinal Herbs: An epitome towards treatment of Prameha (Diabetes)

Sadhana Singh, Rashmi Yadav, Aparana Dixit, Roli Sarjuprasad Mishra, Priyanka Gautam

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ABSTRACT

India has a high prevalence of diabetes and the number is increasing at an alarming rate. The most disturbing trend is the shift in age of onset of diabetes to a younger age in the recent years. This could have long-lasting adverse effects on nation’s health and economy. Being a Dravyaguna (Ayurveda) Scholar, it is our primary duty to explore such plants along with references and their properties mentioned in classics, i.e., Rasa (taste), Guna (physical/chemical property), Virya (potency), and Vipaka (metabolism), and probable mode of action of these medicinal plants based on their rasa panchaka (rasa, guna, virya, vipaka, and prabhava) is also concluded. Prameha has grave and serious clinical manifestations with the possibility of occurrence of serious complications and at times with fatal prognosis. Therefore, in the present study, an attempt has been made to explore the possibility of a better control over diabetes by medicinal plants.

Key words: Diabetes, Guna, Prabhava, Prameha, Rasa, Vipaka, Virya

INTRODUCTION

As Prameha (diabetes) is not merely a metabolic syndrome, it gives rise to fatal complications too. That is why health authorities all over the world and in all countries are trying their best to make a control over the spread of this disease.

Nidana of Prameha (etiology of diabetes in ayurveda) - Asyasukham (comfortable sitting, i.e., sedentary lifestyle and lack of physical activity and exercise), Svapnasukham (comforts of sleeping and excess sleeping), Dadheeni (excessive consumption of Curds and its preparations), Gramya-oudaka-anupa mamsa (meat of animal living in water and marshy regions), Payamsi (excessive consumption of milk, its derivatives, and preparations), Nava-anna panam (food, drinks, and dishes made from new grains, etc.), Guda Vaikruti (jaggery), and Kapha kricha sarvam (all foods and lifestyle activity which increase Kapha) are etiology of Prameha.

DISCUSSION

Madhumeha has been described as one among the 20 types of prameha and is subtype of Vataja prameha. It is tridoshaja vyadhi. Abadha shleshma is particular dosha in all types of prameha. The clinical entity in which patient voids the urine having concordance with madhu, i.e. kashaya and madhura taste, ruksha texture, and madhu (honey)-like color, and body acquires sweetness is called madhumeha.

Treatment of madhumeha is difficult due to contradictory treatment of vata (predominant dosha) and meda (predominant dushya). Drugs which combate vata will increase meda and kapha and vice versa. In avaranajanya madhumeha, the treatment must be such that should not vitiate vata and should clear avarana also.

Most of the plants have kashaya, katu, tikta rasa, ruksha in guna, and ushna in virya. It also has tridoshashamaka action which is desirable in treatment of madhumeha. The plants having of tikta and katu rasa alleviate meda and kapha main etiological factors involved in pathogenesis of disease. Tikta Rasa contains vayu and akasha due to which it attains specific property Sukshma-Srotogamitva, and consequently, Sroto-rodha is counteracted through it.

Being ushna virya, it pacifies vata, and by virtue of kashaya rasa, it reduces Sariragata kleda. The shita virya drugs act on Pittaja Prameha, and it pacifies burning sensation in limbs.

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E-mail: drsadhana085@gmail.com
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<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 575</td>
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<th>Rasa</th>
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<th>Virya</th>
<th>Vipaka</th>
<th>Dosa Karma</th>
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<td><strong>Guggulu</strong></td>
<td>Tikta, Katu</td>
<td>Laghu, Ruksha, Tikshna, sukshma, sara</td>
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<td>Katu</td>
<td>Tridoshahara</td>
<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 54</td>
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<tr>
<td><strong>Palasha (Butea monosperma Lam.)</strong></td>
<td>Tikta, Katu, Kashaya</td>
<td>Laghu, Ruksha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Kaph- vata shamaka</td>
<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 506</td>
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<tr>
<td><strong>Karanja Phala (Pongamia pinnata Pierre)</strong></td>
<td>Tikta, Katu, Kashaya</td>
<td>Laghu, Tikshna</td>
<td>Ushna</td>
<td>Katu</td>
<td>Kaph- vata shamaka, Pitta vardhaka</td>
<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 144</td>
</tr>
<tr>
<td><strong>Shinshapa</strong></td>
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<td>Laghu, Ruksha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Tridoshashamaka</td>
<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 806</td>
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<tr>
<td><strong>Vata (Ficus benghalensis Linn.)</strong></td>
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<td>Guru, Ruksha</td>
<td>Shita</td>
<td>Katu</td>
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<td>Kapha-pitta shamaka</td>
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<tr>
<td><strong>Ashvatha (Ficus religiosa Linn.)</strong></td>
<td>Madhura, Kashaya</td>
<td>Guru, Ruksha</td>
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<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 670</td>
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<tr>
<td><strong>Pareesha (Thespesia populnea Soland.)</strong></td>
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<td>Dravya-Guna Vigyan Vol-2, Prof. P.V. Sharma, Page No. 680</td>
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</table>

Table 1: (Continued)
Table 2: Pramehahar drugs in Bhavaprakash Nighantu of herbal origin with respective references

<table>
<thead>
<tr>
<th>Sanskrit name</th>
<th>Guna Karma</th>
<th>Reference of Varga and Shloka no. in Bhavaprakash Nighantu[^4]</th>
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<tbody>
<tr>
<td>Aamalaki (Emblica officinalis Gaertn.)</td>
<td>Pramehaghna</td>
<td>Haritkyadi Varga-39 Page No. 10</td>
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<tr>
<td>Arkapuspi (Holostemma annularis K. Schum.)</td>
<td>Mehaject</td>
<td>Guduchyadi Varga-271 Page No. 441</td>
</tr>
<tr>
<td>Ashtavarga (Abutilon indicum Linn.)</td>
<td>Mehapranut</td>
<td>Haritkyadi Varga-122 Page No. 58</td>
</tr>
<tr>
<td>Atibala (Aamalaki (Emblica officinalis Gaertn.).)</td>
<td>Mehasamana</td>
<td>Guduchyadi Varga-146 Page No. 352</td>
</tr>
<tr>
<td>Bakuchi (Psoralea corylifolia Linn.)</td>
<td>Mehanut</td>
<td>Haritkyadi Varga-208 Page No. 119</td>
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<tr>
<td>Beejaka (Pterocarpus marsupium Roxb.)</td>
<td>Mehaghna</td>
<td>Vatadi Varga-29 Page No. 512</td>
</tr>
<tr>
<td>Brahmi (Bacopa monnieri Linn.)</td>
<td>Mehaject</td>
<td>Guduchyadi Varga-281 Page No. 446</td>
</tr>
<tr>
<td>Chiribilva (Holoptelia integrifolia planch.)</td>
<td>Pramehajeet</td>
<td>Guduchyadi Varga-124 Page No. 338</td>
</tr>
<tr>
<td>Devadaru (Cedrus deodara Loud.)</td>
<td>Pramehanuta</td>
<td>Karpuradi Varga-25 Page No. 186</td>
</tr>
<tr>
<td>Dhava (Anogiessus latifolia Wall.)</td>
<td>Pramehahara</td>
<td>Vatadi Varga-60 Page No. 527</td>
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<tr>
<td>Dronapuspi (Leucas cephalotes spreng.)</td>
<td>Mehahara</td>
<td>Shaka Varg-34, Page No. 662</td>
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<tr>
<td>Gojihva (Onosma bracteatum Wall.)</td>
<td>Pramehara</td>
<td>Guduchyadi Varga-298 Page No. 456</td>
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<tr>
<td>Guduchi (Tinospora cordifolia Willd.)</td>
<td>Pramehahara</td>
<td>Guduchyadi Varga-10 Page No. 257</td>
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<tr>
<td>Guggulu (Commiphora mukul Hook ex stocks.)</td>
<td>Mehahara</td>
<td>Karpuradi Varga-40 Page No. 195</td>
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<tr>
<td>Gokshura (Thymbrodes terestris Linn.)</td>
<td>Pramenunata</td>
<td>Guduchyadi Varga-46 Page No. 279</td>
</tr>
<tr>
<td>Haridra (Curcuma longa Linn.)</td>
<td>Mehaghna</td>
<td>Haritkyadi Varga-197 , Page No. 111</td>
</tr>
<tr>
<td>Haritaki (Terminalia chebula Retz.)</td>
<td>Pramehahara</td>
<td>Haritkyadi Varga-20, Page No. 5</td>
</tr>
<tr>
<td>Indrayana (Citrus colocynthis Schrad.)</td>
<td>Pramehahara</td>
<td>Guduchyadi Varg-206 Page No. 389</td>
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<tr>
<td>Kadali (Pakwa)</td>
<td>Mehaghna</td>
<td>Vatadi Varga-27, Page No. 511</td>
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<tr>
<td>Kakamachi (Solanum nigrum Linn.)</td>
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<td>Guduchyadi Varga-247 Page No. 423</td>
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<tr>
<td>Arjuna (Terminalia arjuna Roxb.)</td>
<td>Mehaghna</td>
<td>Vatadi Varga-67 Page No.-531</td>
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<tr>
<td>Kampillaka (Mallotus philippinensis Muell. Arg.)</td>
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<tr>
<td>Karanaphala (Pongamia pinnata Pierre)</td>
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<td>Guduchyadi Varga-122 Page No. 335</td>
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<tr>
<td>Karavellam (Momordica charantia Linn.)</td>
<td>Mehaghna</td>
<td>Shaka Varga-63, Page No. 670</td>
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<tr>
<td>Katabhi (Cara arborea Roxb.)</td>
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<tr>
<td>Kataphala (Myrica esculenta Buch-Ham.)</td>
<td>Pramehara</td>
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<tr>
<td>Katuki (Picrorhiza kurroa Royle. Ex Benth.)</td>
<td>Pramehanuta</td>
<td>Haritkyadi Varga-152, Page No. 67</td>
</tr>
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<td>Khadira (Acacia catechu Wild.)</td>
<td>Mehaghna</td>
<td>Vatadi Varga-32 Page No. 513</td>
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<tr>
<td>Mahanimbha (Melia azedarach Linn.)</td>
<td>Pramehahara</td>
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<tr>
<td>Mandukaparni (Centella asiatica Linn.)</td>
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<tr>
<td>Manjistha (Rubia cordifolia Linn.)</td>
<td>Mehanut</td>
<td>Haritkyadi Varga-191 Page no.-107</td>
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<tr>
<td>Meshashringi (Gymnema sylvestre R.Br)</td>
<td>Mehaghna</td>
<td>Guduchyadi Varga-255 Page no.-428</td>
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<tr>
<td>Moorva (Marsdenia tenacissima W. and A.)</td>
<td>Mehanut</td>
<td>Guduchyadi Varga-245 Page no.-419</td>
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<tr>
<td>Nimba (Azadirachta indica A. Juss)</td>
<td>Mehanut</td>
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<td>Palasha (Butea monosperma Lam.)</td>
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<td>Vatadi Varga-53Page no. 524</td>
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<tr>
<td>Pashanabhedha (Bergenia ligualata (Wall.) Engl.)</td>
<td>Pramehara</td>
<td>Haritkyadi Varga-185 Page No. 101</td>
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<tr>
<td>Pippali (Piper longum Linn.)</td>
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<td>Haritkyadi Varga-55 Page No. 15</td>
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<tr>
<td>Shitivara (Marsilea minuta Linn.)</td>
<td>Mehapranut</td>
<td>Shaka Varga- 32 Page No. 661</td>
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<tr>
<td>Tinduka (Diospyros peregrina Gaertn.)</td>
<td>Pramehaghna</td>
<td>Aamradi phalavarga-65 Page No. 555</td>
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<tr>
<td>Tinisha (Ougeinia oojeinensis Roxb.)</td>
<td>Pramehajee</td>
<td>Vatadi Varga-76 page No. 535</td>
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<td>Trikatu</td>
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<td>Triphala</td>
<td>Mehaghna</td>
<td>Haritkyadi Varga-43 Page no.-12</td>
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<tr>
<td>Varahikanda (Dioscorea bulbifera Linn.)</td>
<td>Mehaghna</td>
<td>Guduchyadi Varga-179 Page No. 372</td>
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<tr>
<td>Vasa (Adhatoda vasica Nees.)</td>
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<td>Guduchyadi Varga-90 Page no. 306</td>
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<tr>
<td>Vridhdaruka (Argyreia speciose Sweet.)</td>
<td>Mehapranuta</td>
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### Table 3: Previous researches related to diabetes and plants act on diabetes

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<tr>
<th>Name of the drug</th>
<th>Reported pharmacological activity</th>
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(Contd...)
and it also relieves in burning micturition, whereas an ushna virya drugs increase agni and diminish the production of ama.

Allopathic drugs used for the treatment of diabetes have their own side effect and adverse effects such as hypoglycemia, nausea, vomiting, hyponatremia, flatulence, diarrhea or constipation, alcohol flush, headache, weight gain, lactic acidosis, pernicious anemia, dyspepsia, dizziness, and joint pain. Hence, instead of allopathic drugs, herbal drugs are a great choice which has minimum or no side effects and adverse effects.

### CONCLUSION

Formulations of these medicinal plants are prepared in the form of Swaras (juice), Kalka (paste), Kwath (decoction), Churna (powder), Vati (tablet), Avaleha (lickables), Guggulu (tablet form), etc. and advised according to severity of disease and strength of patient. The present study aims to collect information on various medicinal plants indicating in Prameha (diabetes). Furthermore, on evaluating the reported pharmacological actions of these drugs, Table 1 emphasizes on the pharmacological properties (Guna Karma) of these Pramehahar plants along with references. Table 2 shows drugs of herbal origin and their particular action (Pramehara/pramehanuta/mehajeta/mehahara) as mentioned in Bhava Prakash Nighantu. Table 3 shows previous research carried on Diabetes. Various research articles are studied which provides a clear evidence of their Pramehahar potential. Most of herbs are available in the market, and no research work has been performed on many of them. Thus, there is an urgent need to conduct research on that valuable herbs.

### REFERENCES


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Efficacy of Ayurvedic drugs in the management of gouty arthritis – A case study

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Abstract

Our day-to-day life is very much influenced by joint pain conditions in old age. However, these conditions include osteoarthritis, rheumatoid arthritis, and gouty arthritis. Gouty arthritis is characterized by hyperuricemia, deposition of uric acid crystals in and around joints, as well as nearby soft tissues. Change in lifestyle has strong impact on incidence of gouty arthritis. Modern treatment with synthetic drug neither able to subside painful conditions for longer duration nor completely cure the diseases. Ayurveda describes gouty arthritis under the name of vatarakta in its classics. Several herbal, herbomineral preparations were reported in classics which are helpful in gouty arthritis. In the present article, we report success story of Ayurvedic medicines in a complex case of a 54-year-old male with polyarticular tophaceous gouty arthritis with disabling effects in hand and feet.

Key words: Gouty Arthritis, Vatarakta, Ayurveda

INTRODUCTION

Hyperuricemia as a result of altered purine metabolism contributes in rheumatic disorder known as gout.[1] Long-term untreated condition leads to monoarticular arthritis, intercritical period, and chronic tophaceous gout where monosodium urate (MSU) crystals were deposited in connective tissues and kidneys.[2,3] The disease usually affects middle-aged and elderly men over 40 years and postmenopausal females. Numerous risk factors, namely, genetics, age, and gender or modifiable risk factors including hyperuricemia, diet, alcohol, medications, body mass index, and physical fitness.[4] Overall, typical clinical manifestations of the disease are swelling, pain, tenderness, heat at joints, flares, tophi, and urate arthropathy.[5] Joint stiffness, mobility issues, and erythema also present in some cases. In a typical practice, urate-lowering therapy is of main concern. Treatment includes non-steroidal anti-inflammatory drugs (NSAIDs), colchicine, and corticosteroids. Intra-articular corticosteroid injection is also used in advance cases.[6] Non-pharmacological measures are also helpful in controlling the progress of disease. Several alternative therapies are also used by the patients to treat acute painful episodes of gouty arthritis.[7] Plant-based therapy is one of the most faithful medical systems in Indian subcontinent, where plants are essential element of society and lifestyle. We are witnessing a golden age of scientific and systematic development of Ayurveda in the treatment of such type of chronic diseases. In the present article, we report success story of Ayurvedic medicines in a complex case of a 54-year-old male with polyarticular tophaceous gouty arthritis with disabling effects in hand and feet.

CASE REPORT

A 54-year-old male patient was presented to our OPD at Shanti Ayurvedic Medical College, Ballia. The patient was a farmer and belongs to near village Bairiya. He has long history of pain, swelling, and redness in his right great toe as well as pain, swelling, and deformity of small and large joints of both hands and feet without morning stiffness for approximately 6 years. According to the patient, when he woke up at midnight, unbearable pain occurs in his toe, and in the morning, the toe was dark red and warm. Initially, he took medicine from local health practitioner and treated with indomethacin leading to the relief over a period of time. Subsequently, the patient developed recurring incident of polyarthritus with painless nodules on hand and feet. Then,

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he goes to modern medicine doctor, and he was advised to take allopurinol for 4 months with protein restricted die as his serum uric acid levels reach up to of 11.93 mg/dL. The patient comes to us for better one. On the first visit of the patient, the following observations were made [Figure 1].

He was afebrile, cardiovascular and respiratory system parameters were normal. Locomotor system examination demonstrates muscular atrophy of limbs and multiple deformities of wrists, proximal interphalangeal joints (PIP), metacarpophalangeal joints of hands, and metatarsophalangeal joints of feet. Non-inflammatory subcutaneous nodule of variable sizes (1–2 cm) also present at joints. Biochemical investigation shows hemoglobin 13.6 g/dL, thin-layer chromatography of 7800/µL, platelet counts of 130 × 10^3/µL, ESR of 18/mm 1st, uric acid of 13.46 mg/dL, creatinine of 1.04 mg/dL, negative rheumatoid factor, and C-reactive protein 12 mg/L. X-ray confirms the disease as joint space was reduced, subarticular cysts were present at PIP of middle finger of the left hand. Bilateral reduction of joint spaces and presence of subarticular cysts was also observed in X-ray of feet. Histopathology nodule shows the presence of tophus while no atypical cells were observed.

**Drug and Treatment Protocol**

The patient was advised to take the following medicine for 3 months as follows:
1. Bodhivriksha Kashaya: 50 mL twice daily
2. Vata gajankush Ras: 365 mg twice daily
3. Amrita Guggulu: 500 mg twice daily
4. Punarnava Guggulu: 500 mg twice daily
5. Amrutadi Taila: For local application.

Follow-up was done on every 7th day during the 1st month and later once in 15 days for next 2 months. Assessment was made on the basis of subjective and objective parameters (radiological findings) both before and after treatment. After administration of drug by the end of 3rd week of the treatment, the patient gets relief from pain. He was able to do his day-to-day life work. He was instructed to strictly follow the prescribed diet regime and lifestyle. In next 20 days, the changes appear in radiological findings. Blood report reveals that uric acid was significantly reduced. The treatment will continue till the complete removal of tophus [Figures 2 and 3].

**DISCUSSION**

Gout is a metabolic disorder where uric acid levels exceed its higher limit 6.8 mg/dL because uric acid excretion through kidney was impaired. The excess uric acid deposited in the joint and soft tissues as needle-shaped crystal of MSU known as tophus. The most common sites are skin overlying joints and helix of the ears. Usually, the tophi are formed after a mean period of 10 years of disease duration. This may lead to nephrolithiasis and renal damage. These changes manifest certain radiologic changes asymmetrical, erosive arthritis with preserved articular surface in gouty arthritis. Bone erosions may be seen in advance stage due to tophi deposition. The treatment approaches toward gouty arthritis has been changed a lot in recent years. The pharmacological measures NSAIDs, colchicine, and steroids should not be
used for a longer period due to their side effects. Hence, the use of Ayurvedic medicine in case of arthritis increases day-by-day. Medicinal plants and mineral drug from Ayurveda science can be very helpful in the treatment of hyperuricemia and gout. Ayurveda encourages incorporation of lifestyle modification along with specific herbs and minerals to cure various diseases.\(^7\) The effects of such Ayurvedic drugs are purely based on observation.

**CONCLUSION**

Polyarticular tophaceous gouty arthritis is uncommon considering pharmacological treatment of hyperuricemia and such cases may be considered as differential diagnosis for rheumatoid arthritis so that early treatment will stop the disability effects in such patients. We have treated the patients with such symptoms successfully with the Ayurvedic drugs. Thus, the current case confirms that herbal treatment of gouty arthritis can be achieved with the Ayurveda.

**REFERENCES**


**Source of Support:** Nil. **Conflict of Interest:** None declared.
Prediabetes - an Ayurvedic review (review article)

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Abstract

In today’s fast world, people are not aware about consequences of their busy lifestyle on body. Prediabetes is a condition that is result of disturbed lifestyle and metabolism of a person and if not managed at proper time results in various disorders like increased risk for diabetes and cardiovascular disease. As per Ayurvedic concept, health is the state of proper functioning of dosha, dhatu, and mala. These factors are under the control of proper functioning of agni and ahara consumed by particular person. By giving proper consideration to agni to maintain homeostasis of body, various metabolic disorders can be managed much earlier stage.

Key words: Agni, Ayurveda, metabolic disorders, prediabetes

INTRODUCTION

Prediabetes is the precursor stage before diabetes mellitus in which not all of the symptoms required to diagnose diabetes are present, but blood sugar is abnormally high. It is not a disease; the American Diabetes Association says, “prediabetes should not be viewed as a clinical entity in its own right but rather as an increased risk for diabetes and cardiovascular disease. Prediabetes is associated with obesity, dyslipidemia, high triglycerides, and hypertension.” It is thus a metabolic syndrome, and it usually involves no symptoms and only high blood sugar as the sole sign. Insulin resistance, the insulin resistance syndrome (metabolic syndrome or syndrome X), and prediabetes are closely related to one another and have overlapping aspects.

Insulin enters cells first by binding to target insulin receptors. DM and some of those with prediabetes have impaired glucose tolerance in these individuals; blood glucose rises to abnormally high levels. This may be due to a lack of pancreatic hormone release or failure of targeted tissues to respond to the insulin present or both. Obesity is thought to be a major cause of insulin resistance at tissue level.

Objective

This work will help in better understanding of pathogenesis of prediabetes in relation to agni and ama that will help in prevention and management of prediabetes in better way.

LITERATURE REVIEW

Agni has been considered as route cause of body by maintaining organism’s integrity and vitality by converting the food consumed in various ways into various structural and functional components, i.e., dhatu and dosha. Function of Jatharagni includes digestion of food and Saarakitta vibhajana (absorption). After the function of jatharagni ahara rasa get form, then bhootagni and dhatvagni come into play so vijateeya ahara rasa get converted into sajateeya to different mahabhutas of body and after functioning of dhatupaka gives nourishment to body tissue. However, when proper functioning of agni gets disturbed, ama get formed at various levels in body that leads to different pathological conditions.

When food gets properly digested, it forms sara and kitta bhaga. Sara bhaga gets absorb and after digestion with dhatvagni forms sthayi and asthayi poshaka dhatu. Sthayi poshaka dhatus gives nutrition to permanent dhatu, i.e., sthayi rasa Dhatu gives nutrition to rasa dhatu proper and asthayi rasa dhatu after functioning of raktagni forms sthayi and asthayi rakta dhatus, in the same manner, other dhatus get form and get their nutrition from their previous dhatus.

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Disturbance in function of agni at any level, i.e., jatharagni, bhutagni, and dhatvagni leads to the formation of ama that is causative factor of different pathological conditions. However, gross digestion takes place in amashaya that is why acharyya has described the formation of ama, primarily in amashaya.

Symptoms of Ama\(^{[1]}\) - Srotarodha - obstruction - this can occur in any large, small or minute channel when it is indicated by stagnation and disturbance in transport and metabolism in gross as well as at cellular level. Weakness or reduced working power in any part of body or organ is due to obstruction in their nutrition caused by Ama. Other symptoms of ama are heaviness and lethargy in body along with coated tongue, improper digestion and incomplete evacuation.

**DISCUSSION**

As per Ayurvedic concept, obesity is disorder related to kapha dosha. When a person indulges in kapha ahar vihar,\(^{[9]}\) his/her agni gets vitiated at jatharagni and dhatvagni level that produces ama. As ama is the first cause of almost all diseases, it causes strotodushiti in the form of avarodh in strotasas and disturbs dhatu poshan.

Modern science also believes that there are tight junctions in digestive tract, expressing different levels of tightness and permeability, based on the variety of stimuli, i.e., dietary stimuli, hormonal and neuronal signal, and inflammatory mediator.\(^{[9]}\) That means permeability of intestine varies time to time in response to various types of stimulation such as infection, toxic, stress, and age. There are varieties of human diseases in which abnormal intestinal permeability plays major part in their pathogenesis; these diseases are diabetes, Crohn’s disease, autoimmune diseases, irritable bowel syndromes, atopic dermatitis, and ankylosing spondylitis.\(^{[10]}\) Before the development of proper diseases caused by abnormal gut permeability, various types of symptoms are developed that are combinedly called as leaky gut syndrome.

Once these tight junctions get broken apart, things such as toxins, microbes, and undigested food particle can escape from intestine and reach in blood stream and acting as antigen and causes chronic stress at cellular level and result in various metabolic and autoimmune disorders. Chronic stress stimulates production of betatrophin, a protein that then goes on to inhibit an enzyme involved in fat metabolism.\(^{[11]}\) Betatrophin reduces the body’s ability to break down fat and slows down fat metabolism. Increase body fat is the major cause of insulin resistance and thus for prediabetes also.\(^{[12]}\)

Proper function of agni is responsible for the maintenance of local environment of gut and formation of dhatu and if it get disturbed, it causes the formation of ama at each level of body that is the condition which is similar to the condition when tight junctions of gut get weaken in response to various factors such as toxins, microbes, and undigested food particle and get absorb in blood stream and act like chronic stressor at cellular level in whole body. Chronic stress at cellular level induces various factors like betatrophin that alters fat metabolism. Altered fat metabolism is responsible for insulin resistance and leads to prediabetic stage. Ayurvedic concept of agni and Dhatu poshan can help in better understanding and management of altered gut permeability, cellular stress, and fat metabolism. In preventive aspect, we can aware people about food habits that help selection of food according to their prakriti, nature of food, and status of their agni, i.e., person having kapha prakriti should avoid excess intake of guru and snigdha ahar, he/she take ahar that maintains his/her agni, agnimandya\(^{[13]}\) should not be their because agnimandya is the factor which leads the formation of ama at amashaya and Dhatu level that acts as chronic stressor and predisposes the person for prediabetic stage. At therapeutic level, concept of storto-shodhan and agni deepan can help in prediabetic stage in better way by removing cellular stress because it is already discussed that betatrophin that is induced at cellular level due to chronic stress alters fat and lipid metabolism. If one can improve metabolism by agni deepan and storto-shodhan with the help of langhan, deepan pachan, and storto-shodhan by panchakarma, homeostasis of body can be achieved because these processes improve functioning of agni and proper Dhatu formation by clearing tissue channels, i.e., strotasas.\(^{[14,15]}\) Agni deepan and storto-shodhan can help in the management of chronic stress at cellular level that is responsible for altered fat and lipid metabolism by clearing tissue channels and tissue metabolism.

**CONCLUSION**

It is very surprising that researches in the field of increase gut permeability and altered tissue response in disease pathogenesis are in very initial phase in modern medical science. Pathogenesis of diabetes, rheumatoid arthritis, atopic dermatitis, and autoimmune diseases is now redefining on the basis of altered gut microbiota and increases permeability of gut, but concept of agni and ama is very basic concept of Ayurveda that covers similar but much wider area of function than gut microbiota and increases gut permeability along with role of proper digestion on body homeostasis. That is why agni has been considered as cause of life and body (dehadharan) and ama as route cause of all disease (sarva dosha prakopana). Hence, by giving consideration to concepts related to agni, Dhatu poshana, srotavarodh, and ama in researches related to intestinal permeability and insulin resistance, management of prediabetes can be done in better way. Thus, concept of agni and ama can give new vision in the field of maintenance of health and cure of disease.

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Conceptual study of *Langhana karma* W.S.R. to *Gurvadi Guna*

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**Abstract**

When we think about cause, prevention, and cure of any disease, we think about various possible factors. *Langhana karma* is one of among them. It is the causative and contraindicated factors for some pathological conditions like *gulma*, especially *vataja*. It may be used as a preventive measure for some pathological condition like *amadosha* and it is often used as treatment procedure in various diseases such as *Chardi* and *Atisara*. Various literature reviews revealed that *Langhana karma* is one of the two main pillars of *Ayurveda* regarding *Chikitsa karma* - *Aptarpana* and *Santarpana*. Inside the body, all the components have their own properties in form of *Gurvadi Guna*. Outside the body, in this world, various *ahara*, *vihara*, and *ausadha*, etc., also have *Gurvadi guna* which are responsible for their functions. Therefore, in this article, it is tried to explore the various aspects of *Langhana karma* and its importance in *chikitsasastra* with the help of knowledge of *Gurvadi guna*.

**Key words:** *Aptarpana karma*, *Gurvadi guna*, *Langhana karma*, *Santarpana karma*

**INTRODUCTION**

*Ayurveda* has aim to achieve the “Sama” status or balance status of *Doshas*, *Dhatus*, and *Malas*, etc. If *Doshas* increased or decreased, there is an abnormal status known as *Vikara* or disease. Hence, the main aim of *Ayurveda* is to increase and decrease *Dosha*, *Dhatu*, and *Mala*, etc. The principles of remedies are described from the different point of view, i.e. *Shodhan* and *Samshamana*. The five special procedure known as *Panchkarma* is recommended as *Shodhana* therapy while subsiding the aggravated *Doshas* are known as *Shamana* therapy. These types of remedy are applied to manage the disease, but in *Charaka Samhita*, in context of the “basic principles of remedy,” in the title of *लङघनविभूतिकर्मम्*: Six types of special remedies are described:

1. *Langhana*
2. *Bringhana*
3. *Rukshana*
4. *Snehana*
5. *Svedana*
6. *Stambhana*.\(^{[1]}\)

There is no any other remedy in *Ayurveda* which might be beyond of these remedies. All the remedies described in *Ayurveda* may be included under this. Among these, the *Upkrama* which reduces the body weight and causes lightness in the body is called *Langhana* (reducing therapy). *Langhana karma* is described as a weight reducing, *dhatu* reducing, *vata* promoting/aggravating, *kapha* diminishing, *agni* promoting, *ama* digesting, and *ama* preventing procedure in different texts of *Ayurveda*. This procedure is described both as one of the causative factor of many diseases as well as curative procedure of many diseases.

*Gurvaadigunas* are the specific contribution of *Ayurveda*, i.e., it is not described in any other *darshana* or text, as described in *Ayurveda*. The concept of *Guna* is described in *Ayurveda* from applied and therapeutic view. These are the group of 10 pairs of *gunas*. These *gurvadi gunas* perform specific karmas while residing in the *dravyas*. These *karmas* are the basis of treatment and cause of diseases. *Langhana karma* is performed through specific *ahaar*, *vihara*, and *ausadh*. And all these *ahara* have specific type of *gurvadi gunas* responsible for *Langhana karma*.

**AIMS AND OBJECTIVES**

The aim of this study is to collect, compile, and explore the applied aspect of *Langhana karma* for healthy and diseased

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patient from various corners of Ayurvedasastra, so that the vast knowledge of Langhana karma may become concised in the light of Gurvadi guna and every concept could be studied under this.

**LITERATURE REVIEW**

Ayurvedic literature related with Langhana were studied and interpreted to explore the concept of Langhana, its mode of action as causative as well as a curative measure for various diseases in the light of gurvadi guna. For understanding the concept of Langhana karma, Ayurvedic literatures, related with Gurvadi Guna and gurvaadiguna were also studied.

**CONCEPT OF LANGHANA KARMA**

The procedure or process which reduces the body weight or reduce the diameter of body or degenerates the body cells is known as Langhana.[2]

**TYPES OF LANGHANA KARMA**

The four types of elimination therapy, control of thirst, exposure to wind and sun, intake of substance that stimulate digestion, fasting, and physical exercise constitute reducing therapy.[2] The Langhana therapy is of two types - Sodhana and Shamana.[3]

**Properties of Langhana Dravya**

Commonly, this process is performed through Laghu guna, but there are some other Gunas which supports the process in Charaka Samhita in reference of Langhana karma. Laghu guna has been enumerated first, but other Gunas are also mentioned which have an important role in Langhana karma, i.e., Ushna, Tikshna, Vishada, Ruksha, Sukshma, Khara, Sara, and Kathina (hard).[4]

**Persons Advised for Langhana Karma**

Reducing therapy is to be administered in winter to such of the patient as are suffering from skin disease and obstinate urinary disorder and to those who possess corpulent body together with unctuousness and fluidity and even to those who suffer from diseases due to vitiation of Vata.[5]

**Lakshana of Samyag Langhana**

Proper excretion of flatus urine and feces, lightness of body, feeling of purity in heart, eructation, throat and mouth, disappearance of drowsiness and exertion, appearance of sweat and taste for food, excessive hunger and thirst, and contentment. These are the signs and symptoms of proper administration of Langhana therapy.[6]

**Lakshana of Attiyaguna**

Parvabheda, Angamarda, Kasa, Mukhasosha, Loss of appetite, Aruchi, Trishna, weakness of ears and eyes, loss of memory, upward movement of Vata, emaciation of body, loss of the power of digestion, and strength are the lakshana of atilianghana.[7]

**Langhana Karma as Nidana of Various Diseases**

1. Raaj Yakshama: Vayu gets aggravated due to injury to the chest caused by fighting, reading loudly, carrying excessive weight, walking long distance, observing fast for a long time, etc., are the etiological factors of tuberculosis caused by overexertion.[8]
2. Vaat Arsha: Fasting, residing in cold country and cold season, and physical exercise are the etiological factor of Vaatika type of piles.[9]
3. Vata Vyadhi: Keeping fast in excess, etc., are the causative factors for the generation of Vata Vyadhi.[10]
4. Karsyata: Excessive emaciation is caused by the intake of ununctuous diets, drinks, fasting, intake of food in inadequate quantity, overadministration of elimination therapies, and grief suppression of natural urges including the urge for sleep.[11]
5. AshmariRoga: Running, fasting, swimming, etc., aggravates the pain in the patients of Ashmari.[12]

**Langhana Karma as Treatment Measure in Following Disease**

1. Jwara: The Doshas residing in the Amasaya, destroy the fire, become Sama, obstruct the passages, and produce fever, therefore, Langhana should be done.[13]
2. Gulma: In the case of Kaphaja Shula, Yamana, Langhana, Mardana, Swedana, KshapanaKarma should be done. Snehana, etc., karmas should be done in all type of Gulma on the basis of Dosa and condition.[14]
3. Avipakaja shula: In the case of Avipakaja shula, Yamana, Langhana, Swedana, Pachana, Phalavarti, Khsara, Churna, and Gutika are used.[15]
4. Chardi Vega Dharana Janya Vyadhi: Induction of vomiting, smoking, fasting, etc., are indicated in diseases caused by suppression of urge of vomiting.[16]
5. RaktaajaVikara: Langhana is the one of the treatment measures in the vitiation of Rakta.[17]
6. Amasayotha Vikara and Jwara: Diseases having their origin from Aamasya are cured by fasting. Fasting is a therapy for the cure of fever alone.[18]
7. Vrisuchika: During treatment of Vrisuchika Langhana should be given firstly followed by management given after Virechana.[19] In the case of curable Vrisuchika,
Dahana karma should be done on both Parshini along with this, Teeksha Yamana, Agni-Seka should be done in Amavastha. If Doshas are about to Pakwa condition, then Langhana Karma and Swedana Karma should be done for Pachana and also Virechana Karma should be done.\(^{20}\)

8. As a type of AptarpamaVidhi: Aptarpama is of three types - Langhana, Langhana Pachana, and Dosasvechana.\(^{21}\)

9. Sleshma Prakopa: Running, fasting, swimming, whirling, sleeping, awake during night, fighting, sexual intercourse, exercise, unction, bath, and oil massage are some of the measures in the management of Slesma Prakopa.\(^{22}\)

10. Jwara: In the first stage of Jwara fasting is described. It is however not indicated in the Jwara caused by consumption, aggravation of Vayu, fear, anger, passion, grief, and physical exertion.\(^{23}\) Fasting, fomentation, time or passage of 8 days, medicated gruels, and drugs having bitter in taste. These help in Pachana of Avipkva Doshas in the first stage of fever.\(^{24}\) Langhana therapy and similar other therapy described in the 22 chapter of Sutra Sthana should be invariably administered in following condition - first, when the Jwara in the Sama state. Second, when Kapha is aggravated to produce the Jwara. Third, when both the Kapha and Pitta are aggravated together.\(^{25}\) The Doshas residing in the Amasaya, destroy the fire, become Sama, obstruct the passages, and produce fever, therefore, Langhana should be done.\(^{26}\) In patients of Jwara having unstable Dosha and Agni, Langhana should be done to digest AamaDosha. Langhana destroys the Jwara, stimulates the Agni, and increase the interest in food and makes the body light.\(^{27}\)

11. Vishama Jwara: When Kapha is predominant then for the patient emetic therapy, Pachana, ununctuous diet and drinks, fasting, and hot decoction are useful.\(^{28}\) On the day of onset of fever, either Langhana or Bringhana should be adapted first.\(^{29}\)

12. Raktapitta: Keeping in view the tracks through which the diseases is manifested, the association of Doshas and the causative factors, a physician should administer either Langhana or Tarpana therapy in the beginning of Raktapitta.\(^{30}\) On the basis of the condition of Desha and Kala, treatment of Raktapitta should be commenced either with Langhana or Bringhana with either Sodhana or Shamana.\(^{31}\)

13. Sotha: If Svayathu is caused by Ama, then the patient should be given fasting therapy, Pachana and Shodhana, i.e., elimination therapy to alleviate the predominant Dosa involved in the pathogenesis of this disease.\(^{32}\) For their treatment, Siruyadh, Kayavireka, and Dhooma, intake of old ghee, and fasting should be administered.\(^{33}\)

14. Jaalagadrabha: Fasting, bloodletting, therapy causing dryness, purificatory therapies, recepies of Dhatri, and cold application of body should be done always in Jalaagardhabha.\(^{34}\)

15. Pittaslesmic Arsha: If there is predominance of Pitta and Kapha, the patient should be administered elimination therapies. However, bleeding should not be stopped immediately and one should wait for appropriate time or the patient can be given fasting therapy.\(^{35}\)

16. Raktarsha: When the blood is vitiated, Sodhana and also Langhana should be done depending on the strength of person.\(^{36}\)

17. Ama (Grahani): If the Dosa as are in its Ama stage and pervades other parts of the body, then the patient should be made to fast and be given drugs conducive to Pachana of the undigest material, e.g., Vayagu.\(^{37}\) In condition of Ama, Langhana should be done. In condition of Vidagdhata, emesis should be done. In Vistabdha, fomentation should be done and in Rasshesajeerna sleep should be advised.\(^{38}\)

18. Atisara: If the Doshas are only slightly aggravated and causing diarrhoea, then fasting therapy is very useful.\(^{39}\) In the case of Slesmatisar, Langhana, and Pachana, therapy should be prescribed initially.\(^{40}\) For the treatment of Atisara, Langhana should be done initially, and then, Vayagu, made of Pachana drugs, should be given.\(^{41}\)

19. Chardi: Since all the varieties of Chardi are caused by agitation of Doshas in the stomach, Langhana therapy should be administered for their cure. These fasting therapy should not be administered to a patient suffering from Vatika type of Chardi.\(^{42}\) In general, vomiting arises from the upward movement of the Doshas localized in the Amasaya, hence for them, Langhana is ideal in the beginning itself except in that caused by Vata.\(^{43}\)

20. Pratisyaya: Pratishyaya associated with Yamana, Angasada, Jwara, Gaurava, Aruchi, Arti, and Atisara, etc., should be treated by Langhana initially and then by Deepana and Pachana.\(^{44}\)

21. Avarana Vata Chikitsa: When the Vata is Sama, it should be made Nirama by treatments such as Svedana, Langhana, Pachana, application of pastes, and pouring medicinal liquids which are dry, and then, the treatments suitable for Vata alone should be given.\(^{45}\)

**CONCEPT OF GURVADI GUNA**

These are also known as Sharir gunas as they are found in the body tissues and substances influencing them. While describing Samanya gunas, description of these Gurvadi gunas along with Paradi gunas is given by Acharya Chakrapani. Both these groups of Gunas Gurvadi and Paradi are present in Panchmahabhutas, i.e., Prithvi, Jala, Vayu, etc. Hence, these Gunas are important part in treatment part of view also while application of Samanya-visheshas Siddhant, etc.\(^{46}\) There are twenty Gurvadi guna appearing in ten pairs and each pair having opposite characteristics.\(^{47}\) Charaka, Sushruta, and Vagbhata has mentioned the same number of Gurvadi Gunas, but there are some differences in type of Gunas considered by these Acharyas which is given in following Table 1.

Comparison between two Gunas in each pair relatively explains the counteraction and usefulness as per the requirement.
FUNCTIONS OF GUNAS MENTIONED IN LANGHANA KARMA

1. Ushna guna: It is opposite to sheeta guna, and especially helps in digestion.[48]
2. Ruksha guna: It is opposite to snigdha guna, and especially helps in stambhanakarma and generates kharata.[49]
3. Vishada guna: It is opposite to picchila guna and causes kledana, aachushana, and ropanakarma.[50]
4. Teekshana guna: It causes daha, paka, and sravanakarma.[51]
5. Laghu guna: It is opposite to guru guna and causes langhana, lekhana, and ropanakarma.[52]
6. Sara guna: It is responsible for anulomana karma.[53]
7. Sukshama guna: It is responsible for entry in the very minute spaces or pores in body.[54]
8. Khara guna: It is responsible for lekhana karma.

DISCUSSION

20 types of Gurvadi Gunas are described in Charaka Samhita (sharīr sthana 1), Susruta Samhita (sutra sthana 46), Astanga Hridaya (sutra sthana 1) and some other Samhitas of Ayurveda only. These are not described in Darshanas or anywhere else. These Gunas are considered and applied and searched out only in Ayurveda. These Gunas are described with relatives as Guru-Laghu, Sheeta-Ushna, etc. While other Gunas of three groups are not described in such manner because these Gurvadi Gunas are the backbone of the Ayurvedic therapeutic procedure. The Tridosha theory is the clinical basis, a specific classification of GurvadiGunas. These 7 Gunas of Vata, pitta, and kapha are related with Saptadhatus, each Guna for each Dhatu. The theory of Guna is the basis (especially Gurvadi Guna) of clinical evaluation of Dosha, Dhatu, and Mala as, for example, Kapha has Guru guna while Vata has Laghu. Vata has Sheeta guna while Pitta has Ushna. The relative Gunas such as Guru-Laghu and Sheeta-Ushna are sheltered in different three Doshas and have a role to antagonizing activity to maintain the normal status. These Gunas are also responsible to produce the disease, while the virtue of these Gunas any Dosha becomes aggravated. In other word, it can be said that Doshas takes aggravation through Gunas. The “Anshansha Kalpana” (clinical gradation) is based on these Gunas. Any Dosha can aggravate with one Guna, two Gunas, or more. The gradation of aggravated Dosha depends on the increase or decrease state of Guna.

“Sadopkrama” has the meaning of six procedures of treatment. Langhana is one of them. These six are based on Gunas. Over fulfillments or oversaturation results the disease and those diseases are known as “SantarpanaJanyaRoga.” Unsaturated states of Dhatus also produce different types of diseases, which are known as ApatarpanaJanyaRoga. Hence, only two ends are planned in Ayurveda “to increase” or “to decrease” which is known as Langhana-Bringhana or Santarpana-Apatarpana. Among six procedures, some have Langhana effect and some have Bringhana effect. In these six procedures, first of all the Langhana and bringhana have been listed and to support these, remaining four procedures are described. For Langhana Karma, Rakshana, and Svedana are supporting procedure. Langhana is the first Upakrama described among Sadopkrama. The various meanings of Langhana are mentioned from literature point of view, but from medical point of view, Langhana term is applied in meaning of lightness of body. It is responsible for decreasing the Dhatu, Amadosha, Mala, etc. The procedure which reduces

<table>
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<tr>
<th>Pair of Gunas</th>
<th>Charaka Samhita</th>
<th>Sushruta Samhita</th>
<th>Astanga Hridaya/Sangraha</th>
<th>Rasa-Vaisesika</th>
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<td>Slakshna-Khara</td>
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the body weight, body shape, and Shariri Dhatu is known as Langhana. Commonly, the Langhana word is applied for fasting. This procedure is applied as elimination therapy or to minimize the Dosha, Dhatu, and Mala, etc. In reference of Langhana therapy, some Gunas have been enumerated which support this procedure or the Dravya which have enumerated these Gunas, performs this procedure through the Gunas, i.e., Laghu, Ushna, Tiksha, Vishada, Ruksha, Sukshma, Khara, Sara, and Kathina. Among 20 Gurvadi Gunas, these 9 Gunas are mentioned in Langhana Karma. Out of these Gunas, Laghu, and Ruksha Guna are directly responsible and abundantly used in effect of Langhana karma. This procedure can be followed or proceed in different way which have been mentioned as four types of Sodhanachikitsa, Yamana, Virechana, Vasti, and Nasya, minimizing the fluid/liquid intake, exposure to wind, exposure to sun/heat, application and use of Dravyas which accelerates the digestive process, fasting, and physical exercise, etc. These processes can be applied for a selective stage. This Langhana has been also indicated in two ways as Shodhana and Shamana. The good selection of patient is must for this process as in case of skin diseases, especially in patient of overweight or in case of fat, etc.

Some cases are contraindicated for this process such as Vataja Gulma. This Langhana mainly effects on Ama, Atsisnigdha, and Abhisyandi condition, but its clinical scope is very large. It has been considered as the best procedure for prime disease Jwara along with the diseases produced by sustained Chardi, Raktavikara, Viscuchika, Slesma Prakopa, etc. This process is a chief process of Aptrarpana Chikitsa. If this process is continued for long time in normal state or not needed state, various abnormalities and diseases may occur such as Raajyakshama (loss of immunity), Vatajaarsha, especially Karshyaroga, pain in Ashmari. This process is a specific treatment of Stulata/Shaulya. The particular process of this procedure is applied for the proper state as for fasting is the proper process in Jwara and other Amavastha, the Vyayama is suitable process for a Shaulyata or obesity, etc. Clinically, this process may be applied in daily practice.

CONCLUSION

1. Gurvaadi Guna (20 in number) are the specific contribution of Ayurveda and the theory of Gurvaadi Guna has been developed from the clinical point of view.
2. The entire clinical principles are established keeping the view of importance of Guna. The chief principle of Tridosha theory is totally based on Gurvaadi Guna. The basis of drug application is Gurvaadi Guna.
3. The Langhana karma along with other Upakramas of Sadopkrama theory is based on Gurvaadi Guna directly, and this Langhana Upakrama has been established to maintain the Dhatusamya.
4. The Dosha, Dhatu, and Mala have characteristics to gain the state of Vridhdi and Kshaya and Langhana and Bringhana are applied in case of Vridhdi and Kshaya, respectively.
5. The patient visits in hospital in two conditions: first in entitled diseases such as Jwara and Kamala and second in abnormal state of Dosha, Dhatu, and Mala.
6. The Langhana karma may be applied as a perfect therapy for increased and Sama state of Dosha, Dhatu, and Mala and supporting/prime therapy for the diseased condition.
7. This work is totally conceptual. In this study, the concept of Guna related with Langhana karma has been discussed, and this procedure requires further development from the clinical point of view with clinical assessment.

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Brief review of commonly used herbal drugs in ayurvedic management of chronic kidney disease

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Abstract
Chronic kidney disease (CKD) refers to a spectrum of different pathophysiologic processes associated with abnormal kidney function and a progressive decline in glomerular filtration rate over many years. CKD is recognized as a major health problem affecting approximately 14% of the United States population. Numbers of prevalent CKD patients are continuous rising, reflected in the growing elderly population and increasing numbers of patients with diabetes and hypertension. Unfortunately, from India, there is limited data on the prevalence of CKD. In India, diabetes and hypertension account for 40–60% of CKD cases. In this study CKD is chosen, as in present scenario the cost of dialysis is very high and cannot be afforded by every patient and understanding this by means of principles explained in Ayurveda is necessary to manage the disease and make the patient comfortable to perform his daily routine. CKD patients treated with Ayurvedic Herbs such as Punarnava and Gokshur may prolong dialysis time or reduce its frequency.

Key words: Chronic kidney disease, Gokshur, Punarnava

INTRODUCTION
Renal disorders have always remained a major area of concern for physicians for a long time. The chronic kidney disease (CKD) is defined as a reduction in kidney function over many years and is characterized by anuria, dysuria, and retention of urine. The kidneys regulate the composition and volume of blood, remove metabolic wastes in the urine, and help control the acid/base balance in the body. They activate Vitamin D needed for calcium absorption and produce erythropoietin needed for red-blood-cell synthesis. Kidney also makes an enzyme, renin which affects blood pressure through negative feedback. CKD is characteristically a progressive disease.[1] Reduction of kidney function defined as a glomerular filtration rate (GFR) <60 mL/min/1.73 m² for 3 months or more with or without evidence of kidney damage.[2]

Based on recent guidelines of the National Kidney Foundation[3] (Kidney Dialysis Outcomes Quality Initiatives), in which stages of CKD are described as follows:

<table>
<thead>
<tr>
<th>Stage</th>
<th>GFR, ml/min per 1.73 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&gt;90*</td>
</tr>
<tr>
<td>1</td>
<td>&gt;90</td>
</tr>
<tr>
<td>2</td>
<td>60–89</td>
</tr>
<tr>
<td>3</td>
<td>30–59</td>
</tr>
<tr>
<td>4</td>
<td>15–29</td>
</tr>
<tr>
<td>5</td>
<td>&lt;15</td>
</tr>
</tbody>
</table>

*With risk factor for CKD. *With demonstrated kidney damage.

CKD: Chronic kidney disease

The three most common causes of CKD are diabetes mellitus (40%), hypertension (30%), and glomerulonephritis (10%). Together, these cause approximately 75% of all adult cases. Various risk factors for CKD are hypertension, diabetes mellitus, autoimmune diseases, elderly age, family history of renal disease, previous episode of acute kidney injury, the presence of proteinuria, abnormal urinary sediments, and structural abnormalities of the urinary tract.

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A large number of chemicals in common use are potential renal toxins. The prevalence of CKD is increasing worldwide. Most chronic nephropathies lack a specific treatment and progress relentlessly to end-stage renal disease. The prevalence of CKD is high in developing countries. The prevalence of CKD was high in north and southwest regions compared with other regions. As CKD is a morbid and costly disorder with a significant proportion of patients progressing to an end-stage renal disease requiring dialysis. On the contrary, the middle class/lower class cannot afford treatment such as regular dialysis and renal transplant. Many people discontinue the treatment as they cannot afford dialysis.

Being an ancient science (the Upaveda of Atharvaveda), Ayurveda views Urinary system differently from the modern medical science. Accordingly, three types of excretory products of the body, i.e., Purisha (Faeaces), Mooтра (Urine), and Sweda (Sweat) are eliminated through three different routes, and for these three Malas, separate Srotas are described in our classical texts. According to the Ayurveda, waste products will be produced at the end of the metabolic activity of their described Srotas so as the Urine. Every Srota as the last part of its activities produces some amount of “Kleda” (waste metabolic product) which is carried to the kidneys (Vrikkas) by Udak dhatu on one side while major part of urine is formed as the liquid fraction of “Kitta” which is the end part of the process of digestion. Pakvashya is the place where the Sar (useful) and Kitta (waste) are differentiated, and the liquid formation of Kitta is absorbed by several “Mootravaha Nadis.”[4] According to the modern medicine, the “Pakvashya” is a large, water and electrolyte absorbing structure. The activity of substances produced by or traveling through any system is divided into two parts, namely A) Poshaka (i.e., precursor) and B) Poshya (i.e., formed). The urinary system in Ayurveda can be explained by the Poshaka, and Poshya concept as the Poshaka division of Urine is formed in the Pakvashaya itself, while Poshya-Poshaka fraction in the kidneys (Vrikkas). The role of Samana and Apana Vayu is equally important in this process of Poshaka Mootra - Poshya Mootra transformation as Samanavayu travels all over the Koshta and leads to the formation of Poshaka where Sookshmapachana (micro digestion) takes place, and the role of Apana Vayu is for the excretion of many substances.[9]

However, in Ayurvedic classical texts, there is no any clear description about the role of the kidney in the formation of urine. Ayurvedic texts have described the urinary system by the name “Mootravaha Srotas” in all its basic texts. Several diseases such as Ashmarem, Ashtheela, Mootraghat, and Mootra vega dharana have been described in details by Acharya Charaka, Sushruta, and Vagbhata in their texts along with treatment and diet regimen. According to Acharya charak the causes of mooatra dosha vikar are vitiated by the intake of drinks and food, sexual intercourse while having the urge for micturition, and suppression of the urge of micturition, disorders of wasting or malnutrition and severe traumatic injury.[6] In Charak samhita described that Kidney and bladder are the root (controlling organ) of the channels carrying urine and fat, the opening of these channels get affected by fat, mansa, and liquid dhatu of the body. The vitiated doshas while coming in contact with the opening of these channels obstructs them. This results in the manifestation of kidney disease which becomes chronic or incurable due to the affection of all the qualities of doshas and also due to the simultaneous vitiation of homogenous and heterogenous dhatus.[7] The use of herbal drugs for the prevention and treatment of various diseases is constantly developing throughout the world.

According to modern medical sciences, the causes of CKD are many, but three most common causes of CKD are diabetes mellitus (40%), hypertension (30%), and glomerulonephritis (10%). Together, these cause approximately 75% of all adult cases. The most frequent cause is diabetic nephropathy as the high levels of sugar damage the kidneys over several years, and results in a reduced ability to filter blood and excrete waste products in the urine. Hypertensive nephropathy is a common cause in elderly leads to damage of small blood vessels. When small blood vessels in the kidneys that filter the blood are damaged, kidney failure results. Glomerulonephritis may cause a small output of urine, the spilling of blood and protein into the urine, and body swelling. Long-term or repeated kidney infections can also damage the structure of the kidneys, reducing the kidney’s capacity to filter blood.

Aims and objectives

In the present study CKD is chosen, as in present scenario peoples are not well aware about the importance of kidney for their health, so the study is chosen to raise awareness of the importance of our kidneys to our overall health and to reduce the frequency and impact of kidney disease and its associated health problems worldwide. This study is done with an aim to review the recent study done on some common herbs used in India.

MATERIALS AND METHODS

This study is done by going through the literature search in the classical texts, and the pathogenesis of kidney disease and various studies on herbs were obtained by searching various medical research databases such as PubMed, Google Scholar, and other national research databases and in the classical texts. The term entered for search is “CKD,” “chronic renal failure,” and “nephropathy,” “nephroprotective drugs,” “renal disorder,” and “nephrotoxic drugs.” Manual search was made by going through the reference list of retrieved articles to identify
relevant additional study. The study of various Ayurvedic texts was made critically, and a review of the action of commonly used herbs in India had been made.

**OBSERVATIONS AND DISCUSSIONS**

According to Acharya charak, Mootra Dosh Vikara is treatized by Punarnava, Gokshur, Pashanbhedha, Kusha, Kash, etc.\[8\]

Haritaki (Terminelia chebula) is used with Gomutra in edema (shotha) produced due to kidney disorders.\[9\]

Shilajeet used with Triphala Kwath is also helpful in alleviating the edema in kidney disorders.\[10\]

Punarnava (Boerhavia diffusa) has the constituent Punarnavoside is reported to have diuretic, anti-inflammatory, antifibrinolytic, and antibacterial properties. Of the two lignans Liriodendrin and Syringaresinol mono-β-D-glucoside found in the root extract of Punarnava, liriodendrin has a significant calcium channel blocking effect. Calcium channel antagonists or calcium channel blockers are drugs which relax the smooth muscle cells, thereby reducing muscle spasms. They relax blood vessels and lower blood pressure, which are useful in the treatment of kidney disorders produced due to hypertension. The diuretic action of the herb is attributed to the presence of the xanthone beta-ecdysone. Punarnava also has antimicrobial, anti-inflammatory, and antispasmodic properties, which are beneficial in treating urinary tract disorders such as chronic and recurrent urinary tract infections (UTIs), including UTIs in pregnancy. The herb has been reported to increase serum protein levels and reduce urinary protein excretion in clinical trials in patients suffering with nephrotic syndrome. The activity is attributed to the presence of rotenoids in various parts of the plant. Punarnava also reduces edema associated with kidney dysfunction.\[11\]

Gokshura (Tribulus terrestris) also plays an important role in kidney disorders as it has diuretic property due to large quantities of nitrates, potassium salts, and essential oil present in its fruits and seeds and its diuretic action is very useful in hypertensive patients. The ethanolic extract of Gokshura inhibits the expression of cyclooxygenase-2 and induces nitric oxide synthase in lipopolysaccharide-stimulated cells. It also suppressed the expression of pro-inflammatory cytokines such as tumor necrosis factor-alpha and interleukin-4 in macrophage cell line. Hence, it has a beneficial effect on various inflammatory conditions.\[12\]

Mahanimba (Melia azadirachta) an experimental study was conducted, and oral administration of ethanol extract of M. azadirachta against Acetaminophen-induced nephrotoxicity in albino rats shows that oral administration of ethanol extract of M. azadirachta has significantly decreased the concentration of urea and creatinine. Based on this study, it can be concluded that the prolonged use of an extract of M. azadirachta decreases the renal disorder.\[13\]

Various studies demonstrate that mild and moderate CKD is associated with chronic inflammation and low antioxidant activity. Systemic inflammation and impaired antioxidant status may be greater in CKD populations with multiple comorbidities. Haridra (Curcuma longa) contains Curcumin and Shallaki (Boswellia serrata) contain boswellic acid, so both are safe and tolerable and helped to improve the levels of an inflammatory cytokine.\[14\]

Anantmool (Hemidesmus indicus) was found on study base that aqueous and methanolic extracts have a more significant inhibitory effect on saltwater feeding induced severity of microalbuminuria, serum urea and creatinine, myocyte diameter and retention of sodium and water, and increases the serum calcium level. It is potent natural nephroprotective also a cardioprotective.\[15\]

Kakmachi (Solanum nigrum) was found that renal markers (urea, serum creatinine, and uric acid) were brought back
to normal. Thus, it is inferred that *S. nigrum* preserves the functional capacity of the kidney against ethanol toxicity [Table 1].

**CONCLUSION**

According to Ayurveda CKD is a principal disorder which is described in term of Mutra Dosh Vikar and mentioned as a cause of edema. Treatment should be prescribed in both the conditions. Remedies should be diuretic and anti-inflammatory as well as being electrolytes filtration.

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Medicinal use of ashwagandha (*Withania somnifera*) and its cultivation possibilities in Vindhyan Region, Uttar Pradesh, India

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Abstract

Ashwagandha (*Withania somnifera*) is also known as Indian ginseng. The roots of ashwagandha smell like horse and it vitalizes body; its plant has been traditionally used in Indian medicines such as Ayurveda. It has been used for more than 3000 years, and also, its different plant parts, i.e., seeds, root, and leaves are used for preparing various drugs. Ashwagandha is a very powerful ancestral plant which has allowed it to persist through centuries of use to become one of best known in the world today. The crop is cultivated in many states, and Madhya Pradesh, Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, and Maharashtra are major growing states in India. The plant is hardy even in drought conditions and resistant to major pests and infestations. It can be cultivated equally as a rainfed and irrigated crop. Ashwagandha is grown in deep-rooted and well-drained sandy loam or red soil with good drainage facilities, having pH in the range of 6.5–8.0. Waterlogged and eroded soil is not suitable for cultivation, and good quality seeds on different varieties of ashwagandha should be used in cultivation.

Key words: Ashwagandha, medicinal plant, Vindhyan region

INTRODUCTION

Ashwagandha (*Withania somnifera*) is also known as Indian ginseng. The roots of the plant have been traditionally used in Indian medicines such as Ayurveda and unani. Ashwagandha is called winter cherry in English, Ashgandh in Hindi, Ammukiranakazangu in Tamil, Amangura in Kannada, Aasvagandhi in Telugu, and Trittavu in Malayalam. Ashwagandha is originated in India and is used very often in Ayurvedic medicine. It has multiple medicinal property and used in the oldest Indian medicine system in the world.[1] The name “Ashwagandha” is derived as its roots smell like horse and it vitalizes body. It has been used for more than 3000 years, and different plant parts such as seeds, root, and leaves are used for preparing various drugs. All the plant parts are credited with medicinal properties.[2] Ashwagandha is a very powerful ancestral plant which has allowed it to persist through centuries of use to become one of best known in the world today. It is used for medicinal purpose for stress reliever, to treat senile dysfunction, and also, to control anxiety, depression, phobia, schizophrenia, etc. It is a branching shrub with an average height of 30–120 cm with fleshy, whitish brown roots. Flowers are greenish in color with orange-red berries.

The Vindhyan region is a complex, alternating chain of mountain ridges, hill ranges, highlands, and plateau escarpments in West Central India. The Vindhyan region consists of the Vindhyan plateau and the hills in the southern part of the state and lies between 23°52’ and 24°21’ N Latitude to 82°42’ and 88°24’ E Longitude. Most area covered in Vindhyan region is basically undulated land and soil of this region is having low fertility and low organic carbon content, but most of the area has red lateritic soils with often pronounced nodules locally called “Murram.” The depth of the soil also varies, and much of the area has a soil depth of just a few centimeters. Deep and fertile soils are often found in the valleys between folds of hills where the soil washed from hill slopes has accumulated. Hence, the topography presents a contrast from bare rocky outcrops alternating with good deep soils. The climate of the area is characterized by a long and intensely hot summer, low rainfall, and a short mild winter. The hot weather usually

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begins from the middle of March and extends up to the break of the monsoon till June. The summer temperature goes up to 48°C in May and June. However, the average temperature range varied from 80 to 34°C. The rainfall varies from 750 mm to about 1150 mm. Most of the rainfall occurs in June, July, and August. There is a little winter rain also which occurs generally in January and February and is sometimes substantial, fairly regular as compared with other part of the state. Vindhyan region shows good possibilities in the cultivation of Ashwagandha. This paper details about the cultivation and medicinal use of Ashwagandha on Vindhyan region of Uttar Pradesh, India.

AREAS UNDER CULTIVATION

The global demand compared to supply for roots of Ashwagandha is high, and hence, it provides sufficient scope to cultivate it on commercial scale. The crop is cultivated in different states in which Madhya Pradesh, Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, and Maharashtra are major growing states in India. The plant is hardy even in drought conditions and resistant to major pests and infestations. It can be cultivated equally as a rainfed and irrigated crop.

FIELD PREPARATION

Ashwagandha is generally grown in deep-rooted and well-drained sandy loam or red soil with good drainage having pH in the range of 6.5–8.0. Waterlogged and eroded soil is not suitable for cultivation of Ashwagandha. The soil should be loose, deep and black or heavy soils having good drainage are also suitable for cultivation of Ashwagandha. Land preparation for Ashwagandha plantation is done in April–May; it requires well pulverized and leveled soil. For fine tilth, the field is ploughed 2–3 times and ploughing or harrowing should be done before rains. Spread 10-20 tones of farm yard manure, 15 kg of nitrogen and 15 kg phosphorus per ha required as a nutrient dose to the soil. At the time of land preparation, FYM should be mixed with soil, and then the field is leveled with planking. There is no use of chemical fertilizers and pesticides as it is a medicinal plant and grows through organic sources. Some organic sources such as FYM, vermicompost, green manure, concentrated organic manures, and crop residues are used as per requirement.

VARIETIES OF ASHWAGANDHA

1. Jawahar Asgand-20: High alkaloid variety, developed by Jawaharlal Nehru Krishi Vishwavidyalaya, Madhya Pradesh. These are short plant height and grow in higher planting density. The crop yields in 180 days with a total withanolide content of about 0.30% in dry roots.

2. Jawahar Asgand-134: It is a very high alkaloid variety, grown in Madhya Pradesh. It is developed by Jawaharlal Nehru Krishi Vishwavidyalaya. Plant height is short and is known for its higher density planting. The crop yields in 180 days with a total withanolide content of about 0.30% in dry roots.

3. Raj Vijay Ashwagandha-100: It is also developed by Jawaharlal Nehru Krishi Vishwavidyalaya, Madhya Pradesh.

4. Rakshita and Poshita: These are high yielding varieties developed by CSIR-Central Institute of Medicinal and Aromatic Plant, Lucknow.

5. WSR: Developed by CSIR-Regional Research Laboratory, Jammu.

6. Nagori: It is a local variety with feature of having starchy roots.

SEEDS AND SOWING

For good quality crop, seeds of different varieties of Ashwagandha are used in cultivation and 4–5 kg seed is used per acre. To protect crop from seed borne disease and pest, before sowing, do treatment with thiram or dithane M-45 (Indofil M-45) at 3 g/kg of seeds. After treatment, the seeds are then air dried and used for sowing. Spacing of the Ashwagandha plantation depends on the growth habit and germination percentage of seed, normal spacing used for Ashwagandha plantation is about 20–25 cm line-to-line distance 10 cm plant to plant distance, and seeds are usually sown about 1–3 cm deep.

NURSERY MANAGEMENT AND TRANSPLANTING

Before transplanting, field must be ploughed by Mould Board Plough and harrowed twice to bring the soil in fine tilth and fill the soil with plenty of organic matter to nourish the soil. Treated seeds are sown on raised nursery bed. The seeds germinate in 5–7 days and are ready for transplantation in about 35 days. The water is applied in appropriate amount before transplanting so that seedling can be easily uprooted. Nursery of Ashwagandha is prepared in June–July.

Irrigation

Excess irrigation may harm the crops. If rainfall is heavy, then irrigation is not required otherwise 1 or 2 times irrigation is necessary in the crops. Under irrigated conditions, the crop can be irrigated 1 time in 10–15 days. First irrigation should be given after 30–35 days from germination, and then, second irrigation is provided after 60–70 days from first irrigation.
**PLANT PROTECTION**

**Weed control**

Normally two weddings are done to maintain the field free from weeds. First wedding is done in 20–25 days of sowing and second wedding after 20–25 days of first weeding. The dose of isoproturon 1.5/kg and glyphosate 1.5/kg should be used before sowing the seeds to control the weeds.

**Aphids**

It is a small bug which feeds by sucking sap from plants. They reproduce rapidly and cause extensive damage to plants. Imidacloprid 18.5% SL as foliar spray at 10-15 days interval should be applied.

**Shoot borer**

This insect belongs to Lepidoptera order. It is creamy in color with brown head and mainly infests leaf and shoot of a young mature plant. This borer can be controlled with the spray of indoxacarb 14.5 SC at 0.5 ml/L.

**Disease and their control**

Diseases such as seedling rot, leaf spot, and blight are seen in crop. To prevent from these diseases, it should be sprayed with dithane M-45 at of 3g/L of water, when crop is 30 days old and the spray should be repeated at 15 days interval if the diseases persist.

**HARVESTING AND STORAGE**

Plant starts yielding 160–180 days. Harvesting is complete in the dry weather when leaves are drying and berries change its color into red–orange. Harvesting is finished by hands by uprooting the whole plant or through machines such as power tiller without damaging the roots. The roots are removed from the plant and cut into smaller pieces, i.e., 8–10 cm in length, and then, it is air dried and graded. The root pieces are stored in tin containers for sale. The higher the length of root pieces, the higher it will fetch the price. Berries are plucked separately, and then, they are air dried and crushed so as to take out the seeds.

**CHEMICAL COMPOSITION**

Whole plant of ashwagandha contains different chemical compounds, and Whole plant of Ashwagandha contains different phyto chemical compounds includes alkaloids (isopelletierine, anaferine, cuseohygrine, anahygrine,[5] Steroidal lactones (withanolides, withaferins) and saponins, Sitoindosides and acylsterylglucosides are anti-stress agents. Active principles of ashwagandha, for instance, the sitoindosides VII-X and withaferin-A, have been shown to have significant anti-stress activity against acute models of experimental stress.

**MEDICINAL USE**

The leaves of ashwagandha plant has anti-inflammatory, hepatoprotective, and antibacterial properties and used for treating several health problems such as tumors, tuberculous gland, swelling, inflammation, boils, conjunctivitis, and blood purification. Its leaves are also very good for weight loss. The plant is being extensively used in traditional system of medicine for treating many ailments of animals and humans.[6] Diuretic activities are shown by fruits and seeds of plant, and roots of plants[7] are numerable pharmacological properties and below are listed some of them:

- Analgesic: Relieve pain.
- Antianemic: Treat or to prevent anemia.
- Adaptogen: Substance considered helping the body adapt to stress.
- Anti-inflammatory: Reducing inflammation by acting on body mechanisms.
- Antioxidant: Neutralize the oxidant effect of free radicals and other substances.
- Antitumor: Inhibiting the growth of a tumor or tumors.
- Antidepressant: Prevent or treat depression.
- Aphrodisiac: Stimulates sexual desire.
- Immunomodulatory: Modifies the immune response or the functioning of the immune system.
- Phytoestrogen: Plant-derived estrogens not generated within the endocrine system but consumed by eating phytoestrogenic plants.
- Reproductive tonic: Tonic for reproductive organs.
- Sedative: Promoting calm or inducing sleep.
- Tonic: Restore or improve health or well-being.

**HEALTH BENEFITS**

- It is natural antioxidant.
- It supports better sleep.
- It improves energy level.
- It stabilizes on blood sugar and lowers cholesterol.
- It helps to reduce the level of stress and tension.
- It increases hemoglobin (red blood count) and hair melanin.
- It helps to lower blood pressure and is highly effective in stopping the formation of stress-induced ulcers.
- Ashwagandha is anabolic in effect and mainly considered to help in weight gain.
- It also helps to lose weight by reducing swelling in body and improving hemoglobin level.
It is a tonic that nourishes the whole body. In weakness, low body weight, emaciation, deficient hemoglobin, anemia, post convalescent weakness, and such other condition, its use gives good result.

It is useful for any imbalance in the muscles as it reduces inflammation and strengthens muscles.

It improves body immunity and strengthens body defense system.

It gives good results in nerve-related conditions such as multiple sclerosis, neurosis, insomnia, anxiety, and stress.

It is used to enhance memory and lesson age-related cognitive deficits.

It may help prevent tolerance and dependence with morphine.

CONCLUSION

The Vindhyan region of Uttar Pradesh has rich medicinal wealth, which has got wonderful commercial national as well as global potentials. This region is a native of many important medicinal plants and has a great potential for their conservation and cultivation. Hence, the cultivation of Ashwagandha can be promoted in this region, in conjunction with marked facilities for the product. However, there are many challenges such as price fluctuations of roots, limited exports by companies, long duration of the crop, low root yields, high fiber content of the roots in some locations, and long-term storage of roots. These challenges may be overcome, by policy formation for promoting medicinal plants and providing skills to farmers for advanced methods of cultivation practices and use of high-yielding varieties.

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Pharmacognostical and phytochemical evaluation of *Tephrosia purpurea* (Linn.) Pers.

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Abstract

The plant *Tephrosia purpurea* (Linn.) Pers. belonging to the family Fabaceae, reach in prenylated flavonoids, is used by the several ethnic groups for its anthelmintic activity. It is also described in traditional medicine for the treatment of splenomegalgy and hepatic disorders. This present study was performed for the identification of the plant by macroscopical, microscopical, physicochemical, and quantitative study using standard methods. Characters of leaf are, namely, erect, nerved, entire, oblanceolate in shape and 7–10 cm long, 11–15 leaflets (2–2.8 cm × 0.8–1.2 cm), and one terminal leaflet at the appendage. 7–12 mm long petioles, cuneate base, having aromatic, characteristic odor, and unpleasant bitter taste were found in macroscopical study. The unicellular trichomes, uniform cuticle, palisade cells, and collateral type vascular bundle were observed in the transverse section (T.S.) of leaflet. The sclerenchymatous cells, medullary rays, and lignified xylem were observed in the T.S. of stem and root. The calcium oxalate crystals were observed in the pith region of the section of stem. Fluorescence study, ash, extractive, saponification, and acid values were estimated as per the WHO guidelines. The presence of secondary metabolites such as flavonoids, proteins, carbohydrate, steroids/terpene, and phenolics was confirmed, and concentration of heavy metals was also measured. The present study was performed to compile the suitable monograph for the identification and to ensure the purity of crude material of *T. purpurea* (Linn.) Pers.

Key words: Tephrosia purpurea, Sharapunkha, Isoflavones, Chalcones

INTRODUCTION

*Tephrosia purpurea* (Linn.) Pers. belongs to the family Fabaceae, its English name is “Purple Tephrosia” or “Wild indigo,” and in Sanskrit known as Sharapunkha is a highly branched, suberect, and herbaceous perennial herb. In Ayurvedic literature, it is named as “Sarwa wranvishapaka” which means it has property of healing all types of wounds.¹ The generic name *T. purpurea* is derived from the Greek word tephros, means “ash-colored,” giving the grayish tint on to the leaves. *Tephrosia* is a genus of flowering plants in the pea family, Fabaceae, having more than 400 species.² It is the native plant of Africa, Southeast Asia to Australia, Western part of Pacific, China, Sri Lanka, and India. In India, Andhra Pradesh, Haryana, Rajasthan, and Tamil Nadu are the places where *T. purpurea* found.³ This genus has rich amount of prenylated flavonoids.⁴ Phytochemical screening of the plant shows the presence of rotenoids, iso flavones, flavanones, chalcones, sterols, flavonols, and flavones.⁷ The whole plant is anthelmintic, alexeteric, antipyretic, use in liver diseases, spleen, heart, blood, cures tumors, ulcers, leprosy, asthma, bronchitis, piles, caries of teeth, and used internally as a blood purifier. In Ceylon, it is employed as an anthelmintic for children.⁸ Infusion of seed is used as anthelmintic oil.⁹ Seeds oil used to treat eczematous itching, scabies, and for other skin disease. Seeds also used for piles, gonorrhea, and syphilis.¹⁰

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MATERIALS AND METHODS

Plant Material

Whole plant (fresh) and seeds of *T. purpurea* were collected from the Rajiv Gandhi South Campus, Banaras Hindu University, Mirzapur, Uttar Pradesh, India, in September month and whole plant specimen was authenticated at Botanical Survey of India, Howrah, West Bengal, India (plant identification letter: CNH/2017/Tech.II/48, specimen No. SK-01, Dated: 17-10-2017).

Preparation of Plant Extract

The collected seeds of *T. purpurea* were dried well and coarsely powdered with mechanical grinder, then sieved through 20 #. 5 g coarse powder was successively extracted by cold maceration process with 100 mL each of petroleum ether, chloroform, alcohol, and water by shaking continuously for 6 h and allowed to stand for 18 h. All the different extracts were filtered and concentrated under reduced pressure in rotary evaporator (Perfit India, Pvt. Ltd.) below 60°C and stored in a desiccators until its use.

Pharmacognostical Evaluation

**Powder study**

For the powder study, small amount of powder was stained with phloroglucinol:HCl (1:1), observed under microscope and pictures were taken at different magnifications.

**Macroscopical, microscopic, and powder evaluation**

The macroscopical evaluation of the whole plant parts, namely, leaf, stem, and roots of *T. purpurea* was performed by studying the different organoleptic characters such as size, shape, color, surface characteristics, odor, taste, and texture. For the microscopical studies, free-hand sections of the fresh leaf, stem, and root of plant were taken and washed with chloral hydrate. The sections were immersed into absolute alcohol to dehydrate and stained with phloroglucinol and conc. hydrochloric acid (1:1 v/v) and finally mounted with glycerin on slides and observed under Nikon trinocular digital microscope (Eclipse E200). Images were captured at different magnifications.

**Determination of physicochemical parameter**

Physicochemical standardization of seeds powder of *T. purpurea* was done using several parameters, namely, total ash value, acid-insoluble ash value, water-soluble ash value, loss on drying, and foreign matter, extractive values in organic solvents such as alcohol, chloroform, water, petroleum ether, foaming index, and swelling index, while saponification value and acid value were estimated using petroleum ether extract. All these standardization parameters were performed as per the WHO guidelines.

**Foreign matter determination**

The seeds of plant (250 g) were spread uniformly in the form of a thin layer without overlapping. The sample was inspected using magnifying lens (6×). Foreign matter was separated manually. After whole examination of sample, the foreign matter was weighed and percentage w/w present in the sample was calculated.

**Fluorescence analysis of powdered drug**

Fluorescence characteristic was carried out by treating the coarse powder of *T. purpurea* seeds with different reagents and observing in the visible light, short UV (254 nm), and long UV (366 nm).

**Phytochemical Evaluation**

**Preliminary phytochemical screening**

Presences of various phytochemical constituents were analyzed by preliminary phytochemical screening methods. For the detection of secondary metabolites such as alkaloids, carbohydrate, glycosides, saponins, terpenoids, phenolics, steroids, and flavonoids, and protein different extracts, namely, petroleum ether extract, chloroform extract, ethyl acetate extract, methanol extract, and aqueous extract of *T. purpurea* seeds were used.

**Thin-layer chromatography (TLC)**

TLC was used for the further confirmation of secondary metabolites in the various crude extracts of seeds. TLC was performed using silica gel 60 F254 as stationary phase and various compositions of different organic solvents with varying polarity were used as mobile phases to develop chromatogram. For the detection of components, various visualizing reagents including Dragendorff’s reagent (alkaloids), benzidine and sodium metaperiodate (glycosides/sugars), Liebermann–Burchard reagent (saponins/sterols/terpenoids), 5% ferric chloride (phenolics), and Sinoda reagent (flavonoids) were used.

**Quantitative estimation of heavy metals**

Heavy metals Zn, Cd, and Pb were quantitatively estimated in the powdered seeds of *T. purpurea*, using atomic absorption spectrophotometer (Shimadzu-AA6300).

RESULTS

Pharmacognostical Evaluation

**Morphological evaluation**

Leaves of the plant were found to be erect, nerved, entire, lanceolate in shape and 7–10 cm long having 11–15 leaflets
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(2–2.8 cm × 0.8–1.2 cm), and one terminal leaflet at the appendage. Upper surface was dark grayish-green, glabrous, while lower surface was light in color than upper having fine hairs. Length of petioles was 7–12 mm, cuneate base, and ascending slender. Leaves have aromatic, characteristic odor, and unpleasant bitter taste. Leaflets form tongue-shaped structure when break by stretched longitudinally. Seeds were light brown in color having dark brown spots. The stem was cylindrical, brown colored, woody, branched, bitter in taste, and odorless. Roots were small, pale yellow, cylindrical, odorless, and bitter in taste having many root hairs and small roots [Figure 1].

Microscopical evaluation

In the T.S., leaflet showed uniform cuticle or isobilateral in nature. The upper epidermis, mesophyll tissue, and lower epidermis were present in the lamina portion. Upper epidermis of lamina containing tangentially elongated single layer of cells is covered with cuticle. Upper palisade has 2–4 layers of palisade cells while lower has 2–5 layers. Spongy parenchymatous cells loosely arranged in between the upper and lower palisade consist of vascular bundle. The uniseriate, covering trichomes were present on lower and upper epidermis. The upper epidermis is less convex than lower epidermal part of midrib. The midrib part consists of collateral type of vascular bundle surrounding spongy parenchymatous cells. The vascular bundle is arc shaped having spiral xylem vessels [Figure 2].

The T.S. of the stem observed having elongated epidermal layer, was covered with cuticle. Layers of parenchymatous cells were present after the epidermis. Lignified sclerenchymatous cells were also found in cortex region. Bicollateral vascular bundles were situated beneath the cortex having lignified xylem. Medullary rays were uniseriate type present with the xylem. The pith occupied the central portion containing calcium oxalate crystals and no intercellular spaces [Figure 2].

In the same fashion, T.S. of root was also found to contain epidermal layer, which was made up of irregular compact cork cells. After the epidermis, cortex containing collateral arrangement of xylem and phloem (vascular bundle) with lignified xylem observed. A thin layer of phloem found surrounding the xylem. The medullary rays were spreaded in the whole central part [Figure 2].

Microscopical study of powder of whole plant showed the presence of un lignified multicellular covering trichomes, fragments of leaf epidermis, compressed cork cells of root, fragments of pitted xylem vessel, tracheids, and fibers.

Physicochemical characteristic

The results of physicochemical standardization parameters represented as in Table 1.

### Fluorescence powder drug analysis

The results of the fluorescence analysis of seeds powder of the plant in day light (visible light), short UV light (λmax

<table>
<thead>
<tr>
<th>Physicochemical parameters</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign matter</td>
<td>Not &gt;1.0% (w/w)</td>
</tr>
<tr>
<td>Loss on drying</td>
<td>Not &gt;0.5% (w/w)</td>
</tr>
<tr>
<td>Acid value</td>
<td>Not &lt;8.75</td>
</tr>
<tr>
<td>Saponification value</td>
<td>Not &lt;287.51</td>
</tr>
<tr>
<td>Ash value</td>
<td></td>
</tr>
<tr>
<td>Total ash value</td>
<td>Not &gt;11.26% (w/w)</td>
</tr>
<tr>
<td>Acid-insoluble ash value</td>
<td>Not &gt;2.5% (w/w)</td>
</tr>
<tr>
<td>Water-soluble ash value</td>
<td>Not &gt;10.98% (w/w)</td>
</tr>
<tr>
<td>Extractive value</td>
<td></td>
</tr>
<tr>
<td>Water-soluble extractive value</td>
<td>Not &lt;20.65% (w/w)</td>
</tr>
<tr>
<td>Alcohol-soluble extractive value</td>
<td>Not &lt;2.85% (w/w)</td>
</tr>
<tr>
<td>Choriform-soluble extractive value</td>
<td>Not &lt;6.84% (w/w)</td>
</tr>
<tr>
<td>Petroleum ether-soluble extractive value</td>
<td>Not &lt;12% (w/w)</td>
</tr>
<tr>
<td>Foaming index</td>
<td>Not &lt;100</td>
</tr>
<tr>
<td>Fiber content</td>
<td>Not &lt;6.18%</td>
</tr>
<tr>
<td>Swelling index</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>Heavy metals</td>
<td></td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>0.1941 ppm</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.0050 ppm</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>1.5045 ppm</td>
</tr>
</tbody>
</table>

**Figure 1:** Dorsal and ventral view of leaf (a), stem (b), and root (c)

**Figure 2:** Transverse section of leaf (a), stem (b), and root (c) of Tephrosia purpurea. UE: Upper epidermis, LE: Lower epidermis, Ep: Epidermis, UP: Upper palisade cell, LP: Lower palisade cell, Sc: Sclerenchymatous cell, Ph: Phloem, Xy: Xylem, Mr: Medullary ray, Pi: Pith, T: Trichome, C: Calcium oxalate crystals
Kumari, et al.: Pharmacognosy of Tephrosia purpurea

Leaves are the photosynthetic machinery and constitute the several metabolites of the plants. Seeds, stems, and roots are also important source of bioactive compounds. Morphological and microscopical evaluation of leaves, stems, and roots reveals the different characters and special arrangements of various types of cells to constitute the plant tissue which are presented in results. In the evaluation of physicochemical parameters, the total ash value was approximately 4 times more than acid-insoluble ash and water-soluble ash indicating the presence of inorganic and silica components in the seed powder. The water-soluble extractive value was the highest value and petroleum ether-soluble extractive value was the second highest extractive value. Chloroform-soluble extractive was 3 times more than alcohol but less than water and petroleum ether extractive values. The seed powder was found to contain steroid, phenolics and flavonoids in various extracts. Preliminary phytochemical screening revealed the presence of high amount of carbohydrate and proteins in aqueous extract. Petroleum ether extract of T. purpurea seeds was found to contain free acids and fatty acids resulting acid value and saponification value 8.75 and 287.51, respectively. In the quantitative analysis of heavy metal, the concentration of lead (Pb) and cadmium (Cd) was 0.1941 ppm and 0.0050 ppm, respectively, is very low concentration than zinc (Zn) which was present in 1.5045 ppm concentration.

T. purpurea is described in Vedic literature for the treatment of scrofula, wound, rat poisoning, splenomegaly and use to expel worms from abdomen, and several preparations for different health problems. It is also described for hepatic disorders, and seed oil used for the treatment of skin disease. T. purpurea plant used by different ethnic groups for the treatment of several diseases, so it is important to standardize the plant. The reported data in this study for T. purpurea, namely, pharmacognostic features, values of physicochemical standardization, and quantitative estimations will help to compile the suitable monograph for its identification and to ensure the purity of this drug.

CONCLUSION

The plant T. purpurea is used by different ethnic groups for the treatment of several diseases. The whole plant is anthelmintic, alexeteric, antipyretic, use in liver diseases, spleen, heart, blood, cures tumors, ulcers, leprosy, asthma, bronchitis, piles, caries of teeth, and used internally as a blood purifier. In the present study, pharmacognostical and physicochemical standardization of T. purpurea were performed. Tephrosia is a genus of flowering plants in the pea family, Fabaceae, having more than 400 species. Standardization parameters developed in the present study will be helpful in the identification and authentication of T. purpurea as well as to differentiate with other species of genus Tephrosia.

DISCUSSION

The plant-derived medicines have less adverse effects, more therapeutic activity and safe to use, if compared with modern medicine. Leaves are the photosynthetic machinery and constitute the several metabolites of the plants. Seeds, stems, and roots are also important source of bioactive compounds. Morphological and microscopical evaluation of leaves, stems, and roots reveals the different characters and special arrangements of various types of cells to constitute the plant tissue which are presented in results. In the evaluation of physicochemical parameters, the total ash value was approximately 4 times more than acid-insoluble ash and water-soluble ash indicating the presence of inorganic and silica components in the seed powder. The water-soluble extractive value was the highest value and petroleum ether-soluble extractive value was the second highest extractive value. Chloroform-soluble extractive was 3 times more than alcohol but less than water and petroleum ether extractive values. The seed powder was found to contain steroid, phenolics and flavonoids in various extracts. Preliminary phytochemical screening revealed the presence of high amount of carbohydrate and proteins in aqueous extract. Petroleum ether extract of T. purpurea seeds was found to contain free acids and fatty acids resulting acid value and saponification value 8.75 and 287.51, respectively. In the quantitative analysis of heavy metal, the concentration of lead (Pb) and cadmium (Cd) was 0.1941 ppm and 0.0050 ppm, respectively, is very low concentration than zinc (Zn) which was present in 1.5045 ppm concentration.

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INTRODUCTION

There are millions of insect species in the world occupying virtually every possible ecological niche. The largest phylum “Arthropoda” consists of three subphyla, comprising of nine classes. In the arthropod class, insecta is the largest, containing thousands of species. Apidae, bombidae (bees), vespidae (wasps), and formicidae (ants) are the important species that molest man. The range of disorders caused by arthropods varies from mild local reactions due to bites and stings to severe systemic reactions or even death.\[1\]

Ayurveda explains shopha or edema to be of exogenous and endogenous verities. The causes of exogenous type of edema are affliction of the external skin by the impact of wood, stone, weapon, fire, and poison. Edema due to insect bite, hence, is classified under the exogenous edema or Aagantu Shopha.\[2\] Toxic edema or vhishaja shopha is produced by crawling or urinating of insects over the body, injured by tusks, teeth, or claws of poisonous animals or even by the contact of excreta, urine, or semen; or of cloth contaminated by these or of even non-poisonous animals; touch of poisonous trees, exposure to polluted air, wind, and rubbing of artificial poisons.\[3\] The signs and symptoms of toxic edema include soft swelling which is movable, drooping down, quickly manifesting and causing burning sensation, and pain.\[4\] Apart from edema, the local reactions of keeta visha include raga (redness), strava (discharge), and vedana (pain).\[5\]

Shigrupunarnavadi lepa mentioned in Prayoga samucchaya,\[6\] a textbook of Keraleea Visha Chikitsa, is traditionally used for toxic edematous conditions and is found to be very effective in insect-bite associated with edema. This paper intends to discuss the effect of external application of Shigrupunarnavadi lepa on local reactions of keeta visha.

METHODOLOGY

The study employed a single arm before-after clinical trial design. A sample of 30 participants attending the outpatient department of visha chikitsa, who had a history of insect bite or sting with acute toxicity with a maximum duration of 72 h and between the age group of 10–70 years were enrolled into the study. Patients with fatal conditions such as coma and convulsions, following the bite, or with complications due to the presence of sting were excluded from the study. Informed consent from each participant was obtained. The 30

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participants were treated with trial drug-Shigrupunarnavadi lepa.

**DETAILS OF THE DRUG**

The drugs in Shigrupunarnavadi lepa were included in the study:

Shigru (*Moringa oleifera*), Punarnava (*Boerhavia diffusa*), Haridra (*Curcuma longa*), Vacha (*Acorus calamus*), Chandana (*Santalum album*), Patha (*Cyclea peltata*), Eswara Mooli (*Aristolochia indica*), Yashti (*Glycyrrhiza glabra*), Shireesha (*Albizia lebbeck*), and Gokshura (*Tribulus terrestris*).

**Preparation of the Choorna**

The above-mentioned fresh drugs after identification, collection, and cleaning with normal water were dried for 7 days. They were then converted to Sookshma choornam (fine powder) and used for the study.

**Method of Application of the Drug**

The drug was applied externally as lepa. Required amount of the powder was mixed with sufficient quantity of water and applied as a coating over the affected area with even thickness. The lepa was washed once dried. This procedure was done twice daily with a gap of 12 h.

The application was over the lesion and surrounding area. The first dose was on the first visit, irrespective of time.

**Assessment Criteria**

It was tried best to grade the four cardinal symptoms such as Ruja, Kandu, Raga, and Shopha in the participants (Table 1). Apart from the above researches states that individually all the drugs of Shigrupunarnavadi lepa possess anti-inflammatory activity(Table 2). [9-17]

**Pain**

1. No pain.
2. Pain only on pressure.
3. Continuous but not disturbing the patient in any way.
4. Pain disturbing some physical activities of the patient.
5. Excruciating pain disturbing routine and sleep.

**Itching**

1. No itching.
2. Mild itching, at the bite sight, found only immediately after the bite.
3. Mild itching, at the bite sight, found for a few hours after the bite.
4. Moderate itching, at the bite sight, found for a few hours after the bite.
5. Continuous and severe itching, at the bite sight, found for a few hours after the bite affecting the routine activity.

**Redness**

1. No redness
2. Slight color change, only at the point of bite, not well appreciable.
3. Slight color change, in surrounding area up to 5 cm, not well appreciable.
4. Marked color change, in surrounding area up to 5 cm, well appreciable.
5. Marked color change involving area >5cm.

**Swelling**

1. No swelling.
2. Slight edema, just at the point of bite, not well appreciable.
3. Slight edema involving surrounding area.
4. Marked edema, involving surrounding area, well appreciable.
5. Marked pitting edema involving surrounding area.

**OBSERVATIONS AND RESULTS**

Among the 30 participants studied, males outnumbered the females (73.3%), the majority of them were found in the age group of 31–40 years (53.3%). Almost three-fourths of the participants were Hindus (73.3%). 60% of the participants were agriculturists followed by students who constituted 10% of the study participants. 20% of the bite was in the upper arm,
13.3% in the forearm, and 10% in the palm, thus constituting a total of 43.33% on the upper limb, 6.6% of the bite was on the thigh, 6.66% in the calf region, and 23.33% on the foot thus constituting a total of 46.66% in the lower limb. 10% of the bite was noted on the face and neck region. Out of the 30 participants, 16.66% came with single bite mark, 60% had two bite marks, whereas 23.33% had no bite marks. Maximum bites were seen in the intervals between 6 and 8 A.M and 5 and 7 P.M (43% and 37%, respectively). 30% of the total participants showed the features of Vataja keeta damsaa, 50% of Pittaja, 10% of Kaphaja, and 10% showed the features of Sannipatajakeetadamsa. 10% of the total participants belonged to the Lootadamsha, 13.33% to Vrischikadamsha, 6.66% to Kanabha, 6.66% to Makshika, 10% to Pipeelika, 6.66% to Mashaka, 10% to Shatapadi, and 36.66% were Anirdishyakeetadamsa.

Results

Ruja in the subjects showed an improvement of 76.59%, Kandu 58.75%, raga 54.16%, and shopha 81.03%, respectively.

DISCUSSION

Table 3 summarizes Guna and Karmas of ingredients of Shigrupunarnavadi powder.

Vishaghna Property

All the ingredients of this yoga possess vishaghna property. Hence, this combination may be administered in all conditions of visha.

Doshahara Property

Shigru, Punarnava, Haridra, Vaca, Paata, Eswara Mooli are having kapha and vata hara property; Yashtimadhu is having vata and pitta hara property; shireesha is having pitta and vata hara property, and Gokshura is having vata pitta hara property. Visha vitiates all the dosha, so the combination of drugs, which is tridoshahara with property of vishaghnata, will be very efficacious in this condition.

Table 2: Chemical constituents and probable action of the ingredients of the trial drug

<table>
<thead>
<tr>
<th>Name of drug</th>
<th>Chemical constituent</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shigru</td>
<td>Sterols, terpenes, moringine, pteregospermine</td>
<td>Oedema suppression, anti-inflammatory action</td>
</tr>
<tr>
<td>Punarnava</td>
<td>Hentriacontane, B-sitosterol, punarnavine</td>
<td>Possesses free radical scavenging effect thus reducing inflammation</td>
</tr>
<tr>
<td>Haridra</td>
<td>Curcumene, Curcumenenone, B-sitosterol</td>
<td>Molecules involved in inflammation are inhibited by curcumin</td>
</tr>
<tr>
<td>Vaca</td>
<td>Acolamone, Aryl aldehydes, Acorin, Eugenol,</td>
<td>Significant anti-inflammatory activity</td>
</tr>
<tr>
<td>Candana</td>
<td>Santalol, santalenes,</td>
<td>Anti-inflammatory effect</td>
</tr>
<tr>
<td>Paata</td>
<td>Fangchinoline, cycleapeltine, cycleadrine, burmannaline</td>
<td></td>
</tr>
<tr>
<td>Eswara Mooli</td>
<td>Aristalochine, aristolochic acid cephaeradiones</td>
<td>Anti-inflammatory effect</td>
</tr>
<tr>
<td>Yashthi</td>
<td>Glycyrrizine, Isoliquiritin, Liquiritin</td>
<td>Anti-inflammatory effect</td>
</tr>
<tr>
<td>Shireesha</td>
<td>Tannins, B-sitosterol, Albigenin, saponins</td>
<td>Anti-inflammatory effect</td>
</tr>
<tr>
<td>Gokshura</td>
<td>Glycoside, Sterol, Tannin, and Harmine chlorogenin, diosgenin, gilogenin</td>
<td>Anti-inflammatory effect</td>
</tr>
</tbody>
</table>

Table 3: Rasa panchaka of ingredients of Sigrupunarnavaadi Choorna

<table>
<thead>
<tr>
<th>Name of drug</th>
<th>Rasa</th>
<th>Guna</th>
<th>Veerya</th>
<th>Vipaka</th>
<th>Prabhava</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shigru</td>
<td>Katu, Tikta</td>
<td>Lagu, Rooksha, Teekshna.</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Punarnava</td>
<td>Madhura, Tikta, Kashaya</td>
<td>Lagu, Rooksha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Haridra</td>
<td>Tikta, Katu</td>
<td>Lagu, Rooksha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Vaca</td>
<td>Tikta, Katu</td>
<td>Lagu, Teekshna.</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Candana</td>
<td>Tikta, Madhura</td>
<td>Lagu, Rooksha</td>
<td>Sheeta</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Paata</td>
<td>Tikta</td>
<td>Lagu, Teekshna</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Eswara Mooli</td>
<td>Tikta, Katu</td>
<td>Lagu, Teekshna</td>
<td>Ushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Yashthi</td>
<td>Madhura</td>
<td>Guru, Snigdha</td>
<td>Sheeta</td>
<td>Madhura</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Shireesha</td>
<td>Kashaya, Tikta Madhura</td>
<td>Lagu, Rooksha, Teekshna</td>
<td>Eeshatushna</td>
<td>Katu</td>
<td>Vishahara</td>
</tr>
<tr>
<td>Gokshura</td>
<td>Madhura</td>
<td>Guru, Snigdha</td>
<td>Sheeta</td>
<td>Madhura</td>
<td>Vishahara</td>
</tr>
</tbody>
</table>
In inflammatory edema, pain is due to vata; redness, temperature, and burning sensation, is due to pitta; edema, oozing, and itching; is due to kapha; and induration is due to vaatakapha. Hence, the above-said combination aptly acts on this clinical condition by virtue of its doshaghna property.

**Action by Virtue of Rasa-guna**

Out of the ten drugs in the combination, eight drugs have tiktapradhana rasa. Tikta rasa acts as raktaprasadaka, kandughna, and kushtaghnaanddaha prashamana.\[^{7}\] By virtue of these karma based on the rasa, the drug could have reduced itching, redness, and swelling.

By virtue of its gunas, the drug is laghu and rookshagunapradhana and also is kaphaghna.\[^{8}\] Due to this, shopha, which is Kaphaja, gets reduced.

Apart from the above researches states that individually all the drugs of Shigrupunarnavadi lepa possess anti-inflammatory activity.\[^{9-17}\]

**CONCLUSION**

Within the limits of the present study, it can be concluded that Shigrupunarnavadi lepa helps to reduce the local reactions including ruja, kandu, raga, and shophaand, hence, can be recommended as external application in the management of keeta visha.

**REFERENCES**


**Source of Support:** Nil. **Conflict of Interest:** None declared.
Review on antianxiety activity of some indigenous plants

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Abstract

Anxiety is a public emotional phenomenon in humans characterized by uneasiness, discomfort, and concern or fear about some determined or indeterminate future warning. Anxiety is considered to be a usual reaction to stress and involves heart palpitations, fatigue, nausea, and shortness of breath. In the current decade, anxiety is the most mutual mental illness affecting 1/8th of the total population and has become a very significant area of investigation in psychopharmacology. About 500 million individuals in the world suffer from anxiety disorder. The prevalence of anxiety disorders is 30.5% and 19.2% in women and men, respectively. The prevalence of anxiety disorders is remarkably high in young people. Children of age 7–11 years reported a 15.4% prevalence rate of anxiety disorders. A survey has also revealed that <14% of people with such psychiatric disorders receive treatment in any form. Current medications (selective serotonin reuptake inhibitor and tricyclic antidepressants) focus on the blockade of norepinephrine and serotonin uptake, thereby prolonging their synaptic effects. The relative success of these agents generates a conceptual impasse that limits identification of novel therapeutic targets for these disorders.¹⁴ Several models (amphetamine-induced, pentylenetetrazole-induced, picrotoxin-induced, strychnine-induced, isoniazid-induced, yohimbine and footshock-induced anxiety, etc.) are used for the evaluation of antianxiety activity of different extracts as well as isolated compounds in rats. In the present manuscript, data on antianxiety activity of different extracts and isolated compounds from 39 indigenous plants were represented.

Key words: Anxiety, psychopharmacology, stress, tricyclic antidepressants

INTRODUCTION

S tress and anxiety are psychiatric manifestations of the modern world and lifestyles. However, too much stress, or a strong response to stress, is injurious to the health. It is responsible not only for poor health but also for specific physical or psychological sicknesses such as infections, heart disease, and depression. Persistent and unrelenting stress may lead to anxiety and harmful behaviors. Psychiatric illnesses are major disorder of organic or emotional origin and always associated with severe distortion of thought, behavior, and capacity to recognize reality as well as deficient perception leading to delusion and hallucination and subsequent neurochemical imbalance in the brain.¹⁰ Anxiety is a public emotional phenomenon in humans characterized by uneasiness, discomfort, and concern or fear about some determined or indeterminate future warning.²⁻⁵ Anxiety is considered to be a usual reaction to stress and involves heart palpitations, fatigue, nausea, and shortness of breath. In the current decade, anxiety is the most mutual mental illness affecting 1/8th of the total population and has become a very significant area of investigation in psychopharmacology.⁶

Some unit of anxiety is a part of normal life and treatment is needed when it is disproportionate to the situation and extreme. Approximately psychotics and depressed patients also exhibit pathological anxiety.⁷ Psychological anxiety and distress can be categorized as generalized anxiety disorder, social phobia, and post-traumatic stress disorder.⁸

It is considered to be a normal reaction to stress or characterized as a state of being that arises from common and non-specific stimuli perceived as being potentially aggressive in the future. This perception often results in an apprehensive
mood accompanied by increased arousal and vigilance, which when taken to an extreme persist for extended periods of time.\textsuperscript{[9]}

Several studies revealed that among the behavioral disorders, anxiety has the maximum frequency.\textsuperscript{[10]} Anxiety has several mental and physical signs including palpitation, cramp, perspire, asthma, nausea, provocation, urination, failure to encounter position, uncertainty about future, feeling of fear and stress, expectation of sorrow occurrence, inability of concentration, and night sleeplessness.\textsuperscript{[11]} About 500 million individuals in the world suffer from anxiety disorder.\textsuperscript{[12]} Anxiety disorders are psychiatric disorders affecting nearly 25\% of the adult population at several stages of their life. The prevalence of anxiety disorders is 30.5\% and 19.2\% in women and men, respectively. The prevalence of anxiety disorders is remarkably high in young people. Children of age 7–11 years reported a 15.4\% prevalence rate of anxiety disorders. A survey has also revealed that <14\% of people with such psychiatric disorders receive treatment in any form.\textsuperscript{[13]}

**HERBAL MEDICATIONS FOR ANXIETY**

Major limitation in the development of new antianxiety drugs is a fundamental lack of a coherent pathophysiology and etiology for major depression, bipolar disorder, and common anxiety disorders. Current medications (selective serotonin reuptake inhibitor and tricyclic antidepressants) focus on blockade of norepinephrine and serotonin uptake, thereby prolonging their synaptic effects. The relative success of these agents generates a conceptual impasse that limits identification of novel therapeutic targets for these disorders.\textsuperscript{[14]} Several models (amphetamine-induce, pentlenetetrazole-induced, picrotoxin-induced, strychnine-induced, isoniazid-induced, yohimbine and footshock-induced anxiety, etc.) are used for the evaluation of antianxiety activity of different extracts and as isolated compounds in rats.\textsuperscript{[15]}

**Ashwagandha**

*Withania somnifera* is commonly known as *Ashwagandha*, Indian ginseng, and winter cherry belongs to the family Solanaceae.\textsuperscript{[16]} Roots of *W. somnifera* showed anxiolytic activity at the dose of 20 and 50 mg/kg body weight due to glycoside withanolides.\textsuperscript{[17]} Chloroform and water fractions of the hydroalcoholic extract of roots at the dose of 40 mg/kg show anxiolytic activity.\textsuperscript{[18]} Traditional extract (water: honey: ghee) of roots showed anxiolytic and antidepressant activity at 250 mg/kg dose.\textsuperscript{[19]}

**Yasthimadhu**

*Glycyrrhiza glabra* Linn. is commonly known as *Yasthimadhu* belongs to the family Fabaceae. The hydroalcoholic extract of the roots and rhizomes showed anxiolytic activity at 100–300 mg/kg dose.\textsuperscript{[20]}

**Atibala**

*Abutilon indicum* L. commonly known as *Atibala* belongs to the family Malvaceae. Alcoholic extract of leaves showed anxiolytic activity at 100–400 mg/kg doses.\textsuperscript{[21]}

**Shirish**

*Albizia lebbeck* (L.) Benth. commonly known as *Shirish* belongs to family Mimosaceae. n-butanol extract of dried leaves containing saponins showed anxiolytic and nootropic activity at the dose of 25 mg/kg dose.\textsuperscript{[22]}

**Taalisa patra**

*Abies pindrow* Royle is a large evergreen tree commonly known as *Taalisa* belonging to family Pinaceae. Ethanolic extract of leaves showed anxiolytic effects at 50–100 mg/kg dose.\textsuperscript{[23]} Chloroform and methanol extract of aerial parts exhibited significant antianxiety activity at 200–400 mg/kg dose, respectively. The ethyl acetate and n-butanol fractions of methanol extract showed anxiolytic activity at the dose of dose 50 mg/kg.\textsuperscript{[24]}

**Lahsune**

*Allium ascalonicum* Linn. is an annual herbaceous plant, commonly known as *Shallot*, belongs to family Liliaceae. The hydroalcoholic extract of aerial part showed anxiolytic activity at the dose of 100 mg/kg.\textsuperscript{[25]}

**Apamarga**

*Achyranthes aspera* Linn. commonly known as *Apamarga* belongs to the family Amaranthaceae. Methanol extract of fresh leaves showed anxiolytic activity at 100–600 mg/kg dose.\textsuperscript{[26]}

**Neem**

*Azadirachta indica* commonly known as *Neem* belongs to the family Meliaceae. Aqueous extract of fresh leaves of neem showed anxiolytic activity at 10–200 mg/kg dose.\textsuperscript{[27]}

**Kusmand**

*Benincasa hispida* commonly known as *Kusmanda* belongs to the family Cucurbitaceae.\textsuperscript{[28]} Methanolic extract of fresh fruits showed anxiolytic activity at the dose 300 mg/kg.\textsuperscript{[29]} Alcoholic extract showed anxiolytic activity at 200 and 400 mg/kg dose.\textsuperscript{[30]}
Kasmard  
*Cassia occidentalis* which is commonly called *Kasmard* belongs to the family Caesalpiniaee. Ethanolic and aqueous extracts of leaves show antianxiety activity at 500 mg/kg, but an ethanol extract possesses more significant antianxiety and antidepressant activity compared to aqueous extract.[31]

Dhanyak  
*Coriandrum sativum* L. is an annual herb commonly known as *Dhanyak* belongs to the family Umbelliferae. The aqueous extract of seeds at the dose of 200 mg/kg showed an anxiolytic effect.[32] Aqueous extract of leaf showed antianxiety activity at 50, 100, and 200 mg/kg dose.[33] Hydroalcoholic extract of fruits showed antianxiety activity at the doses of 100 and 200 mg/kg.[34] The aqueous extract of seed shows an anxiolytic activity at 50, 100, and 500 mg/kg.[35] The aqueous extract of seed shows an anxiolytic activity at 10–100 mg/kg.[36] Hydroalcoholic extract of leaves showed anxiolytic effect at the dose of 200 and 400 mg/kg.[37]

Kesar/saffron  
*Crocus sativus* L. is a perennial herb, commonly known as *Saffron*, belongs to the family Iridaceae. Crocins, isolated compound from *C. sativus* L. showed anxiolytic activity at the dose of 50 mg/kg.[38] The aqueous extracts of *C. sativus* contain active component safranal showed an anxiolytic activity at the doses of 0.15 and 0.35 ml/kg body weight.[39] Acetonitrile extract of stigmas of the plant showed antianxiety activity at 60 mg/kg.[40]

Talmuli  
*Curculigo orchioides* Gaertn. is commonly known as *Kali musali* belongs to the family Amaryllidaceae. Methanol extract and aqueous extract of dried rhizome showed maximum anxiolytic activity at the dose 400 mg/kg.[41]

Paribhadra  
*Erythrina variegata* is a medium-sized deciduous small tree, commonly known as *Coral tree*, belongs to family Fabaceae. The aqueous extract of stem bark at medium (200 mg/kg) and high (400 mg/kg) doses showed anxiolytic effect.[42]

Snuhi  
*Euphorbia neriifolia* Linn. is small erect, fleshy glabrous shrub commonly known as *Snuhi* belongs to the family Euphorbiaceae.[43,44] Hydroalcoholic extract of leaves shows antianxiety effect at 400 mg/kg dose.[45]

Dugdhika  
*Euphorbia hirta*, an important medicinal herb, commonly known as *Dugdhika*, belongs to the family Euphorbiaceae. Hydroalcoholic extract of the whole plant showed anxiolytic property at the dose of 200 mg/kg.[46] The lyophilized aqueous extract showed sedative and anxiolytic activity at 12.5 and 25 mg/kg dose.[47]

Kakodumber  
*Ficus hispida* Linn.is a moderate-sized tree commonly known as *Kakodumber* belongs to the family Moraceae.[48] Methanol extract of the leaf showed anxiolytic activity at the dose of 200–400 mg/kg.[49]

Fennel  
*Foeniculum vulgare* Mill. commonly known as *Fennel* belongs to Apiaceae family. Ethanolic extract of fruits showed anxiolytic activity at 100–200 mg/kg dose.[50] The essential oil of *F. vulgare* showed anxiolytic activity at 100 and 200 mg/kg doses.[51]

Krishna Vasa  
*Justicia gendarussa* Burm f. commonly known as *Willow-leaved justicia* belong to the family Acanthaceae. The ethanol extract of aerial parts possesses significant antianxiety activity at 200–500 mg/kg doses.[52]

Rugmini  
*Ixora coccinea* Linn. a small-to-medium sized hardy shrub commonly known as *West Indian jasmine* belongs to family Rubiaceae. The ethanol extract of the whole plant at 400 mg/kg dose showed anxiolytic activity.[53]

Ikhwaku  
*Lagenaria siceraria* is commonly known as *Bottle gourd* belongs to the family Cucurbitaceae.[54] Aqueous extract of fresh fruits showed anxiolytic activity at 200 mg/kg dose.[55] Methanol extract of *L. siceraria* at higher dose 400 mg/kg produced anxiolytic effect.[56]

Amra  
*Mangifera indica* commonly known as *Mango* belongs to the family Anacardiaceae. Aqueous extract of leaves showed anxiolytic activity at 250 mg/kg and 500 mg/kg dose.[57]
**Shigru**

*Moringa oleifera* commonly known as *Drumstick tree* belongs to the family Moringaceae. Ethanol extract of leaves showed anxiolytic property at 200 mg/kg and 400 mg/kg dose.

**Jatiphala**

*Myristica fragrans* an evergreen tree commonly known as *Nutmeg* belongs to family Myristicaceae. Ethanolic extract of the whole plant at the doses of 25 mg/kg and 50 mg/kg possess anxiolytic activity.

**Kumud**

*Nymphaea alba* is an aquatic, flowering, and rhizomatous herbs commonly known as *White lotus* or *Water lily* belongs to the family Nymphaeaceae. Ethanol extract of the whole plant showed anxiolytic activity at 100 and 200 mg/kg doses.

**Changeri**

*Oxalis corniculata* Linn. is somewhat delicate appearing, low growing, herb, commonly known as *Creepers wood sorrel*, belongs to the family Oxalidaceae. Ethanolic extract of the whole plant at 100 and 300 mg/kg showed anxiolytic activity.

**Passion flower**

*Passiflora incarnate* is commonly known as *Passion flower* belongs to family Passifloraceae. Aqueous fraction of methanol extract of leaves showed anxiolytic effect at 30 mg/kg dose. Methanol extract of *P. incarnate* showed anxiolytic activity at 200 mg/kg dose. Ethanol extract of *P. incarnate* showed anxiolytic activity at 375 mg/kg doses.

**Kava kava**

*Piper methysticum* is a perennial plant commonly known as *Kava* belongs to Piperaceae family. Ethanol extract of kava roots showed anxiolytic activity at 125 mg/kg and 88 mg/kg doses. Extract of roots showed anxiolytic activity at 120-240 mg/kg doses.

**Lemon balm**

*Melissa officinalis* L., commonly known as *Lemon balm*, is a perennial shrub belongs to the family Lamiaceae. Ethanol extract of leaves showed anxiolytic activity at 100 mg and 300 mg/kg doses.

**Karvellak**

The plant *Momordica charantia* Linn. is a well-known plant and commonly known as *Bitter gourds* belong to family Cucurbitaceae. Ethanol extract of dry leaves showed anxiolytic activity at 100, 200, and 300 mg/kg doses. Methanol extract of the whole plant showed anxiolytic activity at 200 mg/kg dose.

**Gorakhmundi**

*Sphaeranthus indicus* Linn. is a highly branched herb commonly known as *Gorakhmundi* belongs to family Asteraceae. Hydroalcoholic extract of the whole plant showed anxiolytic activity at 100 mg/kg. Petroleum ether, alcohol, and aqueous extract of flowers showed anxiolytic activity at the dose of 10 mg/kg, 10 mg/kg, and 30 mg/kg, respectively.

**Haritaki**

*Terminalia chebula* is a medium-to-large-sized tree commonly known as *Haritaki* belongs to family Combretaceae. Aqueous extract of fruits shows anxiolytic activity at the dose of 1.3 and 2.6 mg/kg. Aqueous extract of fruits shows anxiolytic activity at the dose of 18 mg/kg. Hydroalcoholic extract of dry fruits which contains active component chebulinic acid showed anxiolytic activity at 20 mg/kg and 40 mg/kg.

**Nirgundi**

*Vitex negundo* Linn. is a large aromatic shrub, commonly known as *Nirgundi*, belongs to the family Verbenaceae. Chloroform and ethanol extract of the roots showed anxiolytic activity at 400 mg/kg and 100 mg/kg doses, respectively. An ethanol extract of roots of *V. negundo* showed anxiolytic activity at 100 and 200 mg/kg. Ethanol extract of leaves showed anxiolytic activity at 200, 300 mg/kg doses.

**Vacha**

*Acorus calamus* Linn. is commonly called as *Sweet flag* belongs to the family Araceae. Hydroalcoholic extract of rhizome showed anxiolytic activity at 500 mg capsule twice daily for 60 days.

**Brahmi**

*Bacopa monnieri* (L.) Wettst. is commonly known as *Brahmi* belongs to the family Scrophulariaceae. Whole plant extracts showed anxiolytic effects at 10 and 20 mg/kg doses.
Methanol extract of the whole plant showed anxiolytic activity at 10, 20, or 30 mg/kg doses.[99]

**Bhangā**

*Cannabis sativa* is commonly known as *Bhangā* belongs to the family Cannabaceae. Cannabidiol isolated from *C. sativa* showed anxiolytic effect at 2.5–10 mg/kg doses.[90] Cannabidiol showed anxiolytic effect at 300 mg dose in human.[91]

**Mandukparni**

*Centella asiatica* (Linn.) is an herbaceous plant, commonly known as *Mandukparni*, belongs to the family Apiaceae. Hexane, ethyl acetate, and methanol extracts of the whole plant showed anxiolytic activity at 3, 5, and 10 mg/kg doses.[92] Extract of the whole plant showed anxiolytic activity at the 500 mg/kg dose.[93]

**Shunthi**

*Zingiber officinale* Roscoe., commonly known as *Adrakā*, belongs to the family Zingiberaceae. Benzene fraction of petroleum ether extract of dried rhizomes showed anxiolytic activity at 100 and 200 mg/kg doses.[94] Ethanol and aqueous extracts of the rhizomes showed anxiolytic activity at 200 and 400 mg/kg doses.[95]

**Agatsya**

*Sesbania grandiflora* (L.) Poiret., is commonly known as *Agatsya*, belongs to Fabaceae family. Benzene:ethylacetate fraction of acetone soluble part of a petroleum ether extract of leaves showed anxiolytic activity at 100 mg/kg dose.[96]

**CONCLUSION**

The use of natural products is as ancient as human civilization and for a long time, plants were the main sources of drugs for their therapeutic nature. According to the World Health Organization, plant-based medicine is still the mainstay of about 80% of the population in the developing countries, hence extensive investigation is very much needed to standardize and validate the accrued knowledge of traditional medicine. Synthetic drugs used for the treatment of various diseases are not free from side effects. In the coming future, it is necessary to develop the potential candidates from the plants for the treatment of various psychopharmacological disorders.

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A phytopharmacological review on

*Ludwigia octovalvis*

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Abstract

Medicinal plants are used for the treatment and prevention of various diseases from ancient time due to their medicinal activities. The demand of traditional system of medicines is increasing day to day due to population explosion, restricted supply and more side effects of synthetic drugs, and development of resistance to antibiotic used for contagious diseases. Recently, phytomolecules isolated from medicinal plants such as taxol, vincristine, morphine and quinine are getting preference for the treatment of diseases over synthetic drugs due to their fewer side effects. One of the Indian medicinal plants *Ludwigia octovalvis* (Onagraceae) is used traditionally for the treatment of various diseases such as edema, nephritis, hypotension, antimalarial, dysentery, diarrhea, diabetes, headache, fever, and toxemia, as carminative, laxative, vermifuge, astringent, and anthelminthic in nervous disorders and as analgesic in rheumatic pain and for swollen glands. Preliminary phytochemical study of the various extracts of *Ludwigia octovalvis* reported that the plant is rich with phenolics, alkaloids, steroids, glycosides and flavonoid compounds. Some phytomolecules such as beta-sitosterol, oleanolic acid, ursolic acid, oleanane-type triterpenes, daucosterol, luteolin, quercetin, and apigenin are isolated. Pharmacological activities such as hypoglycemic, antimicrobial, antioxidant, and anti-inflammatory activity are also investigated on this plant. This study compiles the information related to *L. octovalvis*, which will help the researchers for further study on this plant.

**Key words:** Antioxidants, flavonoids, *Ludwigia octovalvis*, triterpenes

INTRODUCTION

Medicinal plants are used for the treatment and prevention of various diseases from ancient time due to their medicinal activities. Plants rich with various phytochemicals and are used as whole or its parts in both traditional and modern medicines for the treatment or management of various chronic diseases.¹ Traditional systems of medicines are widely adapted on many countries, and 80% of the world population of the developing countries depends on traditional medicines for their primary health care.² In developed country like the United States of America, about 38% of adults and 12% of children population are also prefer medicines designed from medicinal plants for their primary health problems.³ Recently, the demand of traditional system of medicines increased due to population explosion, restricted supply and more side effects of synthetic drugs, and development of resistance to antibiotic used for contagious diseases.⁴ Pharmaceutical companies are now designing new formulation for the treatment of diseases from phytomolecules isolated from medicinal plants such as taxol, vincristine, morphine, and quinine for the treatment of diseases over synthetic drugs due to their fewer side effects.⁵ India has a good diversity of medicinal plants, and near about 7800 pharmaceutical companies in India involved in the manufacturing of formulation containing medicinal plants or its parts and consumes about 2000 tons of plants in every year.⁶ The traditional system of medicines has a hopeful future as the world rich with millions of plants, and most of them have some medicinal values, some are investigated and some are yet to be studied. One of the Indian medicinal plants *Ludwigia octovalvis* is used traditionally for the treatment of various diseases, some pharmacological effects are investigated, and some are yet to be studied. The present review is designed to highlight the traditional use, pharmacognostical, phytochemical, and pharmacological studies carried out on *L. octovalvis* so that other possible pharmacological activities could be investigated.

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**PLANT PROFILE**

Kingdom: Plantae  
Division: Tracheophyta  
Class: Magnoliopsida  
Order: Myrtales  
Family: Onagraceae  
Genus: Ludwigia  
Species: Octovalvis

**DESCRIPTION**

*L. octovalvis* (Synonyms: *Oenothera octovalvis* and *Jussiaea suffruticosa*) belongs to family Onagraceae. The family Onagraceae comprises 17 genera and 650 species, which have potential bioactive compounds and used in traditional folk medicines. It is commonly known as Mexican primrose - willow (local name - Hiran khuri or bhulabang). It is mostly grown in the moist area and native to India, Australia, China, and Tropical America. It is a perennial herb, which grows up to a maximum height of 4 m. The plant has erect, grooved, and woody stem. Leaves are elongated with small hairs on both sides. Flowers are yellow in color with four petals and sepals and eight stamens. Fruits are ribbed capsule type with very small seeds.

The plant is used traditionally for the treatment of diseases like edema, nephritis, hypotension, antimalarial, dysentery, diarrhea, diabetes, fever, toxemia, body ache, carminative, laxative, vermifuge, astringent, antihelminthic, nervous disorders, rheumatic pain and swollen glands.

**PHYTOCHEMICAL REVIEW**

Biological activity shown by the plant extract is due to the presence of primary and secondary metabolites, and phytochemical screenings are performed to ascertain the primary and secondary metabolites present in the extract of the crude drugs. Kumar and Kashyap studied the extract of *L. octovalvis* and revealed that the alcoholic extract of whole plant part of *L. octovalvis* is rich with phenols, alkaloids, steroids, glycosides, and flavonoids. Further, Mandal and Rath also studied separately the aqueous extract of leaf of 13 ethnomedicinal plants of Chilika lagoon including *L. octovalvis* and the study revealed that the plant extract is rich with flavonoids, alkaloids, phenols, tannin, saponin, and steroids but lack of glycosides.

Yakob *et al.* studied the leaf, stem, and root of *L. octovalvis* extracted in 80% methanol, ethyl acetate, chloroform, and hexane for the total phenolic content. It has been reported that 80% methanolic extract of leaf and stem is rich in the total phenolic content as 264.76 ± 0.23 gallic acid equivalent (GAE) mg/g dry weight and 239.05 ± 0.29 GAE mg/g dry weight, respectively, whereas other extracts have comparatively low amount of total phenolic content. Quantitative estimation of total phenolics and flavonoids content were also studied for the aqueous extract of leaves of *Ludwigia octovalvis*, and the study reported that the total phenolic content in the extract was determined as 170 mg of GAE/g dry weight of extract and total flavonoids content was determined as 147.102 mg CE (catechin equivalent)/g dry weight of extract.

Yan and Yang isolated 13 phytomolecules from the medicinal plant *L. octovalvis*, and these were characterized from their spectroscopic data as beta-sitosterol, oleanolic acid, 2 alpha-hydroxy ursolic acid, tormentic acid, daucosterol, luteolin, quercetin, apigenin, methyl brevifolincarboxylate, gallic acid, 3, 4, 8, 9, 10-pentahydroxydibenzo[b, d]pyran-6-one, and ellagic acid.

Chang and Kuo also studied extract of *L. octovalvis*, and it has been reported that four compounds were isolated from the ethyl acetate fraction of methanol extract of whole plant as (23Z)-feruloylhederagenin, (23E)-feruloylhederagenin, beta-amyrin acetate, and beta-amyrin palmitate.
In another study, Chang et al also isolated five compounds ([23Z]-coumaroylhederagenin, [23E]-coumaroylhederagenin, [3Z]-coumaroylhederagenin, oleanolic acid, and ursolic acid) from the extract of the whole plant of \textit{L. octovalvis}.\cite{21}

Structure of the some phytomolecules isolated from \textit{Ludwigia octovalvis} is given below:

**PHARMACOLOGY REVIEW**

**Antiaging effect**

Lin et al. revealed that extract of \textit{L. octovalvis} significantly increased the lifespan of both male and female \textit{Drosophila melanogaster}, when fed with high calorie diet but the extract was not effective with low-calorie diet. The extract blocked the age-related cognitive damage in both male and female flies and in SAMP8 mouse. This study also reported that extension of lifespan in flies may be due to high rich in polyphenols and flavonoids content in the extract of \textit{L. octovalvis}. It has been reported that gas chromatography–mass spectrometry study of the extract of \textit{L. octovalvis} showed the presence of 17 bioactive phytomolecules with the amount of \textit{β}-sitosterol and squalene was maximum. Further reported that \textit{β}-sitosterol extended the lifespan of adult flies through AMP-activated protein kinase and would be helpful in treating age-related disorders.\cite{11}

**IMMUNE-STIMULATING PROPERTIES**

In this study, Yakob et al. experimentally evaluated that 80% methanolic extract of \textit{L. octovalvis} at a dose of 200 mg and 400 mg/kg enhances the immunity stimulating properties in balb/c mice infected with Shiga toxin of \textit{Escherichia coli} strain O157: H7. The study reported that after 14 days treatment of extract, the level of serum IgA antibodies increased, whereas the level of serum IgG and IgM antibodies was not altered. It indicated that the immune-stimulating properties of 80% methanolic extract of \textit{L. octovalvis} against Shiga toxin-producing \textit{E. coli} O157:H7 in Balb/c mice potentiated through increased level of serum IgA antibodies.\cite{12}

**DIURETIC ACTIVITY**

Further, Murugesan et al. reported that methanolic extract of aerial part of \textit{J. suffruticosa} showed dose-dependent diuretic activity in Wistar rats. This study has been performed on the basis of measurement of the volume of urine excreted and quantitative estimation of sodium, potassium, and chloride ions in the excreted urine after administration of a methanolic extract of \textit{J. suffruticosa} at 200 and 400 mg/kg body weight. This study suggested that the plant could be an effective hypernatremic, hyperchloremic, and hyperkalemic diuretic drug.\cite{14}

**ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY**

Yakob et al. studied the 12 extracts of leaf, stem, and root of \textit{L. octovalvis}, extracted in 80% methanol, ethyl acetate, chloroform, and hexane to determine the total phenolic content and antioxidant activity by \textit{in vitro} method. The ferric-reducing antioxidant power (FRAP) activity and 2, 2-diphenyl-1-picrylhydrazyl (DPPH) scavenging activity were determined using the extract by spectrophotometer method at 593 nm, and trolox was used as antioxidant in both the methods as standard. It has been reported that 80% methanolic extract of leaf showed maximum antioxidant activity and the DPPH value and FRAP value for 80% methanolic extract of leaf were 1080.84 ± 6.07 µM trolox equivalent (TE)/mg dry weight and 1256.88 ± 5.38 µM TE/mg dry weight. It showed that, with decrease in polarity of solvent, the \textit{in vitro} antioxidant activity decreases with the exception that the ethyl acetate extract of root had highest antioxidant value.\cite{18}

In this study, they reported that 12 extracts of the plant were evaluated for antibacterial activity against \textit{Bacillus cereus} (ATCC 10876), \textit{Bacillus licheniformis} (ATCC 12759), \textit{Bacillus spizizenii} (ATCC 6633), \textit{Staphylococcus aureus} (ATCC 12600), \textit{Staphylococcus epidermidis} (ATCC 12228), \textit{Streptococcus mutans} (ATCC 25175), \textit{E. coli} (ATCC 25922), \textit{Klebsiella pneumoniae} (ATCC 13883), \textit{Pseudomonas aeruginosa} (ATCC 27833), \textit{Pseudomonas stutzeri} (ATCC 17588), and \textit{Shigella boydii} (ATCC 9207) by disc diffusion method and broth microdilution method. The study showed
that 80% methanolic extract of leaf is most effective against \textit{E. coli} and \textit{B. spizizenii}, while 80% methanolic root extract most effective against \textit{P. aeruginosa} at minimum inhibitory concentration (MIC) and minimum bactericidal concentration value 62.5 µg/ml and 125 µg/ml.[18]

In another study, Chen \textit{et al.} evaluated the antibacterial activity of aqueous extracts of 79 medicinal plants against cariogenic bacterium, \textit{S. mutans}. It has been reported that aqueous extract of \textit{L. octovalvis} showed highest antibacterial activity along with \textit{Morus australis} and \textit{Thuja orientalis}, and the MIC value for the antibacterial activity was less than or equal to 2.5–7.8 mg/ml.[22]

**GLYCEMIC CONTROL AND MEMORY PERFORMANCE ACTIVITY**

Lin \textit{et al.} studied the effect of \textit{L. octovalvis} extract and β-sitosterol (isolated from it) for hypoglycemic activity in C2C12 muscle cells and in HepG2 hepatocellular cells (\textit{in vitro} model). This study reported that both \textit{L. octovalvis} extract and β-sitosterol significantly induced AMPK phosphorylation and \textit{L. octovalvis} extract also inhibited glucose production and enhanced uptake of a fluorescent glucose derivative (2-NBDG). Lin \textit{et al.} also studied the effect of \textit{L. octovalvis} extract, β-sitosterol, and metformin in streptozotocin-induced diabetic mice, and it has been reported that both induce antihyperglycemic effect like metformin. Further, it has been reported that \textit{L. octovalvis} extract also improves memory performance and attenuates glucose level in HFD feeding mice.[23]

**ANTIOXIDANT ACTIVITY**

Shyr \textit{et al.} studied the antioxidant activity and DNA protecting activity with extracts of 26 medicinal plants by DPPH and superoxide anion scavenging activity \textit{in vitro} method. The study has been reported that of 26 medicinal plants, \textit{L. octovalvis} most significantly inhibits free radical and superoxide anion and also protected the DNA damage by hydroxyl radicals. The study reported that IC\textsubscript{50} value for \textit{L. octovalvis} was lowest among 26 plants. The IC\textsubscript{50} values for free radical (DPPH) scavenging activity and superoxide anion scavenging activity were 4.6 µg/ml and 25.9 µg/ml, respectively.[24]

Mandal and Rath also evaluated the antioxidant activity of aqueous leaf extract of \textit{L. octovalvis} by various \textit{in vitro} methods as DPPH scavenging activity, superoxide radical scavenging activity, hydroxyl ion (OH) radicals scavenging activity, and nitric oxide (NO) scavenging activity methods. The study reported that the IC\textsubscript{50} values for (DPPH) scavenging activity, superoxide radical scavenging activity, hydroxyl ion (OH) radicals scavenging activity, and NO scavenging activity were 80 µg/ml, 125 µg/ml, 60 µg/ml, and 70 µg/ml, respectively. This study indicated that the aqueous extract of leaf has good antioxidant activity.[17]

**TOXIC EFFECT**

Yakob \textit{et al.} studied 80% methanolic leaves extract of \textit{L. octovalvis} and evaluated both acute and subacute toxic effect on mice. In this acute toxicity study, the leave extract at a dose of 2000 mg/kg body weight was administered to mice for 14 days, and for sub-acute toxicity study, 200, 400, and 800 mg/kg of extract were administered to mice for 28 days. This acute and subacute study revealed that 80% methanolic leaf extract of \textit{L. octovalvis} did not cause any lethality and toxicological effects on mice.[25]

**ANTIDIABETIC STUDY**

Murugesan \textit{et al.} evaluated the hypoglycemic and antihyperglycemic activity of methanolic extract of \textit{J. suffruticosa} in normal and alloxan-induced diabetic rats. In this study, it has been reported that the extract at a dose of 200 mg/kg and 400 mg/kg body weight significantly reduced plasma glucose level after oral administration and only the extract at a dose of 400 mg/kg reduces showed hypoglycemic activity in the alloxan-induced diabetic rats.[26]

**ANTIPYRETIC ACTIVITY**

Murugesan \textit{et al.} evaluated the methanolic extract of aerial part of \textit{J. suffruticosa} for antipyretic activity in normal and yeast-induced pyrexia in rats. The study reported that all the dosages of extract (100, 200, and 300 mg/kg of body weight) showed a significant reduction in body temperature both in normal and yeast-induced pyrexia in rats, and the effect was maintained up to 5 h after administration in a dose-dependent manner.[27]

**CENTRAL NERVOUS SYSTEM (CNS) ACTIVITY**

Murugesan \textit{et al.} also evaluated the methanolic extract of the whole part of \textit{J. suffruticosa} for CNS activity in rats and mice. In this study, the extract was evaluated at doses of 200 mg/kg and 400 mg/kg body weight for general behavior, exploratory behavior, muscle relaxation activity, and sleeping time induced by phenobarbitone sodium. The study reported that psychopharmacological parameters were significantly influenced by the both doses of methanolic extract.[28]
ANTI-INFLAMMATORY ACTIVITY

Murugesan et al. reported that the methanolic extract of the whole part of J. suffruticosa showed dose-dependent anti-inflammatory activity by carrageenin, serotonin-induced paw edema model, and cotton pouch granuloma model. The study reported that the extract at a dose of 100, 200, and 300 mg/kg body weight showed dose-dependent anti-inflammatory activity in rats.[29]

ANTHELMINTIC ACTIVITY

Mythreyi et al. studied the methanolic extract of root of J. suffruticosa for anthelmintic activity against Pheretima posthuma and Ascaris lumbricoides parasites. This study reported that the plant extract at a concentration of 1%, 2%, 3%, and 5% was evaluated against both worms and only 5% concentration of the extract was 100% effective against earthworm and 90% effective against flat worm.[30]

CONCLUSION

L. octovalvis is an important medicinal plant, having various biological properties. Most of the information related to this plant is documented. Isolation of new phytomolecules from L. octovalvis and their efficacy in various diseases including mechanism of action to be evaluated for the effective use of this herb. Further, lots of work to be explored about the plant for the benefit of human beings.

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Ayurvedic perspective on leucorrhea

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Abstract

Leucorrhea is a symptom not a disease, it appears at any stage of age. In Ayurveda, it is known as Shweta pradar. It is yellowish, whitish discharge occurring from vaginal route. These discharges possess offensive odor that causes itching, back pain, burning sensation, and weakness in whole body. The main causes of leucorrhea are hormonal imbalance, bacterial, fungal, yeast infection in vaginal region, eating spicy and fried food, unhygienic condition and suffering from diabetes, anemia, and hypothyroidism. In Ayurveda, it is caused by vitiation of kapha and vata kapha. It is described in various ayurvedic texts such as Sharangdhar samhita, Charak samhita, Bhavaprakash, and Yogaratnakar. In Ayurveda, many ayurvedic formulations are available for the treatment of leucorrhea such as pradarari rasa, darvyadi kwatha, ashokarishta, and ashoka gritam. However, in western system of medicine, there is no permanent curing treatment.

Key words: Ayurvedic view, modern view, Shweta pradar

INTRODUCTION

Leucorrhea is whitish, yellowish, or greenish discharge occurring from the vagina.[1] The vagina epithelium made up stratified squamous epithelium and lamina propria. It is fibrovascular tube that connecting the uterus.[1] The discharge originates from the vagina, ovaries, fallopian tube, and mostly from cervix.[2] These discharge having offensive odor and creates problem such as itching vulva, back pain, weakness, tiredness, anxiety, tissue inflammation, and burning sensation.[3,4] Leucorrhea basically a symptom not a disease, this symptom may be appearing at any age.[5]

THE MAIN CAUSE OF OCCURRING LEUCORRHEA

1. Infection: Caused by bacteria trichomonas vaginitis, monilial vaginitis, bacterial vaginosis, and cervicitis.
   - Nature: (a) Cardy white in flakes, pruritic. (b) Gray-white, non-pruritic, and fishy odor. (c) Frothy yellow discharge.
   - Nature: (a) Not prominent discharge. (b) Irritation is prominent.
3. Foreign body: Caused by mechanical irritation and forgotten pessary, tampon.
   - Nature: Often blood stained, purulent, copious, and offensive odor.

The excessive secretion makes vulva moistness or staining brownish on drying, sometimes need to wear vulval pad. Sometimes, it becomes frustrating and makes women uncomfortable, and they feel the urge to change their undergarments in a day, excess perspiration occur and due to unpleasant odor, that creates embarrassing situation for women. Due to excessive discharge, excessive lubrication occurs which reduces the gripping over penis that causes disappointing experience during sexual intercourse. There is

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the growth of microorganism due to moist environment and inflammation of vagina occurs due to excessive secretion.[5]

**Modern View on Leucorrhrea**

Leucorrhrea can be defined as excessive whitish, yellowish or greenish, sticky, viscous having offensive odor or odorless vaginal discharge occur from vagina, cervix, fallopian tube, and ovaries and also due to physiological and pathological excess in female which may occur normally or due to infection. The women encounter normal fluid discharge which comprises all worn out dead cells in the vaginal tract.[7] The chronic stage of leucorrhrea leads to pelvic inflammatory disease.

**Types of Leucorrhrea**

1. Physiological excess:
   a. During the time of pregnancy, vascularity increases which leads to the increase in cervical gland secretion.
   b. During menses, the level of estrogen increases which cause increase in cervical gland secretary activity.
   c. Puberty - At the time of puberty, the level of endogenous estrogen increases, thus causing excessive growth of endocervical epithelium leads to congenital ectopy, thereby enhancing the secretion.[8]
   d. It is also observed in newborn female infants for 1 or 2 month after birth due the exposure of estrogen in womb.
   e. Abundant secretions occur from Bartholin gland at the time of sexual intercourse.
   f. It is caused due to natural defense mechanism of vagina to maintain pH balance in vagina.

2. Pathological excess:
   a. It can be defined as vaginal discharge due to infection or disease in female reproductive system.[9]
   b. The vaginal infection may occur due to bacteria, virus, and fungi.
   c. It may be caused due to infection vaginal mucosa by *Trichomonas vaginalis* and Candida.[10]
   d. Hormonal imbalance and metabolically disorder may lead to its enhancement.

**SYMPTOMS**

It may include excessive vaginal discharge, itching in vaginal part, foul smell, irritability, digestive disturbance, black patch around eyes, anorexia,[11] polyuria, pain adhesiveness in abdomen, pain during menstruation, constipation, body ache and thirst, fever, and vomiting.[12]

**Treatment:**
1. Prevent the use of contraceptive for short time period
2. Surgical treatment such as electrocautery cryosurgery or trachelorrhaphy is used in case of cervical leucorrhrea
3. Maintain of health and hygiene
4. For pathological demonstration, common therapy is used in case of pelvic lesion
5. Estrogen level is balanced naturally
6. The discharge may be reduced by using such solution which is pH balanced

Antibiotics such as nystatin, natamycin, and povidone are used for the treatment of leucorrhrea. They act on bacteria and kill them, thereby preventing leucorrhrea. It has no significant role in hormonal imbalance, neither have they imported the immune system. For the balancing of estrogen level, i.e., hormonal balance Femiforte tablet is used.[13]

**AYURVEDIC VIEW ON LEUCORRHEA**

Raktapradra, pradara, and asrgdara are the terms used for bleeding from vagina but for white discharge word such as *Shweta pradar* or yonisrava has been used which is mentioned in various ayurvedic texts such as Sarangadharm samhita, Bhavaprakash, and Yogaratnakar. Vitiation of kapha leads to the development of symptom of all gynecological disorder which is known as shweta pradara. In disease such as atyananda, karnini, acarana, aticarana, slesmala, upapluta, and prasrmsini, specific clinic features are also described for each disease. Charak and Vagbhata have also prescribed symptomatic treatment for pandura asrgdara after describing the treatment of all the gynecological disorder.[14] Pandura asrgdara is described as shweta pradar and Indu as shukla (white) asrgdara by chakrapani.[15] Explanation of Indu was found to be doubtful since Asrgdara indicates discharge of blood which is red in color but cannot be white. For the treatment, the medicine prescribed is not specifically hemostatic but include kasaya rasa or astringent which have capability of suppressing any discharge. It assumes that the word asrgdara also denotes the type of vaginal discharge, along with bleeding from the vagina. Since shweta pradara is a symptom not a disease which was mentioned earlier, the etiopathogenesis of the main disease would also be the etiopathogenesis of the symptoms which is described previously. Aggregation of kapha occurs due to own vitiation factor or vitiation of rasa dhatu of reproductive system which is greatly influenced by excessive sexual intercourse, abortion or better living habit, or diet during menstruation.[16]

**Ayurvedic Treatment According to Classical Text**

1. The rice washing (tandulodaka) along with the kalka of the klush grass drink for 3 consecutive days. 3 g of powder of the bhunimba along with 50 ml tandulodaka.[17]
2. Bhasma of mercury or rasa sindura and decoction of the leave of vasaka plant.[18]
3. Amla seed powder mixed with sugar candy powder and then adds honey in it and take twice a day.
4. Make a churn of bark of Asoka and mix with equal quantity of misri in it and then add 1-1 spoon in cow
milk for 3 times in a day for few weeks.\[^{[19]}\]
5. Take one glass of freshly extracted pomegranate juice one daily at least for 3 times in a day.
6. Make a decoction of stem bark of vata and then mixed with paste of lodhra (\textit{Symplocos racemosa}).\[^{[20]}\]
7. Take a fruit of \textit{Ficus racemosa} and then make juice and take with honey. After that, cooked rice, milk, and sugar are taken dietary supplement.\[^{[21]}\]
8. Darvyadi kwath (Daru – hardira, Rasanjana, bark of the adusa plant, mustaka, the pulp of bilva fructified, purified bhallataka, or red variety of sandalwood and lotus).\[^{[22]}\]
9. Chandanadi churna (Red variety of sandal wood, jatamansi, lodhra, usira, padma kesar, Nagapuspa, bark of the bilva tree, bhadrustuka, raw sugar, natrabala patha, bark of kutaja plant, dried ginger, indrayava, ativisha, dhakiya flower, rasanjana, the pulp of stone of mango fruit, the seed of jambu fruit, mocularas, milkamal, manjistha, root of plant samanga, lesser variety of cardamom, seed of pomegranate, honey, and rice washing).\[^{[23]}\]
10. Pradarantaka rasa (purified mercury, purified sulfur vanga bhasma, rajat bhasma, kharpara bhasma, varatika bhasma, lauha bhasma, and juice of ghrita kumara).\[^{[24]}\]
11. Pradarari rasa (take one part of each of vanga bhasma, lauha bhasma, purified ras sindur, root of the red lotus, flower, and variety of sandalwood).\[^{[25]}\]
12. Madhukadya avaleha,\[^{[26]}\] Sarvanga sundara ras,\[^{[27]}\] Patrangasava,\[^{[28]}\] Ashoka ghritam, and Ashokarista are important formulation use in leucorrhea.\[^{[29]}\]

**DISCUSSION**

Women may suffer from gynecological disorder which may have vagina discharge due to vitiation of vata, pitta, and kapha which may be caused due to involvement of diet regime. The discharge may be profuse yellowish in color viscous, sometimes accompanied with offensive odor. It is mentioned as gynecological disorder. Due to increased level of estrogen it leads to marked overgrowth of the endocervical epithelium, may encroach onto the ectocervix which produces congenital erosion and increased the secretion. Due to chronic inflammation along with erosion, burning sensation, pain, and itching are also noticed. Itching may occur due to unhygienic condition leading to the growth of microorganism. Increase in cervical gland secretion at the time of pregnancy may lead to vaginal discharge. At the time of puberty and menses, the level of estrogen increases in the body. Sometimes, infection due to microorganism or disease in female reproductive system or hormonal imbalance may also lead to vaginal leucorrhea. According to Ayurveda development of symptom, gynecological disorder occurs due to vitiation of vata kapha and kapha. Charak and Vaghbata determining leucorrhea as pandura asrgdara and they also describe some symptomatic treatment on leucorrhea. It may occur due to vitiation of kapha as mentioned earlier which is influence by activities such as excessive intercourse, abortion, unbalance diet, and improper timing during periods. Uncomfortability, uneasiness felt by women prove to a greater hindrance in the treatment. Various ayurvedic formulations are used for the treatment of leucorrhea such as kwatha, vati, varti, avaleha, asava, and arista.

**CONCLUSION**

Shweta pradar is whitish discharge occurring from the vagina which does not possess burning sensation, pain, and discomfort. It is caused due to various conditions such as hormonal imbalance, vaginitis, bacterial, fungal and yeast infection, and various gynecological disorders. Many formulations are available in Ayurveda such as Pradarari rasa, ashoka ghritam, Ashokarista for the treatment of leucorrhea and results are good compared to western medicines.

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Diabetic retinopathy - A vision-threatening complication of diabetes mellitus and its management by *Triphala* - An evidence-based review

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Abstract

As we are living in 2018, a huge population of the world is fighting with a serious metabolic disorder - diabetes. As per the WHO survey, 415 million people of the world were diabetic in 2015. The rate of progression of diabetes is continuously rising. Diabetes mellitus is a metabolic syndrome characterized by chronic hyperglycemia along with disturbance of carbohydrate, protein, and fat metabolism. Diabetes mellitus can give birth to some serious complications such as diabetic ketoacidosis, stroke, cardiovascular diseases, chronic kidney disease, diabetic foot, diabetic nephropathy, diabetic neuropathy, and diabetic retinopathy (DR). DR is a microangiopathy, in which the integrity of the retinal precapillaries, arterioles, and venules becomes disturbed and either due to hemorrhage or occlusion the clinical presentation of DR appears. *Triphala* is a famous drug of Ayurveda, which is described in Brihattrayi, Laghuttrayi, Nighantus, and many other literatures of Ayurveda. In many places, it is used for Prameha. *Triphala* and its ingredients are quoted as Chakshushya in many places. Many studies have been done on *Triphala* in different parts of our country as well as outside the country which shows the hypoglycemic, anti-inflammatory, antioxidant, free radical scavenging, and anti-vascular endothelial growth factor activity of *Triphala* and favors the fact that *Triphala* has very significant role in the management of diabetes as well as DR.

Key words: Chakshushya, diabetes, diabetic retinopathy, hyperglycemia, microangiopathy, Prameha, Triphala

INTRODUCTION

In the 21st century, our world is fighting with some specific type of health issues which are grouped in lifestyle disorders such as diabetes mellitus and hypertension. Developed countries as well as developing countries are suffering from these serious problems.

Data say that approximately 415 million people in the world had diabetes in 2015,¹ Type 2 diabetic patient having 90% share of it.²,³ This represents about 8.3% of the adult population,⁴ with an equal percentage of both male and female.⁵ The rate of progression is continuously rising.⁶ Due to diabetes, a person’s risk of early death doubles.⁷ From 2012 to 2015, approximately 1.5–5.0 million people died due to diabetes per year.⁸ In 2014, global economic cost of diabetes was estimated to be US$612 billion.⁹ India had an estimated 31,705,000 diabetics in the millennium year which is estimated to grow by over 100% to 79,441,000 by 2030. According to the International Diabetes Federation Atlas 2015, an estimated 69.2 million Indians are diabetic, which as per the WHO assessment stood at 63 million in the year 2013. The estimates depict that diabetes prevalence has alarmingly doubled and so far has grown by over 100% in the past 15 years.

According to the WHO, “diabetes” or “diabetes mellitus” is a group of metabolic disorders which depend on multiple factors and characterized by chronic hyperglycemia along with disturbance of carbohydrate, protein, and fat metabolism.⁹ These abnormalities occur due to defects in insulin secretion, insulin action, or both. Symptoms of high

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blood glucose include polydipsia, polyphagia, and polyuria. If diabetes mellitus is left untreated for prolonged time, it becomes the root cause of several other serious conditions such as diabetic ketoacidosis, hyperosmolar hyperglycemic state, cardiovascular disease, stroke, chronic kidney disease, diabetic foot, diabetic nephropathy, diabetic neuropathy, and diabetic retinopathy (DR).[6]

DR is a microangiopathy which occurs due to hyperglycemia (micro = small, angio = vessels, and pathy = abnormality). It involves damage to the retinal capillaries. It is a progressive disease. Early disease may not cause symptoms, but in advance stage, patient may lose his vision completely.[10-12] DR is a leading cause of legal blindness and visual disability in the working age group in industrialized country.[13]

Retina is the innermost tunic of the eyeball which is very thin delicate and transparent membrane. It is the most developed and sensitive part of the eye.[14] We can see objects clearly with accurate shape, size, and color due to the great anatomical structure of the retina. When structure of retina becomes abnormal with or without visual disturbance, condition is referred as DR.

Triphala is an Ayurvedic drug which has three components - Amalaki (Emblica officinalis Gaertn.), Haritaki (Terminalia chebula Retz.), and Bibhitaki (Terminalia belllicera Roxb.). Triphala has great clinical significance. It is given by an Ayurvedic practitioner for many diseases or many purposes. As per our Ayurvedic classics, Triphala can be categorized under Tridosaghna Rasayan as it provides energy to the body and pacifies all three Sharir doshas (vata, pitta and kapha).[15] Acharya Charaka sait that Rasayanas have the qualities of supporting strength and immunity. Hence, due to these properties, Triphala can be given to very young, the infirmed, and to the old one. Triphala has also digestive, Shukral, mild laxative at normal dose, bowel tonic at low dose, purgative at high dose, antispasmodic, expectorant, and bronchodilator properties.[16] Triphala has also antidiabetic property, which has been proven by many studies. It has also a role in the improvement of impaired vision.

Properties of Triphala and its uses have mentioned in Brihattrayi, Laghattrayi, different Nighantus, and many other literature of Ayurveda. Acharya Charaka has described Phalatrikadi Kwatha for the treatment of Prameha (diabetes). Triphala is also the constituent of the Phalatrikadi Kwatha.[17] Acharya Sushruta has described Amalki and Haritaki as Chakshushya drugs.[18] Acharya Vagbhata also said that Triphala strengthens eyes and improves vision. These are just examples.[19] Many literary works have been done previously on Triphala. Many studies have done to prove the effect of Triphala in diabetes and diabetes-related ocular complication - DR. In this paper, we are trying to establish the fact that Triphala is beneficial for the treatment of DR in a scientific manner with the help of Ayurvedic literature and research works which are published in different standard journals.

WHAT IS DR?

DR is a microangiopathy affecting the retinal capillaries, arterioles, and venules. [10-12] It is the complication of diabetes mellitus. In diabetes mellitus, if the blood glucose level is increased for a prolonged time, microvascular and macrovascular changes occur in whole body. These changes also occur in eyes. The retina which is the innermost tunic of the eyeball has 10 layers. The outer four layers are supplied by choriocapillaris and inner six layers are supplied by branches of central retinal artery. The retina has two distinct structures - one is optic disc and another is Macula lutea. Optic disc is pale-pink, well-defined circular area of approximately 1.5 mm diameter. At the optic disc, all the retinal layers terminate except the nerve fibers, which pass through the lamina cribrosa (sieve-like sclera) to run into the optic nerve. Optic nerve transmits the visual sensation to the visual cortex of the brain. Macula lutea is situated in the posterior pole of the eyeball, temporal to the optic disc, and having a diameter of 5.5 mm. The central depressed part of the macula is known as fovea centralis and having 1.5 mm diameter. It is the most sensitive part of the retina. In its center, a central shining pit foveola is present (diameter - 0.35 mm). An area of about 0.8 mm is known as foveal avascular zone because it does not have any retinal capillaries.[14]

BASIC PATHOPHYSIOLOGY OF DR

[FIGURES 1-3][20]

When hyperglycemia persists for long time, vascular and hematological changes occur. They are responsible for microvascular leakage and microvascular occlusion.

DR is also caused by polyol pathway-mediated oxidative damage. Aldose reductase is found in high concentration in pericytes. It converts glucose to sorbitol. Sorbitol has very low tendency of diffusion. Hence, it accumulates within the cell and causes electrolyte imbalance and microvascular abnormalities.[20]

Oxidative stress - It occurs due to an imbalance between oxygen free radicals and antioxidant defenses in biological system. Due to this development of DR and progression, both occur.[20]

Vascular endothelial growth factors (VEGFs) are the major factor for producing DR. VEGFs are responsible for both vasculogenesis and angiogenesis. Insulin such as growth factors and angiopoietin 1 and 2 are also cause by DR.[20]

DR is of four types - non-proliferative DR (PDR), PDR, diabetic macular edema, and advanced diabetic eye disease.
In DR, vision loss is mainly due to macular edema. Macula is responsible for central vision as well as accurate vision. If macula gets swelled, visual disturbance occurs.\cite{10-12}

**Figure 1:** Two pathways for occurrence of Diabetic retinopathy: (i) microvascular occlusion and (ii) microvascular leakage

**Figure 2:** Diagrammatic representation of different pathways responsible for Diabetic retinopathy.

In DR, vision loss is mainly due to macular edema. Macula is responsible for central vision as well as accurate vision. If macula gets swelled, visual disturbance occurs.\cite{10-12}

**PHARMACOLOGY OF TRIPHALA**

*Triphala* is *Pancharasatmaka Aushadh Dravya* that means, except salt, rest five types of rasa are present, i.e., sweet, sour, pungent, bitter, and astringent. The vipaka or post-digestive effect of the *Triphala* is sweet. *Triphala* can balance all *doshas* by its trophism. *Amalaki* is *guru* and *ruksh* in property while both *Haritaki* and *Bibhitaki* are *laghu* and *ruksha*.\cite{21}

**Figure 3:** (a) Normal fundus, (b) non-proliferative diabetic retinopathy, (c) proliferative diabetic retinopathy

**THERAPEUTIC EFFECTS OF TRIPHALA WITH THEIR ACTIVE INGREDIENTS**

Studies have validated a number of potential uses of *Triphala*, which include free radical scavenging, antioxidant, anti-inflammatory, wound healing, hypoglycemic, and radioprotective effects.\cite{22} Many other qualities are also found in *Triphala*, but we quoted here only those which are beneficial for DR. *Triphala* may also maintain homeostasis of the endocrine system which very much concerned with diabetes.\cite{22}

The major constituents of this herbal formula are the chebulinic acid, gallic acid, ellagic acid, and tannins which are potent antioxidants that may account, at least in part, for the observed anti-VEGF and immunomodulatory activity of the formula.\cite{23,24} *Triphala* also contains some other bioactive compounds such as saponins, anthraquinones, flavonoids (e.g., quercetin and luteolin), various carbohydrates, amino acids, and fatty acids.\cite{25} In addition, an alcoholic extract of *Triphala* such as chebulinic acid is also transformed by the microbes of human gut into bioactive metabolites, which have demonstrated the potential effect *in vitro* to prevent oxidative damage and may give beneficial results in DR cases.\cite{26}

**WHAT DOES TRIPHALA IN DR**

VEGFs are one of the important causes of DR. *Triphala* contains chebulinic acid as one of the active constituents. A study has done by some scientist to find the effect of chebulinic acid on VEGF which shows a great result. They said after the experiment that *Triphala* and chebulinic acid are natural inhibitors of VEGFs.\cite{27} They extracted chebulinic acid from *Triphala Churna*. Some scientists used aqueous and alcoholic extracts of *Triphala* and their active compounds chebulagic acid and chebulinic acid to prevent the retinal pigment epithelial cells by inhibiting SMAD-3 phosphorylation.\cite{27}

*Triphala* has anti-inflammatory property. Anti-inflammatory effect of *Triphala* was studied by a group of some Thai doctors and proved by them.\cite{28} It reduced both acute and chronic inflammation.
Many studies have done to show hypoglycemic property of Triphala. In one study, 30 diabetic patients were treated with Triphala (the three myrobalans). Triphala has given as a supplement for 45 days with buttermilk after 2 h of dinner. After this therapy, the result shows significant lowering in the blood glucose levels at 5 g level quantity (both fasting and postprandial). Triphala has menthol and sorbitol as active ingredient which is believed to have hypoglycemic effect.[29]

ANTIOXIDANT ACTIVITY OF TRIPHALA IN ANOTHER OCULAR DISORDER

Triphala has the potential to maintain the eye health due to its antioxidant property. Vitamin C and flavonoids are found in Triphala in very rich amount. Triphala has also a role in cataracts. In a study when Triphala is used in selenite-induced cataracts in mice as a pretreatment, it shows very good results. Glutathione levels in eye lenses become normal by the use of Triphala. Activities of some antioxidant enzymes are also enhanced by Triphala, such as catalase, glutathione peroxidase, glutathione-S-transferase, and superoxide dismutase. In this study, 100% mice of the control group developed cataracts, but only 20% of the mice which were pretreated with Triphala developed cataracts. This preventive effect was may be due to the antioxidant activity of the Triphala.[30]

Triphala can be used as many doses form such as Churna, guggulu, ghrita, and aasav. Triphala has also Meda Shamak property. Meda is also related to Prameha and Pramehajanya Updrava diabetic retinopathy, so it is beneficial for DR.

Acharya Charaka has given the Prameha a special position among diseases as he described it under eight major diseases. Prameha is a group of 20 diseases; diabetes is also a group of many metabolic disorders. DR is a severe vision-threatening complication of diabetes or Prameha. In initial stage of DR, patient may complain for mild diminution of vision, but with the progression of disease, worsening of visual problems also occur, and in extreme stage, patient becomes blind. Triphala has great potency to treat diabetes as well as DR. Triphala has hypoglycemic, anti-inflammatory, free radical scavenging, antioxidant, wound healing, and radioprotective properties. It also contains some specific constituents which have anti-VEGF activity. All these effects have proven by several studies. Some of them are mentioned in our study. Hence, we can conclude now that Triphala has very significant role in the management of DR and we should prescribe the different doses forms for the treatment of DR. But still, there is a need of some additional research work.

REFERENCES


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Ayurvedic review on some medicinal plants, metals, and minerals having anticancer property

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Abstract

Cancer is a major health problem in both developed and developing countries. After cardiovascular disease cancer is the second most common cause of death. In cancer abnormal growths of cells in our bodies occur. Cancer is a complex group of diseases in which involve cell transformation proliferation, invasion, metastasis, and angiogenesis. There is various plant product used in the treatment of cancer. The major problem of chemotherapy is toxicity of the drug. In human being, it is caused by exposure of toxic materials, some genetic factors, and viral infections. The purpose of this review is to explore the medicinal plants, metals, and minerals for treatment of cancer.

Key words: Cancer, medicinal plants, metals, minerals, models for anticancer property

INTRODUCTION

Natural products have been used in various diseases for several of years. Cancer is abnormal growth of cells and these cells usually invade and destroy normal cells. These cells are generated due to an imbalance in the body and treated by correcting the imbalance. Breast cancer is developed one out of 30 women in the country. Colon cancer is second most cause of death in US. Prostate cancer is frequently diagnosed cancer among the men in US, second is skin cancer with an estimated 180,000 new cases and 37,000 deaths expected by American cancer society each year. About 42% male and 18% female cancer deaths caused using of tobacco-related products. Terrestrial plants have been used as medicines in India, Egypt, China, and Greece from ancient time based on ACS report 2014, nearly 1 in every 4 deaths can be caused by cancer with a possibility of 585,720 deaths due to cancer this year in USA. Now a days herbal medicine are said to be potential source of anticancer agents and widely used across the globe due to their therapeutic efficacy and wide applicability with least side effects. Medicinal plants play a role in the health-care system of large proportion of world populations. The anticancer of activity of plants is due to the presence on antioxidant property in them, and they are natural source of anticancer agents.

Over the past decade, herbal medicine has become a topic of global importance, making an impact on both international trade and world health. The major cause of cancer is smoking, hormones, and chronic infections lead chronic inflammation. Cancer can affect any part of the body, and it is termed as malignant tumors and neoplasm.

There are six characteristics of malignancy:
- Insensitivity of antiproliferative signals
- Enabling of limitless replicative potential
- Self-sufficiency of growth signalling
- Activation of metastasis and invasion of tissue
- Evasion of apoptosis
- Sustainment and induction of angiogenesis.

Every year millions of new cancer cases are found. After several diagnosis it was found that cancer cells invade and destroyed normal cells. Chemotherapy is a major treatment for the control of advanced stages of malignancy. Several herbal plants they maintain vitality and health of individual and also cure the diseases including cancer. According to the WHO, several people of developing countries used traditional medicines for their primary health need. According to a recent survey, 60% cancer patient used herbs and vitamins as a therapy.

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associated with cancer and because of serious side effects of chemotherapy and radiation therapy, several cancer patients seek complementary method of treatment.[11]

WHAT CAUSES CANCER

Cancer can be caused by a number of genetic alteration. Mutation in tumor suppressor gene and oncogenes represent the primary genetic lesions - their activation and inactivation, respectively, trigger carcinogenesis. Cancer can be occurring by a mutation in DNA, which instructs the cells how to grow and divide. Normal cells have the ability to repair mutations in DNA. However, mutations cannot be repaired and cause to grow the cells to become cancerous.[1]

ENVIROMENTAL FACTORS

Environmental factors including diet, smoking, radiations in our homes, infectious diseases as well as chemicals and workplace along with trace level of pollutants in drinking water, food, and in air.[1] The cancer risk becomes highly increase where workers are exposed to ionizing radiations, certain metals, carcinomas chemicals, and other specific substance exposed at low levels.[11]

Other factors, which are affect like tobacco use, not enough physical activity, unhealthy diet; however, the degree of risk from pollutants depends on the intensity, concentration, and exposure of radiations.[1]

AYURVEDIC CONCEPT

Charaka and Sushruta are two well-known ayurvedic text describe cancer as a arbuda (major neoplasm) and granthi (minor neoplasm), and it is inflammatory or non-inflammatory swelling.[12] Aspects of the practice of Ayurveda - Charaka Samhita (1100 plants), Sushruta Samhita (1270 plants), and Astanga Hridaya (1150 plants).[13] Ayurveda is known as Astanga Ayurveda, which means that which is made up of 8 parts.[13] The 8 major divisions of Ayurveda are as follow as: (a) Kayachikitsa (Internal Medicine), (b) Kaumar Bhritiya (Pediatrics), (c) Bhoottavidiya (Psychiatry), (d) Shalakaya (Otorhinolaryngology and Ophthalmology), (e) Shaly (Surgery), (f) Agada Tantra (toxicology), (g) Rasayanaya (Geriatrics), and (h) Vajikarana (Aphrodisiacs and Eugenics).[16]

In the ayurvedic text, three dohas are described vata, pitta, and kapha, i.e., nervous system (vata or air), venous system (pitta or fire), and arterial system (kapha or water); they are mutually coordinate and responsible for the normal functions of the body.[13] In neoplasm (vataja, pittaja, and kaphaja) one or two of three body system are out of control, and it is not too harmful because the body still trying to coordinate with these system.[12] Tridoshik arbuda is usually malignant because the major body system loses mutual coordination and cause morbid conditions.[13] Classical Indian Ayurvedic drugs such as Amritaprasham, Ashwagandha Rasayana, Brahma Rasayana, Chyavanprasha, Narasimha Rasayana, and Triphala Churna were found to be radioprotective in cancer treatment.[13] In Ayurveda neoplasm can be classified on the basis of clinical symptoms related to tridoshas.[11]

Group 1: Diseases they are not cancer but considered as a malignancy such as growth and ulcer Examples: Tridosaja gulma, ashadya galganda (thyroid tumor), ashadya udara rog, and abdominal tumor like carcinomas of the liver and stomach.[1]

Group 2: Diseases are having possibility of malignancy such as ashadya pradar, ashadya kamla, and visarpa.[1]

Group 3: Diseases are having clear malignancy including granthi and arbuda such as raktaarbhuda (leukemia), ashadya vrana (malignant ulcer), mukharbuda (oral cancer), and mamsarbuda (sarcoma).[1]

There are many types of cancer treatment such as surgery with chemotherapy and/or radiation therapy. You may also have immunotherapy, targeted therapy, or hormone therapy.[14]

Plants having Anticancer Activity

1. Brahma Manduki (Centella asiatica): Apocynaceae family. It is suppressed mouse lung fibroblast cell proliferation, and oral administration slowed the ascites tumors.[15] it has several compounds such as vallerine, ascorbic acid, flavonoids, and sterol.[16] If pretreatment of these plant occurs, then it increases survival time of animals and protects the damage liver from radiation.[22]

2. Pomegranate (Punica granatum): Lythraceae family. Pomegranate has phenolic compounds, ellagic acid, and ellagitannins that convert urothilins metabolically by the gut of microbiota. It interferes with cell cycle and inhibit proliferate of cancer cell and induce apoptosis. Urothilins found in colorectal (CRC) patients in high concentration.[16]

3. Talispatra (Taxus baccata): Taxaceae family. Taxol as a natural cytotoxic compound has been extracted and used in the treatment of cancer. In which cytotoxic effect of natural resources, branchlets, bark, and fruits of two different species of conifers was identified and collected. The cytotoxic effect of their hydroalcoholic extract was determined on three human tumor cells. T. baccata and its anticancer activity against breast cancer cell lines (MDA-MB 231 and MCF-7) and normal human epithelial cell line (HEK-293) have been studied. Few novel taxoids such as etoposide, elliptinium, homoharringtonine, roscovitine, and flavopiridol derived from naturally occurring 2-DAT-J and screening for their anticancer activity.[17]

4. Yashitimdhu (Glycyrrhiza glabra). Fabaceae family. In vitro cytotoxic screening of standard glycyrrhetic
acid was carried using three different extracts (methanol, chloroform, and water) of drug through MTT method. The percentage viability of two different cell lines was 78.78% for MCF-7 cancerous cell line and 45.71% for Vero normal line.[17] Cell viability of glycyrrhetinic acid in three different extracts was determined by two-fold try pan-blue method using two different cell lines Vero normal cell and MCF7 cancerous cell.

5. Haldi (Curcuma longa): Zingiberaceae family. It is used in ovarian cancer, gastrointestinal cancer, breast cancer, lung cancer, melanoma, lymphoma, leukaemia, and neurological cancer.[17] The target for treatment is cyclin E and cyclin D1, apoptosis (by activation of caspases and downregulation of anti-apoptotic gene products), survival (P13K/KAT pathway), angiogenesis (vascular endothelial growth factor), metastasis (CXCR chemokine receptor 4), invasion (matrix metalloproteinase-9 and adhesion molecules), and inflammation (nf-kappa B, tumor necrosis factor, interleukin-1, cyclooxygenase-2, and 5-lipoxygenase).[18]

Metals and minerals having Anticancer Property

1. Vanadium: The compounds have insulin-like action.[19] and it reduces hypertension and hyperglycemia. Antiproliferative effect of vanadium compounds on malignant cell and normal cell lines appear to be exerted through mainly cell cycle arrest. Zhang et al. demonstrated that vanadate induced G2/M-phase arrest in p53-deficient mouse embryo fibroblasts and promoted S-phase entry in the corresponding p53 wild-type cells.[20] Oxidation state of vanadium can also be determine various vanadium biological effect of vanadium compounds; for instance, the activation of intracellular signal transduction pathways which in turn regulate cytosolic protein tyrosine kinases.[21] With the help of X-ray energy fluorescence, concentration of vanadium can be estimated.[22]

2. Magnesium: It is essential for good health, and it is fourth most abundant mineral in human body. 50% magnesium found in bones and other half is found in inside the cell of body tissue and organs. Magnesium deficiency results in metabolic abnormalities and clinical consequences even cancer development. High dietary magnesium may decrease risk of CRC cancer.[23] Over 300 enzymes and ion transportation require magnesium for its role in fatty acid and phospholipid metabolism which affects permeability and the stability of the membrane. Magnesium deficiency seems to be carcinogenic, and in case of a solid tumor, high level of supplemented magnesium inhibits carcinogenesis.

3. Arsenic: Arsenic is a natural compound, and it is used in China for medical treatment about more than 25 centuries. Arsenic trioxide (Ar,SO3) has been used in patients having acute promyelocytic leukemia.[24] Arsenic trioxide is safe not only in leukemia patients but also in patients having many other malignancies. There are several explanations for the mechanism of action of arsenic trioxide. It induces p53 dependent G1 and G2/M cell cycle arrest through an activation of caspase.[25] Arsenic trioxide also induces apoptosis and cell cycle arrest.[26] The anti-carcinogenic effect of arsenic trioxide may be related to the induction of apoptosis.[27] Several cell lines are sensitive to arsenic trioxide: Esophageal carcinoma cell, renal cell carcinoma cell, and small cell lung cancer (Natural cytotoxic cells (Ne cells) Hydrocortisone (He cells)).[28] Arsenic trioxide has been shown to be active against nasopharyngeal carcinoma xenografts in BALB/C nude.[29]

4. Selenium (Se): Se is an essential mineral and trace element for animals including humans. It has been shown to affect the functions of several specific intracellular selenoproteins by being a compound of their essential constituents selenocysteine (SeCys) (Zeng and Combs 2008).[30] Both organic (Seleno amino acids) and inorganic (e.g., selenite and selenate) form of Se shown impressive cancer chemopreventive effects in animals and human models (Woo et al.). Se has antioxidant property, inhibition of tumor growth and inverse epidemiological correlation with cancer. Lee et al. reported the inhibition of LNCaP human prostate cancer xenograft by monomethylate Se. Selenium is an important mineral, which is found in food in nutritional doses, it is also an essential component of SeCys in selenoproteins, it prevents cell death and also promotes cell cycle progression. However, at higher doses that are greater than the nutritional requirement but not toxic, Se induces apoptosis and cell cycle (Zeng, 2009).

5. Germanium: It has antioxidant properties which have been shown to protect against cancer. It is an element which is found in some plant-based foods. Inorganic and organic both germanium have been sold as dietary supplements, recently the organic form of germanium most commonly. Germanium is a constituent of many medicinal plants such as ginger, garlic, and ginseng root and it plays an important role in the pharmacological effects of the plants (Lu, 1998). It is also reported that many organogermanium compounds can inhibit tumor and metastatic growth and modify immune response by inducing interferon-gamma (IFN-γ), increasing peritoneal macrophage activity, and enhancing NK cell activity (Aso et al. 1985 and Suzuki 1985 and Kuwabara et al., 2002 and Kaplan et al. 2004).

Animal Model for Cancer

1. Spontaneous tumor models.[31]
2. Virus-induced tumor models.[31]
   a. Friend leukemia
   b. Rous sarcoma.
3. Radiation-induced tumor models.
   a. UV induced skin tumorigenesis in SKH-1 hairless mouse[32]
CONCLUSION

Ayurveda is the ancient system of medicine having various effects in diseases but research of Ayurvedic drugs is in preclinical stage, and the basic principles are valid until today. Current modern therapies cause various toxic side effects to the patient. For this reason, draw the global attention toward herbal medicines. It is also known to everyone that western medicines provide symptomatic treatment which does not look about the underlying conditions but in ayurvedic treatment treats the diseases from the root of origin. The ayurvedic researchers and practitioners improve the medicines by increasing their contribution. In this study, we discuss about the plants, metals, and minerals having the anticancer property and also discuss about the models used for anticancer property. Ayurveda concepts have not yet been sufficiently validated; hence, the collaborations between these two medicinal systems are mutually beneficial.

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apoptosis in myeloma cells: p53-dependent G1 or G2/M cell cycle arrest, activation of caspase 8 or caspase 9 and synergy with APO2/TRAIL. Blood 2003;101:4078-87.


A review on medicinal plants described in Ayurvedic classics having antidiarrheal and antidysenteric activity

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Abstract

Diarrhea and dysentery are the most common disease among people of various age. Morbidity and mortality also occur. The diarrhea occurs from unhygienic environment, unsafe drinking water, and food poisoning and sometimes caused by pathogen. Dysentery is caused by excess intake of spicy, salty, and oily food material and also related with human pathogen *Escherichia coli*. In Ayurvedic classics, diarrhea and dysentery are correlated with Atisara and Pravahika, respectively. The popularity of herbal medicine is increasing day by day in global market. This paper review shows the efficacy of the plants describing for various related activities.

Keywords: Atisara, Ayurveda, diarrhea, dysentery, medicinal plants, pravahika

INTRODUCTION

Diarrhea is one of the most common health problems in developing countries that occur in all groups, and sometimes, it causes death in rural area as well as urban area. The mortality of death is vast in rural area than urban area for their unawareness about health and disease.¹ Diarrhea is the third most common cause of death in children, liable for 13% of deaths an every year.² Poor sanitation is an important factor and most common problem for diarrheal disorder and mainly found in rural.³ The second common cause of the problem is lack of safe drinking water.⁴ Mainly Shigella bacteria is responsible for bacillary dysentery and transmitted by oral route and amoebic dysentery caused by *Escherichia coli* which transmitted through water.⁵

TYPES OF DYSENTERY AND DIARRHEA

Commonly dysentery are two types: One is amoebic dysentery which caused by *Entamoeba histolytica* (protozoa) and another is Bacillary dysentery caused by *Bacillus subtilis*. Similarly, diarrhea is two types which are acute watery diarrhea (dehydration of water) caused by *E. coli* and another is bloody diarrhea caused by Shigella.⁶

AYURVEDIC VIEW OF DIARRHEA AND DYSENTERY

In Ayurveda, diarrhea is compared with Atisaara, it is condition where repeated passing of excessively watery stool with frequent bowel movements due to indigestion (ajeerna) or lack of digestive fire (agnimandya). Dysentery is correlated with Pravahika and it is occur due to vitiated Kapha and Vata dosha, where Kapha get aggravated in stomach and pulled down by vitiated Vata dosha into intestines. As a result, stool becomes sticky, thus body requires an additional effort for elimination of such stool.

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TYPES OF ATISAAR (DIARRHEA) AN
PRAVAHIKA (DYSENTERY) IN AYURVEDA

Depending on the etiology, there are seven types of diarrhea, namely, Vataja, Pittaja diarrhea, Kaphaja, Tridoshaja, Raktaja, Shokaja, and Bhyajawhere as depending on which particular Dosha is vitiated, and Pravahika (dysentery) has been classified into Vataj, Pittaj, Kaphaj, and Raktaj types in Ayurveda.

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Family</th>
<th>Chemical constituent</th>
<th>Pharmacological action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papaver somniferum (L.)</td>
<td>Papaveraceae</td>
<td>Morphine</td>
<td>Non-narcotic part of ahiphena is used in back pain in diarrheal condition, and it gives relief from internal hemorrhage which occurs in dysenteric condition[8]</td>
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<td></td>
<td></td>
<td>Codein[7]</td>
<td></td>
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<tr>
<td>Trachyspermum ammi (L.)</td>
<td>Umbelliferae</td>
<td>Thymol, carvacrol, dipentene</td>
<td>Aqueous extract of ajwain is having hepatoprotective activity and gives a very good result in diarrhea[9]</td>
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<tr>
<td>Terminalia arjuna (L.)</td>
<td>Combritaceae</td>
<td>Arjunetine, tannin[7]</td>
<td>The bark of this plant has antidysenteric property[13]</td>
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<tr>
<td>Mangifera indica (L.)</td>
<td>Anacardiaceae</td>
<td>Flavonoid, triterpenoid,</td>
<td>The seed kernel of mango plant having antidiarrheal activity, and it reduces internal hemorrhage and also relieves from dysentery[16]</td>
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<td></td>
<td></td>
<td>mangiferin, tannic acid[7]</td>
<td></td>
</tr>
<tr>
<td>Psoralea corylifolia (L.)</td>
<td>Fabaceae</td>
<td>Alkaloid, resin, essential</td>
<td>Leaves having antidiarrheal property which reduce intestinal motility.[18]</td>
</tr>
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<td></td>
<td></td>
<td>oil[17]</td>
<td></td>
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<tr>
<td>Psidium guajava L.</td>
<td>Myrtaceae</td>
<td>Catechin, epicatechin, rutin,</td>
<td>Bark decoction is used in diarrheal condition, and leaf and shoot juice also inhibit gastric secretion and reduce intestinal motility and capillary permeability[20]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sesquiterpene[19]</td>
<td></td>
</tr>
<tr>
<td>Garcinia pedunculata</td>
<td>Guttiferae</td>
<td>Riboflavin, thiamine,</td>
<td>The fruit and leaf having properties which reduce gastric empty time and relief from internal hemorrhage in diarrheal and dysenteric condition[21]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gallic acid minerals[21]</td>
<td></td>
</tr>
<tr>
<td>Aegle marmelos Corr.</td>
<td>Rutaceae</td>
<td>Tannin, pectin, marmeline,</td>
<td>The fruit of this plant inhibits prostaglandin synthesis and significantly reduces and stops intestinal movement or motility and gives quick relief from diarrheal and dysenteric condition[23]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>aegelin[7]</td>
<td>The root parts are also used for treatment of dysentery[24]</td>
</tr>
<tr>
<td>Acacia arabica Wild.</td>
<td>Fabaceae</td>
<td>Tannin[7]</td>
<td>The pod of this plant having antidiarrheal and antidysenteric properties.[25]</td>
</tr>
</tbody>
</table>

(Contd)
### List of some common plants found in India having antidiarrheal and antidysenteric activity

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Family</th>
<th>Chemical constituent</th>
<th>Pharmacological action</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acacia nilotica</em></td>
<td>Mimosaceae</td>
<td>Minerals, protein[26]</td>
<td>Pods and tender leaves having antidiarrheal property[27]</td>
</tr>
<tr>
<td><em>Sida cordifolia</em> (L.)</td>
<td>Malvaceae</td>
<td>Palmitic acid, ephedrine, pseudoephedrine, indole alkaloid[28]</td>
<td>The root of this plant having good antimicrobial property and fight against pathogen <em>Staphylococcus aureus</em> which sometimes occurs in diarrheal condition and relief from this disease[29]</td>
</tr>
<tr>
<td><em>Cannabis sativa</em> (L.)</td>
<td>Cannabinaceae</td>
<td>Cannabinol, tetrahydrocannabinol, cannabidiolic acid[7]</td>
<td>Cannabis gives relief in inflammatory bowel disease and abdominal pain which occurs in diarrheal condition. and by the way, it relieves from diarrhea[30]</td>
</tr>
<tr>
<td><em>Eclipta alba</em> Hassk.</td>
<td>Asteraceae</td>
<td>Alkaloid, flavonoid, volatile oil[32]</td>
<td>Whole plant is used in dysentery[33]</td>
</tr>
<tr>
<td><em>Ziziphus jujuba</em></td>
<td>Rhamnaceae</td>
<td>Alkaloidmauritine-A, mucronine-D, amphibine-H, flavonoid[34]</td>
<td>Aqueous extract of <em>Ziziphus jujube</em> reduced intestinal motility and inhibit gastric emptying time, and it is responsible for constituent tannin present in it which having antidiarrheal activity[35]</td>
</tr>
<tr>
<td><em>Oxalis comiculata</em> (L.)</td>
<td>Oxalidaceae</td>
<td>Alkaloid, flavonoid, glycoside, tannin,[36]</td>
<td>The plant fights against pathogen like <em>Entamoeba histolytica</em> and kills the pathogen <em>Giardia lamblia</em> which is the main cause of diarrhea and dysentery[37]</td>
</tr>
<tr>
<td><em>Acalypha hispida</em></td>
<td>Euphorbiaceae</td>
<td>Alkaloid, flavonoid, carbohydrate[38]</td>
<td>The root extract of this plant having cooling property which gives relief from abdominal pain, occurs in diarrhea and also contains tannins and flavonoids which give antidiarrheal activity[38]</td>
</tr>
<tr>
<td><em>Punica granatum</em> (L.)</td>
<td>Punicaceae</td>
<td>Tannin, alkaloid, flavonoid, asiatic acid[39]</td>
<td>Decoction of the leaf having antidiarrheal effect due to the presence of tannin[40-41]</td>
</tr>
<tr>
<td><em>Coriandrum sativum</em> (L.)</td>
<td>Apiaceae</td>
<td>Tannin, flavonoid, alkaloid[42]</td>
<td>The extract is having antidiarrheal property by reducing intestinal motility[42]</td>
</tr>
<tr>
<td><em>Santalum album</em> (L.)</td>
<td>Santalaceae</td>
<td>Santalol, volatile oil[7]</td>
<td>The methanol extract of this plant having antidiarrheal property which reduces intestinal motility which occurs in diarrhea[43]</td>
</tr>
<tr>
<td><em>Xanthium indicum</em></td>
<td>Asteraceae</td>
<td>Alkaloid[7]</td>
<td>The plant is having antidiarrheal property[44]</td>
</tr>
<tr>
<td><em>Woodfordia fruticosa</em> Kurz.</td>
<td>Lythraceae</td>
<td>Tannin, lawsone[7]</td>
<td>The flower of this plant having antiamoebic activity and fight against round warm. And used in diarrhea and dysentery[45]</td>
</tr>
<tr>
<td><em>Fagonia cretica</em> (L.)</td>
<td>Zygophyllaceae</td>
<td>Flavonoid, alkaloid, protein[46]</td>
<td>The infusion of leaves having cooling property and give relief from diarrheal condition[47]</td>
</tr>
<tr>
<td><em>Berberis aristata</em></td>
<td>Berberidaceae</td>
<td>Barberini, berbamine, aromoline, karachine, palmatine[48]</td>
<td>The plant gives antidiarrheal effect which inhibits intestinal secretion and increases absorption and reduces removing of fecal matter and relief from diarrhea[49]</td>
</tr>
</tbody>
</table>

(Contd)
# List of some common plants found in India having antidiarrheal and antidysenteric activity

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Family</th>
<th>Chemical constituent</th>
<th>Pharmacological action</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Euphorbia thymifolia</em> (L.)</td>
<td>Euphorbiaceae</td>
<td>Sterols, minerals, antioxidants, cinnamic acid glycoside, essential oil tannin[50]</td>
<td>The plant having antibacterial activity and fight against bacteria, <em>E. coli</em> and inhibit their growth and give relief from dysentery[51]</td>
</tr>
<tr>
<td><em>Scindapsus officinalis</em></td>
<td>Araceae</td>
<td>Flavonoid, terpenoid, steroid[52]</td>
<td>Fruit of this plant having activity against pathogen <em>E. coli</em> and relief from dysentery[52]</td>
</tr>
<tr>
<td><em>Syzygium cumini</em> (L.)</td>
<td>Myrtaceae</td>
<td>Tannin, protein, carbohydrate, mineral[7]</td>
<td>The plant having antidiarrheal property and it inhibits gastric secretion and increases absorption, reduces intestinal motility and gastric emptying time, and relieves from diarrhea[63]</td>
</tr>
<tr>
<td><em>Terminalia chebula</em> Retz.</td>
<td>Combretaceae</td>
<td>Chebulenic acid, chebulagic acid, tannin[7]</td>
<td>Fruit of this plant having laxative property which reduces intestinal motility and increases the stomach emptying time and by this way, relieves from diarrhea[54]</td>
</tr>
<tr>
<td><em>Valeriana hardwickii</em> Wall.</td>
<td>Valerianaceae</td>
<td>Valerianic acid[7]</td>
<td>The rhizome of this plant inhibits intestinal motility or bowel contraction and relieves from diarrhea[55]</td>
</tr>
<tr>
<td><em>Myristica fragrans</em> Houtt.</td>
<td>Myristicaceae</td>
<td>Glycoside, eugenol[56]</td>
<td>A study shows that anti nutmeg oil having antidiarrheal effect which reduces number of faces in rats. Iwu (1993)[57]</td>
</tr>
<tr>
<td><em>Holarrhena antidysentrica</em> (L.)</td>
<td>Apocynaceae</td>
<td>Triterpenoid, alkaloid. Stigmasterol, lupeol, wrightia[58]</td>
<td>The seed having antidiarrheal activity. It fights against pathogen <em>E. coli</em> and relief from diarrhea[59]</td>
</tr>
<tr>
<td><em>Raphanus sativus</em> (L.)</td>
<td>Brassicaceae</td>
<td>Oleic, linoleic, palmitic acid[60]</td>
<td>The extract <em>R. sativus</em> of shows a strong antibacterial activity and it inhibits the growth of <em>E. coli</em> which is a intestinal flora, and by the way, it gives relief from dysentery. the juice also having these property[61]</td>
</tr>
<tr>
<td><em>Butea monosperma</em> (L.)</td>
<td>Fabaceae</td>
<td>Triterpene, butin, flavonoids[62]</td>
<td>The flower of this plant having antidiarrheal activity and it reduces intestinal motility[63]</td>
</tr>
<tr>
<td><em>Trichosanthes dioica</em> Roxb.</td>
<td>Cucurbitaceae</td>
<td>Tannin, vit-A, vit-C, flavonoid[64]</td>
<td>Water extract of this plant having antidiarrheal property which reduces excretion of watery stool and inhibits secretion and gastric motility reduce. The plant also contains flavonoid containing compound which mainly responsible for it[65]</td>
</tr>
<tr>
<td><em>Cissampelos pareira</em> (L.)</td>
<td>Menispermaceae</td>
<td>Alkaloid hyatidine[66]</td>
<td>Root of this plant having antidiarrheal property, and it reduces gastric emptying time[67]</td>
</tr>
<tr>
<td><em>Oroxylum indicum</em> Vent.</td>
<td>Bignoniaceae</td>
<td>Ellagic acid, oroxyline, chrysin, baicalein [68]</td>
<td>The whole part of plant used in diarrhea and dysentery[69]</td>
</tr>
</tbody>
</table>

*E. coli: Escherichia coli*
<table>
<thead>
<tr>
<th>Classical name</th>
<th>Part use</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahiphena</td>
<td>Seed</td>
<td>Ahiphena mixed with bark of kupilu, taken with honey[^70]</td>
</tr>
<tr>
<td>Ajmoda</td>
<td>Fruit</td>
<td>Ajmoda, aralu, and madhuka mixed with milk and administered with honey. It gives relief in diarrhea related with abdominal pain[^71]</td>
</tr>
<tr>
<td>Chincha</td>
<td>Seed</td>
<td>Amlika seed, sunthi, rock salt, and ajwain mixed and taken with anupan. It gives an efficacious result very quickly in diarrheal condition[^72]</td>
</tr>
<tr>
<td>Ankolah</td>
<td>Root bark, stem</td>
<td>Root bark is taken with buffalos buttermilk and it is very efficacious in diarrhea[^73]</td>
</tr>
<tr>
<td>Aralu</td>
<td>Stem bark</td>
<td>Bark of aralu spread over with ghee, apply heat, and administered with honey which give relief from diarrhea[^74]</td>
</tr>
<tr>
<td>Arjuna</td>
<td>Stem bark</td>
<td>Arjun bark is administered with honey and taken with milk, very efficacious in bloody diarrhea[^75]</td>
</tr>
<tr>
<td>Kadamba</td>
<td>Fruit and bark</td>
<td>Kwath of bark used in rakta-atisara[^70]</td>
</tr>
<tr>
<td>Amra</td>
<td>Seed kernal</td>
<td>Decoction of bilva mixed with seed kernel of amra and taken with honey and sugar for vomiting and diarrhea[^76]</td>
</tr>
<tr>
<td>Bavchi</td>
<td>Leaves</td>
<td>Cooked leaves of the plant administered with curd daily in dysenteric condition[^77]</td>
</tr>
<tr>
<td>Amratafalam</td>
<td>Leaves</td>
<td>The leaf juice of guava mixed with pomegranate juice and administered in diarrheal condition[^78]</td>
</tr>
<tr>
<td>Amlavetasen</td>
<td>Fruit and leaves</td>
<td>At first, fruit is dried in sunlight, then soaked into water and used in dysentery[^78]</td>
</tr>
<tr>
<td>Babool</td>
<td>Pods</td>
<td>Babbularistha is administered in diarrheal condition[^79]</td>
</tr>
<tr>
<td>Babool (vilayati)</td>
<td>Pods and leaves</td>
<td>Fruit is administered in diarrheal. Powder of bark is used in dysenteric condition[^80]</td>
</tr>
<tr>
<td>Bala</td>
<td>Root</td>
<td>Bala is cooked with milk, administered with sunthi and jaggery[^81]</td>
</tr>
<tr>
<td>Bhang</td>
<td>Leaves</td>
<td>Bhang and jatiphal mixed with each other and administered with indrayava[^13]</td>
</tr>
<tr>
<td>Bibhitaki</td>
<td>Fruit</td>
<td>Fruit of bibhitaki with salt is used in diarrheal condition[^82]</td>
</tr>
<tr>
<td>Bhringaraja</td>
<td>Whole plant</td>
<td>Root of <em>Elipta alba</em> is taken with water[^83]</td>
</tr>
<tr>
<td>Bilva</td>
<td>Fruit</td>
<td>The fruit of this plant administered with madhu in atisara[^84]</td>
</tr>
<tr>
<td>Changery</td>
<td>Leaves</td>
<td>Changery and dugdhika mixed with dadim seed, administered with curd, ghee, etc[^85]</td>
</tr>
<tr>
<td>Dadima</td>
<td>Bark</td>
<td>Bark of kutaja and dadima mixed with honey and give relief from bloody diarrhea[^86]</td>
</tr>
<tr>
<td>Dhanyaka</td>
<td>Fruit</td>
<td>Decoction of dhanyak is powerful digestive and act against diarrheal[^13]</td>
</tr>
<tr>
<td>Chandan</td>
<td>Heartwood</td>
<td>Chandan is taken with rice water in diarrheal condition. It gives a cooling effect and give relief from pain[^87]</td>
</tr>
<tr>
<td>Kamal</td>
<td>Whole plant</td>
<td>Part of the plant taken with lajjalu and administered with honey and milk[^88]</td>
</tr>
<tr>
<td>Chameleonsn</td>
<td>Whole plant</td>
<td>Decoction of whole plant used in dysentery[^5]</td>
</tr>
<tr>
<td>Dhakai</td>
<td>Flower</td>
<td>Dhatyakadichurnai is administered with badari, kapitha, and honey used in atisara[^89]</td>
</tr>
<tr>
<td>Durlabha</td>
<td>Root</td>
<td>Durlabhs is administered with curd in diarrheal[^13]</td>
</tr>
<tr>
<td>Daruheridra</td>
<td>Rhizome</td>
<td>Decoction of rhizome is used in diarrheal[^90]</td>
</tr>
<tr>
<td>Dugdika</td>
<td>Whole part</td>
<td>Whole plant used in diarrheal[^90]</td>
</tr>
<tr>
<td>Gajapippal</td>
<td>Fruit</td>
<td>It is administered in bloody diarrheal[^90]</td>
</tr>
<tr>
<td>Jambu</td>
<td>Seed</td>
<td>Seed of jambu is very beneficial in diarrheal and dysentery and administered with jaggery. Sometimes, decoction of bark used in diarrheal and dysentery[^91]</td>
</tr>
<tr>
<td>Haritaki</td>
<td>Fruit</td>
<td>Decoction of fruit powder of this plant administered in dysenteric condition[^92]</td>
</tr>
<tr>
<td>Jatiphala</td>
<td>Fruit</td>
<td>The paste of jatiphal mixed with sunthi and pounded with cold water relief from diarrheal[^93]</td>
</tr>
<tr>
<td>Kutaja</td>
<td>Bark</td>
<td>Decoction of stem bark with seed and musta taken with sugar, honey and used in diarrheal condition[^94]</td>
</tr>
<tr>
<td>Mulaka</td>
<td>Root</td>
<td>The seed of this plant used in diarrheal[^61]</td>
</tr>
</tbody>
</table>

(Contd)
CONCLUSION

Diarrhea and dysentery are one of the common health problems in rural and urban areas of all age grouped peoples, and it is mainly due to unawareness about environment, use of unsafe drinking water, use of poor sanitation, and bad hygienic practice. Sometimes, this disease also related with poor nutrition and food poisoning. Various plants have been reported for having antidiarrheal and antidysenteric activity which is traditionally used in Indian system of medicine for a long time. The plants listed above have shown related activity in clinical and experimental study, and the active principles of some plants are also identified for antidiarrheal and antidysenteric activity.

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Current and future perspectives of Ayurveda and Yoga for management of Prameha

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Abstract

Ayurveda and Yoga are the ancient most systems of holistic approaches to healing of suffering humanities. Ayurveda is based on Tridosh theory of diseases wherein Ahar (diet), Vihar (lifestyle), and Aushadh (drug) have been advised for alleviation of diseases with a primary focus on the body along with mind while the approach of Yoga is directed more toward control of mind through its eight limb path. The clinical features of passage of excessive quantity of urine resembling honey in taste and color along with sweetness of the whole body of Madhumeha and the Vatika variety of Prameha are nearly equivalent to that of diabetes mellitus which is a chronic metabolic disorder of carbohydrate, protein, and fat caused by absolute or relative deficiency of insulin. Prameha is characterized by Prabhutavil - Mutrata, i.e., passage of excessive and turbid urine with increased frequency. There are 20 types of Prameha described in Ayurvedic texts, and Madhumeha is one of the Vatika varieties of Prameha which has been considered in Asadhyayapas. All the types of Prameha, if untreated for longer duration get converted to Madhumeha, hence become incurable/Yapya. Ayurveda advocates specific lifestyle and dietary habits from early life. These lifestyle measures can prevent Prameha in its primordial stage and also help in the management. Various Yogic postures have also been found effective in preventing and treating Prameha. This paper will deal in length of the current and future perspectives of Ayurveda and Yoga for management of Prameha.

Key words: Ahar, diabetes mellitus, Madhumeha, Prameha, Vihar, Yoga

INTRODUCTION

Prameha is one of the chronic diseases having 20 types enumerated in Ayurvedic classical texts, and Madhumeha is considered under vataja category. It is the incurable/Yapya and advanced stage of prameha characterized by excretion of urine which resembles honey in taste and characteristics and also accompanied by sweetness of whole body of the patient. Prameha is an amusangi roga (adherent disease) and santarananjaya (caused by over nutrition) roga (disease) caused by saturation of body due to overeating. Due to difficulty in treatment, seriousness, and complications, prameha has been mentioned as one of eight Maharogas (Major diseases). In Sushruta Samhita, Madhumeha has been described as “Medo dushtijanay vikara (disorder of fat/lipid).” Prameha includes clinical conditions involving pre-diabetes, diabetes mellitus (DM), and obesity. Integration of the theory and therapeutic measures of Ayurveda in the management of these disorders may prove to be beneficial. Prameha is a Tridoshaja Vyadhi that involves all the three functional units with a predominance of Kapha. Prabhutavil –Mutrata, i.e., passage of excessive and turbid urine is the characteristic feature of Prameha. There are 20 types of Prameha resulting from the interaction of the three Doshas (Vata, Pitta, and Kapha) and 10 Dushyas (disturbed functioning of the principles that support the various bodily tissues), namely, meda (fat), mansa (muscle), kleda (water contents), shukra (semen regulating factors and hormones), shonita (blood), rasa (plasma), vasa (fat content of muscles), majja (bone marrow), lasika (lymph), and oja (immunity regulating factors); many of these subtypes have sweet urine, whereas some of them have different coloration of the urine. It is notable that 20 types of Prameha in fact do not refer to 20

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types of diabetes, but these represent to 20 types of physical abnormalities of urine which may be found in different patients with or without association of DM. This disease is closely related with 

\textit{Sthautya} (i.e., obesity). \textit{Sahaja and Jatah} (hereditary) \textit{Pramehi} can be correlated with Type I diabetes (IDDM), while \textit{Apathyanimittaja} (acquired by faulty diet and lifestyle) \textit{Prameha} can be correlated with Type II diabetes (NIDDM). \textit{Madhumeha} is a subtype of \textit{Vataja Prameha} that can occur as the terminal stage of Type II diabetes (in which insulin is required) or as Type I diabetes beginning in early childhood. Various dietary, lifestyle, and psychological factors are involved in the etiology of \textit{Prameha}, particularly in relation to disturbances in fat and carbohydrate metabolism.

The increasing stress during the work and rapid industrial growth, changing dietary habits and various types of foods such as preserved food items and fruits, excess amount of soft drinks and beverages, and canned foods along with lack of exercise result into the disturbance of \textit{Agni} or metabolism and ultimately cause various chronic and non-communicable diseases. DM is one of these diseases whose current estimated number of cases is predicted to double by 2025. About 20% of the current global diabetic population resides in the Southeast Asia region and the number of diabetic persons are likely to triple by the year 2025.\cite{9}

Although there is the availability of insulin and a large number of oral hypoglycemic agents, none is an ideal for the treatment of the majority of NIDDM patients; most individuals cannot be adequately controlled and secondary failure to oral treatment is common feature as the disease progresses. Hence, there is a need of finding better treatment option for DM. \textit{Ayurveda} and \textit{Yoga} may prove to be better alternatives or complementary to the management of this rapidly rising disease.

Careful obeying the rules mentioned under \textit{Swastha Vritta} (preventive medicine and Hygiene) such as proper dietary habits, \textit{Dinacharya} (day regimen), \textit{Ratricharya}(night regimen), \textit{Nidra}\cite{10} (sleep), \textit{Ritucharya}\cite{12} (seasonal regimen), \textit{Sadvritta}\cite{13} (good conduct), \textit{Achara Rasayana}\cite{14} (promotive ethical practices), and use of \textit{Rasayana}\cite{15} (rejuvenation therapy) are some of the measures which can prevent DM at all levels. Various Ayurvedic herbal and herbomineral preparations have been found to be effective in \textit{Prameha}.

Yoga originated in India over 4,000 years ago as a traditional form of mind–body training that seeks to unite the individual self with the transcendental self. Several trials have shown that yogic practices such as \textit{asan}, \textit{agni}, and \textit{pranayama} (breath control) can reduce fasting blood glucose and glycosylated hemoglobin A1c, as well as improve the lipid levels and quality of life of Type II DM patients.\cite{16}

\section*{Etiopathogenesis of Prameha}

The causative factors of prameha, namely, sedentary habits and dietary factors in general are also applicable to \textit{Madhumeha} which is a type of \textit{Vatika Prameha}.\cite{17} Depending on hereditary and dietetic factors, the patients are classified as \textit{saahaja pramehi} and \textit{apathyanimittaja pramehi}.\cite{18}

\textit{Prameha} is a kulaja vikara, i.e., it has tendency of inheritance.\cite{19} Excessive intake of \textit{madhura rasa} (sweet substances) by mother during pregnancy can induce \textit{prameha} in the child.\cite{20} Chakrapani has opined that the main cause of defect in \textit{bij} (spermatozoa or ovum) is apathya sevana (faulty diet and lifestyle) by the parents.\cite{21} The specific etiology of \textit{Madhumeha} is depicted in Table 1.

The following risk factors have been found associated with DM which also resemble with the most of the etiological factors mentioned in ayurvedic texts Table 2.

Kaphaja and pittaja prameha which are present since long period may get anubandha of vata due to chronicity, i.e. they may be converted into vataja prameha - Madhumeha.

Due to ksaya (diminution) of vital dhatus there is provocation of vata which causes excretion of urine resembling honey i.e., Madhumeha.\cite{24,25}

Excessive intake of unctuous substances, articles having acidic and salty taste, guru, snigha ahara (unctuous diet), and indulgence in excessive sleep and sedentary habits lead to excessive increase of kapha, pitta, and mamsa which causes srotorodha (obstruction of channels) leading to avarana (covering) of vata. This vitiating vata carries the oja (vital essence) to basti, resulting in Madhumeha and appearance of the symptoms of vata, pitta, and kapha alternately and frequently.\cite{22}

\section*{Role of Ayurveda in Management of Prameha}

There are two main goals of \textit{Ayurveda}: (i) Protection of health and (ii) cure of disease of a patient.\cite{23} Individual peculiarities such as \textit{Prakriti}, \textit{Satmya}, \textit{Sara}, \textit{Samhana}, and so on are also considered.\cite{96}

Aharsione of the three pillar of life, namely, (i) \textit{Ahara}, i.e. proper diet, (ii) \textit{Nidra} (i.e., proper sleep), and (iii) \textit{Brahmacharya}, i.e., divine lifestyle and control of sexuality.\cite{27} Specific rules

\begin{tabular}{|c|c|}
\hline
\textbf{Ahara} & \textbf{Vihara} \\
\hline
Excessive intake of Guru dravya & Excessive indulgence in Nidra \\
Snigdha dravya & Asya sukha (indulgence in sitting) \\
Amla dravya & Tyakta vyayama \\
Lavana rasa & Tyakta chint \\
Nava anna & Samsodhana akurvata \\
Nava pana & \\
\hline
\end{tabular}
for taking diet such as Ashtaharvidhi Visheshayatanani\textsuperscript{[28]} and Dwadasha Ashanapravicharana\textsuperscript{[29]} and also specific regimens for regulating lifestyle such as Dinacharya,\textsuperscript{[10]} Ratricharya,\textsuperscript{[30]} Ritucharya,\textsuperscript{[31]} and Sadvritt\textsuperscript{[32]} are special features of Ayurveda. A person whose lifestyle is based on these principles and is truthful, liberal, forgiving, and serves noble persons will never be sick.\textsuperscript{[33]} For the purpose of treatment, the patients suffering from Prameha have been classified as (1) Shtula and Balwan (obese and strong) and (2) Krisha–Durbala (thin and weak) which resemble the modern principle of management of DM wherein diabetic patients have been classified as obese and non-obese. Sthula Pramehi are advised Sanshodhan while Krisha Pramehi are given Samshamana Therapy.\textsuperscript{[34]}

**Role of Ahar in Management of Prameha**

*Ahar* has been called as Mahabhaishajya (the super most medicine) in the *Kashyap Samhita*.\textsuperscript{[13]} *Ojas*, glow, geniousness, and radiance all such qualities in the human beings develop from the only diet which is congenial, appropriate in quantity, and time having six *Rasas*.\textsuperscript{[35]} For the purpose of taking food, one part of stomach should be filled up with solid food, the second part with liquids, and the third part should be left for *Vata, Pitta, and Kapha*.\textsuperscript{[37]}

There are eight factors - *Prakriti, Karana, Samyoga, Rashi, Desh, Kala, Upayoga Samstha*, and *Upayokta* which determine the utility of food and are jointly responsible for bringing about the requisite benefits.\textsuperscript{[38]}

### Table 2: Risk factors for DM\textsuperscript{[23]}

<table>
<thead>
<tr>
<th>Non-modifiable</th>
<th>Modifiable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Sedentary lifestyle</td>
</tr>
<tr>
<td>Male gender</td>
<td>Diet</td>
</tr>
<tr>
<td>Family history of diabetes mellitus</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Genetic factors</td>
<td>Alcohol</td>
</tr>
<tr>
<td>-</td>
<td>Obesity</td>
</tr>
<tr>
<td>-</td>
<td>Viral infections</td>
</tr>
<tr>
<td>-</td>
<td>Stress</td>
</tr>
</tbody>
</table>

DM: Diabetes mellitus

### Table 3: Certain preparations mentioned for prameha in different ayurvedic texts

<table>
<thead>
<tr>
<th>Preparations</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svarasa</td>
<td>Amrita, Dhatri (S. M.K.1), Satavari (Bha. Ra. 37)</td>
</tr>
<tr>
<td>Kvatha</td>
<td>Phalatrikadi Kvatha (C.Ci. 6), Vidangadi Kvatha (Yo. Ra)</td>
</tr>
<tr>
<td>Churna</td>
<td>Eladi Curna (Bha. Ra. 37) Karkatibijadi Curna (Yo. Ra.)</td>
</tr>
<tr>
<td>Kalka</td>
<td>Triphala Kalika (Yo. Ra.)</td>
</tr>
<tr>
<td>Gutika (Vati)</td>
<td>Chandraprabha Vati (Sa. S. M. K.7), Candrakala Gutika (Bh. Ra. 37)</td>
</tr>
<tr>
<td>Guggulu preparations</td>
<td>Goksuradi Guggulu (Sa. M.K. 7)</td>
</tr>
<tr>
<td>Modaka</td>
<td>Trikatukadya Modaka (B.P.M.K. 38)</td>
</tr>
<tr>
<td>Asava</td>
<td>Lodhrasava (C.Ci. 6), Sarivadyasava (Bha. Ra. 38)</td>
</tr>
<tr>
<td>Arishta</td>
<td>Deodarvyadyarishta (Sa. M.K. 10)</td>
</tr>
<tr>
<td>Ghrita</td>
<td>Dhanvantara Ghrita (Ca. Da. 35), Dadimadya Ghrita (Bha.Ra. 37)</td>
</tr>
<tr>
<td>Taila</td>
<td>Haridradi Tail (Yo. Ra.)</td>
</tr>
<tr>
<td>Paka</td>
<td>Puga Paka (Yo. Ra.), Ashvagandha Paka (Y. Ra.)</td>
</tr>
<tr>
<td>Rasa Aushadhi</td>
<td>Basanta Kusumakara Rasa, Bhrat Vangesvara Rasa, Svama Vanga, Prameha Chintamani Rasa (Bha. Ra. 37)</td>
</tr>
<tr>
<td>Others</td>
<td>Guducyadi Yoga, Bhdatryadi Yoga, Nisha Triphala Yoga (Yo. Ra.), Silajita (S. Ci. 13)</td>
</tr>
</tbody>
</table>

### Role of Aushadh in Management of DM

In *Prameha/Madhumeha*, drugs having *rasayana, balya*, and *jivaniya* action as well as pramehaghna properties such as *Amalki, Guduci, Pippali*, and *Haridra* have been found effective and globally proven hypoglycemic agents. Such measures which reduce meda and kapha, for example, heavy exercise, ruksa udavartana, and ratri jagarana are beneficial for patients of prameha.\textsuperscript{[39]}

Herbs and formulations used in *Prameha/Madhumeha* (DM) as per Ayurvedic texts are mentioned in Table 3.

### Role of Vihar in Management of DM

Regular *Vyayam* (exercise) should be performed till the appearance of signs of proper *Vyayam* characterized by appearance of perspiration, increased respiration, lightness of the organs, and feeling of obstruction in cardiac region.\textsuperscript{[40]} Exercise conditions the skeletal muscles which decreases oxygen consumption for the same workload.\textsuperscript{[41]} Stress can be reduced regulating daily regimen, proper exercise, and *Yogic* practices along with meditation.\textsuperscript{[42]} Exercise reduces
the Meda, increases the digestive power, and maintains the compactness of the body tissues. Sushruta has recommended exercise and diet for the management of poor and rich patients. Poor patients should move from one to the other village and earn his living by begging. Persons who eat Shyamaka and fruits of Amalaki, live along with animals, and break the stones become free from Prameha within 1 year.[43]

**Role of Yoga in Management of DM**

The term *Yoga* means to unite or to combine, and it may be taken to mean a state of union of the individual soul or consciousness with the cosmic or supreme soul or consciousness or a total integration of the physical, mental, intellectual, and spiritual aspects of the human personality.[44]

The ultimate goal of Yoga is not the treatment of diseases, Various diseases may get pacified in the course of following the path of Yoga to achieve its real goal of union of individual consciousness with cosmic consciousness. There are eight limbs of Yoga, namely, *Yama, Niyam, Asana, Pranayam, Pratyahara, Dharana, Dhyan,* and *Samadhi* described by Patanjali.[45]

Yogic practices such as *Pranayam, Paschimotanasa, Dhanurasana, Bhujangasana, Halasana, Vajrasana,* and *Ardhamatsyendrasana* in various studies have produced an increase in the lean body mass and decrease in the body fat percentage. This leads to an improvement in insulin sensitivity and reduction in insulin resistance. Insulin is the major abnormality in Type II diabetes and precedes the development of overt diabetes by several years. The reduction in free fatty acid levels also reduces the lipotoxicity, which has now been shown to have a significant effect on beta cell function. Therefore, it is reasonable to postulate that the beneficial effect of yogic asanas on the insulin kinetics and the lipid metabolism prevents the beta cell exhaustion and the development of a beta-cell secretory defect, thereby preventing the development of Type II diabetes.[46]

**Future Perspectives of Ayurveda and Yoga in Management of Prameha -Discussion**

There is a lot of stress and strain in the present era due to modifications in lifestyle, change in dietary habits, urbanization, and industrialization. This sedentary lifestyle along with changed food habit has lead in the emergence of many diseases, and one of them is Prameha which in turn leads to Madhumeha on advancement. On the basis of its symptomatology, Madhumeha can be correlated to the features of DM. DM is a metabolic disorder of carbohydrate, fat, and protein characterized by hyperglycemia with or without glycosuria. DM is aggressively progressive, and the prognosis is poor unless definite measures are taken to control the disease. At the present time, there is no known cure for DM and even with proper medical management; prognosis may still be poor due to irreversible major impairments or severe disabilities. It is most often treated with diet and exercise in conjunction with oral hyperglycemic drugs and insulin. Controlling the disease is the prime aim because there is no cure and the complications are very critical and hazardous. Oral hypoglycemic agents and insulin used for the treatment of DM by the allopathic system of medicine have numerous side effects. Ayurveda because of its holistic approach not only aims to achieve strict glycemic control but also treat root cause of the disease.

Ayurveda can provide better management for Madhumeha without hazardous side effects. Vagbhatta has classified Madhumeha into two categories,[26] namely, Dhatukshayajanya Madhumeha and Avaranajanya Madhumeha. The factors which provoke Vata directly cause Apatarpanajanya Madhumeha and the factors which provoke Kapha and Pitta cause Santarpanajanya Madhumeha. In the former type, the patients are usually asthenic can be correlated with Type I DM, and in the latter type, patients are obese and can be equated with Type II DM. Under the Samprapti of Santarpanajanya Madhumeha or in Sthula Madhumehi, the vitiated Kapha and Pitta obstruct the Path of Vata causing its provocation. Understanding ayurvedic view of the etiopathogenesis of Madhumeha in integration with modern science will help in developing proper dietary and lifestyle modification in the form of Nidan parivarjana, i.e. avoiding the causative risk factors and adopting beneficial dietary habits and lifestyles because 50% of cases of DM respond well to diet and exercise regimens.

Modern medical science is materialistic having concern primarily with the body and drugs are the mainstay of its management. On the other hand, *Ayurveda* being a holistic system is concerned with the development of physical, mental as well as spiritual aspects. With the advancement of the modern medicine, powerful drugs have conquered many infections and decimated epidemics. However, it primarily depends on drugs which have many harmful side effects. It does not have full answers for many chronic and degenerative diseases whose incidence is increasing rapidly. Many patients of chronic and non-communicable diseases such as DM and heart disease have to take life-long treatment using drugs that are not only expensive but have many undesirable side effects. In such situation, the only option that remains is the primordial and primary prevention of chronic and non-communicable diseases with proper implementation of dietary and lifestyle practices. *Ayurveda* has vast scope in this area. *Ayurveda* considers improper and unnatural food habits and lifestyle as important factors in causation of disease. Undigested, junk food, and accumulated wastes are considered toxic as they produce changes in blood, lymph, and other body fluids resulting in imbalance of elements.[47] With regulated diet, many diseases can be prevented and cured, and without that, drugs cannot give a real/lasting cure. Ideal diet according to ayurveda should be nutritionally balanced, pleasing to senses, easily digested, fresh and...
natural, obtained, prepared, served, and eaten with a pure and calm mind and taken in moderation. A diet which is pleasantly agreeable, taken in appropriate amount at proper time and easily digestible, satisfies our senses and nourishes our body. Yogic practices reduce stress, increase insulin sensitivity, and also reduce fat.

**CONCLUSION**

Prameha vis a vis DM is our modern epidemic affecting population. It results from unfavorable modification of lifestyle and dietary habits which are associated with urbanization. Ayurveda advocates the proper use of diet and regulation of lifestyle from very early life. Therefore, various Ayurvedic measures followed as per instructions can prevent Prameha (DM) in primordial and primary stages and can also stop the progress of the disease to later stages. Yogic practices such as Pranayam, Paschimottanasa, Dhanurasana, Bhujangasana, Halasana, Vajrasana, Ardhamatsyendrasana, and so on are beneficial in DM. Various studies have shown that yogic practices decrease blood sugar (fasting and postprandial), reduce insulin resistance, improve insulin sensitivity, decrease blood pressure, and also improve exercise tolerance.

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Teratology from spectacles of Ayurveda

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Abstract

In Ayurveda, the description about the congenital birth defects has been mentioned in many places. Ayurveda has also given some quotes on the anomalies or congenital defects precipitating in the fetus and stressed on factors that attached to the defective Shukra (sperm), Shonit (ovum), Atma (Soul), Kaal (time), and Aahar Vihar (habitat and dietetic regimen of the mother). Teratology is the study of abnormal development or congenital malformations, which may be caused by exposure to various chemicals, physical factors, and environmental factors. Alterations of morphogenesis, alterations of central nervous system function, other functional impairments, death of the conceptus, embryo, or fetus, prenatal-onset growth deficiency, and carcinogenesis are teratogenic effect seen in human. These all type of descriptions by our Acharyas strongly suggests that they have got knowledge about the teratogens.

Key words: Congenital defects, environmental factors, fetus

INTRODUCTION

In Vedic and other contemporary literature, the matter related to the abnormal growth and development in intrauterine life and congenital malformation has limited dealing in comparison to the description present in Ayurvedic literature Atharva Veda, Shatpath Brahmana, YajnavalkyaSmrti, Matsya Purana, and Garbhapanihada in which there is wide description of congenital anomalies and birth defect were present.

Atharva Veda has described about the invisible factors available in the labor room, very close to woman (Pregnant) and which are likely to kill the fetus when it is partially delivered. A type of medicine has been advocated to kill or remove them (A.V. 18/6/19). [16]

According to Garbhapanihada described about the Psychological state of women. Mental stress during pregnancy leads to congenital abnormalities such as blindness and deformed body organs such as vertebral column and dwarfism in newborn baby. That type of description has a direct concern with true mental stress (Garbhapanihada/3). [16]

The description of Vedic literature about the infection, maternal causes, mental stress, and other genetic and environmental factors establishing the relationship in between the teratogen and teratogenic changes in the fetus. That could be established with the teratological knowledge of the modern medical science. This information suggests the knowledge of Teratogenic factor during the ancient period was well known.

In Ayurveda, the description about the congenital birth defects has been mentioned in many places. Ayurveda has also given some quotes on the anomalies or congenital defects precipitating in the fetus and stressed on factors that attached to the defective Shukra (sperm), Shonit (ovum), Atma (Soul), Kaal (time), and Aahar Vihar (habitat and dietetic regimen of the mother).

Charaka Samhita has also mentioned about the birth defects. In the Sharira Sthana, about the defects in impairment of the shape, color, sensory, and motor organs of the offspring. Description of the Dviretas, Pavanendriyatva, samskaravahi suggests that at that time congenital birth defects were also present. According to Charak samhita, the pregnant lady should avoid the use of drugs of high potency, Vyayava (sexual intercourse), and Vyayama (physical exercise) for pregnant lady (Ch.Sh.25/40).

In the Sushruta Samhita mentioned about some works, act causes, which can cause congenital defect in the fetus. The

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pregnant woman should avoid copulation, physical exercise, too much of excessive diet or attenuation (making the body very plumpy or very emaciated, respectively), sleeping during day and keeping awake at night; grief, riding on animals/vehicles, fear, sitting on her heels for long periods, indulging in oleation and other therapies, bloodletting at unsuitable time, and suppression of the urges of the body (of urine, faces, flaws, etc.). (Su.Sh.3/16). All the above factors vitiate the doshas of the pregnant lady, in turn, the affected doshas can cause injury or trauma to the same parts of the fetus as the same type injury mother has got (Su.Sh.3/17). [12]

A pregnant lady should avoid Garbhaghatkarabhas (the factors which can destroy the fetus) for avoiding any injury to the fetus such as all the types of heavy, excessive hot, bitter taste food, and violent exercise. She should not wear red clothes to prevalent the (attacks of) gods, demons, and their followers. She should not take intoxicating wines, ride over vehicles, and eat meat, should abstain completely from the things which are unfavorable to all the sense organs and many others which (elderly) woman know (Ch.Sh.4/18). [13,14]

In Astanga sangraha, Vagabhatta has also described about the birth defects. According to him Doshas get vitiated and causes defect in the fetus. When Vāta, develops upward movement (which is abnormal) and dries up the channels of rasa in the fetus, the future child will be either a patient of vātaroga or one born with deficient/poorly developed parts; or it (the fetus) may even remain inside the abdomen for many years (A.Sa.Sh.2/20). If the pregnant women indulges constantly in foods and activities which cause increase of Vāta, then Vāta getting increased abnormally, travels all over her body and also in the uterus, and produces many diseases of Vāta origin in the child; the child may become inactive, deaf, mute, of nasal speech, stammering, lame, hunch-back, dwarf, of deficient organs (in number) or of extra organs, or any other Vāta diseases (A.Sa.Sh.2/34). [13,11]

Maharishi Kashyap has indicated the adverse effect of the smoking of the mother during her prenatal period. In his opinion, such activities are likely to produce congenital abnormalities blindness, sickness, discoloration of the newborn baby, and even Garbhapata or abortion (Kashyap/chi. 10/20). [15]

These all type of descriptions by our Acharyas strongly suggests that they have got knowledge about the teratogens and what is the outcome of that. Hence, they have also told about the precautions should be taken by pregnant women to avoid these untoward effects. In modern science, they also described agents such as physical, chemicals, and environmental that can cause teratological effects.

Characterization of teratogenic exposures involves the specific agent, the dose of the agent, the gestational age, and other factors such as genetic susceptibility. [3] Characterization of teratogenic effects includes general effects such as death of fetus, growth retardation, visible malformation, and functional disorder along with specific effects such as carcinogenesis and recognizable syndromes, magnitude of risk (absolute, relative), and prenatal diagnosis (invasive and non-invasive techniques). [3]

Any drug or chemical given to the mother will cross the placenta to some extent unless it is destroyed or altered during placental passage or its molecular size or lipid solubility limits transplacental transfer. The onset of this placental transfer starts at the fifth embryonic week to 7th gestational week. For drugs or chemicals with low molecular weight, the transplacental passage to the fetus is based on the concentration gradient. [7,17]

There is no specific constellation of fetal/neonatal signs and symptoms that are pathognomonic of infection. Each infectious agent, depending on the time of exposure and viral-host interactions, can result in a diverse range of manifestations. [3]

**TERATOGENIC EXPOSURES**

There are many factors, which are responsible for the teratogenic changes. They are teratogenic agents, drugs dosage to embryo or fetus and period of pregnancy. [1,2,7]

**Agent**

Teratogenicity also depends on the nature of the chemical, physical or infectious agent, inherent developmental toxicity, and the capacity to produce other kinds of toxicity in the mother.

**Dosage to Embryo or Fetus**

Teratogenicity may occur due to single, repeated, or chronic exposure, duration of exposure. Another factor also influences the teratogenicity such as maternal dose, maternal route of exposure, maternal absorption, maternal metabolism and clearance as well as, and placental transfer.

**Period of Pregnancy**

Exposure of specific teratogen during first, second, or third trimester may lead to the development of congenital anomalies. In other words, specific congenital anomalies may be the result of teratogenicity drug exposure between conception and onset of embryogenesis, during organogenesis, and fetal period.

**Other Factors**

Other factors are genetic susceptibility of mother, genetic susceptibility of the fetus, other concurrent exposures,
maternal illness, or other condition associated with exposure, availability of tests to quantify the magnitude of maternal exposure.[4]

TERATOGENIC EFFECT

Alterations of morphogenesis, Alterations of CNS function, other functional impairments, Death of the conceptus, embryo, or fetus, Prenatal-onset growth deficiency, Carcinogenesis. Specific effect includes recognizable syndrome and Other distinctive features.[5,6]

CONCLUSIONS

These all type of descriptions by our Acharyas strongly suggests that they have got knowledge about the teratogens and what is the outcome of that. Hence, they have also told about the precautions should be taken by pregnant women to avoid these untoward effects before taking allopathic medicine or even ayurvedic medicine if it is not formed purely following all standard parameter.

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A review on management of diabetes mellitus (prameha): Current scenario

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Abstract

The traditional medicine is increasingly entraining through the practitioners in the treatment of many diseases. Among the medicament used, plant drugs constitute an important part as they play a key role for the development of new drugs. However, due to increase in lifestyle modifications leading to different lifestyle diseases, treatment methodology focuses more the management principles as the first-line approach along with the herbal drugs. Diabetes mellitus (DM) refers to a group of common metabolic disorders characterized by hyperglycemia with disturbance of carbohydrate, fat, and protein metabolism resulting from defects of insulin secretion, insulin action, or both. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Etiology of the DM that is factors contributing to hyperglycemia which include reduced insulin secretion, decreased glucose utilization, and increased glucose production. Diabetes is known as Prameha, which has been discussed in Ayurveda since antiquity.

Keywords: Diabetes mellitus, herbal drugs, lifestyle, Prameha

INTRODUCTION

According to the World Health Organization, diabetes is among the top 5 leading cause of death in the world. Diabetes is the world’s fastest growing chronic diseases. Currently, 246 million people are affected worldwide. The number expected to rise to 380 million by 2025. Each year 3.8 million death are attributable to diabetes. Every 10 s a person dies from diabetes. Ancient text describes 20 types of Prameha,¹ out of these 10 are due to kapha (early stage),² 6 are due to pitta (acute stage),³ and 4 are due to vata (chronic stage).⁴ Diabetes mellitus (DM) (Prameha) explicit two main etiological factors, i.e., Sahaja (hereditary/congenital) due to unnatural and abnormal shukra and shonita and the other one Apathyanimittaj due to improper dietary intake and activities.⁵ Causative factors of Prameha include sedentary lifestyle, sleeping during daytime, intake of all other kapha promoting substance, laziness, consuming food which are cold, unctuous, fatty, and sweet food⁶ and food, drinks, and activities which aggravates meda, mutra, and kapha are main characteristics for genesis of Prameha.⁷

PATHOGENESIS⁸,⁹

Due to causative factors (wrongful diet - high glycemic food, lack of exercise, etc.)

- Doshas get imbalanced (specifically kledakkapha, pachak pitta, samanvayu) – (high blood sugar; insulin secreted by pancreas)
  - Agnimandya (dhatvagnimadhya) – (cell become to resistant to insulin)
  - Culminates all dushyas (specifically medodhatu) – (more glucose present in the blood)
  - Kledavriddhi (unnecessary excessive body fluid oozed out from all dhatu) – (body tries to dilute high blood glucose)
- Body tries to excrete in the form of urine (polyuria)

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Classification Value for Fasting Blood Glucose Levels are[10]

- Normal blood glucose: 4–6 mmol/L
- Moderate blood glucose: 4–7 mmol/L
- High blood glucose: Above 7 mmol/L.

However, the symptoms of diabetes may not appear until blood glucose level is higher. Hence, some people may have diabetes without knowing about it. Classical symptoms of Prameha comprises excessive thirsty, passing more urine, feeling tired and lethargic, always feeling hungry, having cuts, that is, cleans slowly, itching, skin infections, blurred vision, gradually putting weight, mood swings, feeling dizzy, and leg cramps.[11]

PREVENTION: CURRENT SCENARIO[12]

- Maintaining a healthy weight
- Regular physical activity
- Making healthy food of choices
- Managing blood pressure <140/80 mmHg*
- Managing cholesterol levels*.
  1. LDL: <100 mg/dL
  2. Triglycerides: <150 mg/dL
  3. HDL: >40 mg/dL (men), >50 mg/dL (women).
- No smoking
- No alcohol
- Screening of prediabetes with an informal assessment of risk factors should be considered in asymptomatic adults. Prediabetes criteria include[13]
  1. Fasting blood glucose: 100–125 mg/dL (5.6–6.9 mmol/L: IFG)
  2. 2 h plasma glucose: 140–199 mg/dL (7.8–11.0 mmol/L: IGT)
  3. HbA1C: 5.7–6.4%.
- Regular monitoring blood glucose level*
  1. Fasting blood glucose: ≥7.0 mmol/L
  2. 2-h plasma glucose: ≥11.1 mmol/L
  3. HbA1C: ≥7%.
- Avoiding sweet, salty, and acidic taste of food which are Kapha producing and increase the risk of diabetes. Pungent, bitter, and astringent taste of food are less Kapha producing food and reduce/prevent the risk of diabetes.[14]
- Delay or prevent complications of diabetes.

*HbA1C, blood pressure, and cholesterol goals need to be altered for the individual based on age, duration of diabetes, health history, and other present health conditions.

MANAGEMENT PRINCIPLES

The American Diabetes Association endorses lifestyle modifications as the initial treatment for diabetes. If pharmacologic intervention is required, metformin is the only drug that is recommended in conjunction with diet and exercise in high-risk patients (those with both impaired glucose tolerance [IGT] and impaired fasting glucose).[15] Triangular approach toward prevention of the disease exhibits:

1. Ahara (diet)
2. Vihara (lifestyle)
3. Aushadhi (medicine).

Diet plan of an individual is based on height, weight, age, sex, physical activity, and nature of the disease conditions in managing diabetes. Modified lifestyle and faulty Agni are the potential source of this disease, so more emphasis should be given on diet and biopurificatory measures. That is described as “Nidana Parivarjana” in the classics. Hence, ahara which do not increase body weight and opposite to etiological factors of Prameha is advised to the patient.[16] Sushruta also elucidates that in advance stages of Prameha, regular physical exercise should be practiced, wrestling, active sports, horse riding, or an elephant, long walks, pedestrian journeys, practicing archery, casting of javelins, etc., should be done.[17] Ayurveda recommends drugs having Tikta (bitter), Katu (pungent), and Kasaya (astringent) Rasa[18] in Prameha as it is kapha predominant disease, and dashyantha has the same nature as that of kapha.[19] Susruta clearly indicated the decoction of Salasaradi Gana drugs with Shilajatu for the treatment of Prameha.[20] Popular and effective herbs used in the treatment of the disease are Amalki (Indian Gooseberry), Karela (bitter Melon), Methi (Fenugreek), Jamun seed, Garum, Vijaysar, Haridra (turmeric), Neem, Triphala, Guduchi, Harivaridra, Bel, Chayrata, Kutki, Nevadaru, Shilajatu, etc., are included in Samana Chikitsa also Panchkarma procedures such as vaman, virechan, and basti are mentioned under Shodhan chikitsa.[21] Individuals who lose 7% of their body weight and maintain 150 min of exercise weekly can reduce the rate of progression from IGT to diabetes by 58%.[22]

DISCUSSION

On expositing all the management principles, dietary requirements for a diabetic person should involve eating habits which include wheat, rye, barley and, for some, oats. Furthermore, avoid eating or drinking anything containing a lot of sugar such as cakes, sweets, and chocolate. Vegetables that can be consumed in larger quantities such as cabbage, mint, spinach, bitter gourd, lady’s finger, cauliflower, cucumber, carrots, radish, onion, gourd, and pumpkin. It is very important to never skip any meal and always eat small amount of meal frequently. Person should never overeat at any time of the day. Intake of large quantities of rice, potatoes, and bananas must be avoided as these can raise the blood sugar level. Reducing the intake of salt in the food lowers the risk toward CVS problems. Regular walk and exercise should be the chief component of daily lifestyle procedures. Drinking plenty of water (approx 2.2-3 litres a day). The person should try to choose low or
non-fatty dairy products in their meals. These practices will ultimately minimize the dependency over medicines and insulin and improve the healthy lifestyle. Therefore, every treatment advice should include dietary and exercise plan to a person along with the therapeutic advice. Furthermore, further, exploration of the same should be considered for the proper social and economic development of the individual and the society in the management of lifestyle disorders.

Thus, nutritional recommendation for a diabetic individual can be grouped into following key points:

i. Person should be emphasized toward healthy food choices and portion of food control which is more helpful for those with type 2 diabetes who are not taking insulin or prone to hypoglycemia.

ii. Adequate weight loss achieved by the combination of lifestyle modification and the lowering calorie intake directly benefits overweight or obese adults with type 2 diabetes and also those with prediabetes.

iii. Emphasis on intake of food higher in fiber and lower in glycemic load and carbohydrate intake from whole grains, vegetables, fruits, legumes, and dairy products, should be advised over other sources, especially those containing sugars.

iv. Sugar-sweetened beverages with minimal consumption of foods with added sugar should be avoided to control weight and reduce risk for CVD and fatty liver that displace healthier and more nutrient-dense food in our daily diet.

v. Intake of protein tends to increase insulin response without increasing plasma glucose concentrations. Therefore, carbohydrate sources high in protein should not be advised to treat or prevent hypoglycemia.

vi. An eating plan emphasizing elements of a diet rich in monounsaturated fats is an effective alternative to a low-fat, high-carb diet which improves glucose metabolism and lowers CVD risk.

vii. People with diabetes along with alcohol consumption are at an increased risk for hypoglycemia, especially if taking insulin or insulin secretagogues.

viii. The use of non-nutritive sweeteners possibly reduces overall calorie and carbohydrate intake if substituted for caloric sweeteners.

ix. Children with diabetes/prediabetes: At least 60 min/day physical activity should be recommended. Most adults with types 1 and 2 diabetes are endorsed for 150+ min/week of moderate-to-vigorous activity over at least 3 days/week with no more than 2 consecutive days without exercise. Shorter durations (minimum 75 min/week) of vigorous-intensity or interval training are sufficient for younger and physically fit individuals.

CONCLUSION

Ayurveda offers a balanced and holistic approach in treating DM. Prevention is better than cure, on this node, nowadays, prevention measures and improvement in daily lifestyle habits are taken into prime consideration for maintaining proper health. Through triangular approach of Ahara (diet), Vihara (exercise), and Aushadhi (medicine), it can be well managed by Ayurveda. These attributes of Ayurveda play a major role in disease prevention and promotion of health with a better quality of life. Ayurveda with its strong scientific fundamentals with unique features will be emerging as the best medical system. Thus, the system requires scientific validation for global acceptance.

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Yoga: A potential tool for curbing neurological disorders

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Abstract

With the improvement of health-care services in preventive and promotive domains, developing countries including India are passing through a phase of epidemiological transition with increasing burden of non-communicable diseases, of which a major portion is shared by neurological disorders. According to the WHO estimates, neurological disorders are responsible for between 4.5 and 11% of all illnesses ranging from low- to high-income countries which are far higher than the number of respiratory ailments, gastrointestinal disorders, or cancers, and the burden is still expected to increase. The number of disability-adjusted life years (DALYs) lost due to neurological diseases is expected to rise from 95 million worldwide in 2015 to 103 million in 2030. Neurologic disorders and cerebrovascular disease combined represent 7.1% of the total global burden of disease measured in DALY for all causes and ages. Further, treatment options for neurological disorders are also extremely limited with interventions including preventative measures, lifestyle changes, physiotherapy or other therapy, neurorehabilitation, pain management, medication, or operations performed by neurosurgeons. Still, the outcome is not very sure, and in many cases, the quality of life of the patients remains poor despite these ongoing therapies and conventional medicines. In this scenario, it is crucial to integrate Yoga to facilitate the needs of health-care delivery system for the management of neurological disorders. The integration of Yoga for the management of neurological disorders can help overcome the disability, improve the quality of life in the patients and will help in reducing the burden of suffering and disability due to neurological disorders. This paper will detail about the role of yoga in the management of neurological disorders and its future prospects in the prevention.

Key words: Yoga, Neurological disorders, Prevention, Management

BACKGROUND

With the improvement of health-care services in preventive and promotive domains, developing countries including India are passing through a phase of epidemiological transition with increasing burden of non-communicable diseases (NCDs). Unlike, NCDs are chronic in nature associated with high cost of treatment and investigation which generally lasts lifelong. The out-of-pocket expenditure for the NCDs is quite large and sometimes is the cause behind the non-initiation or restriction of treatment. The out-of-pocket expenditure is also the reason for the deteriorating economic status of the families of people suffering from NCDs. The five major NCDs (cardiovascular diseases; endocrine and metabolic diseases; neoplasm; respiratory infections; and mental and neurological disorders) account for almost 39% of total health expenditures in 2004.[¹]

One of the major contributors to the burden of NCDs is neurological disorders. According to the WHO estimates, neurological disorders are responsible for between 4.5 and 11% of all illnesses ranging from low- to high-income countries which are far higher than the number of respiratory ailments, gastrointestinal disorders, or cancers, and the burden is still expected to increase. The number of disability-adjusted life years (DALYs) lost due to neurological diseases is expected to rise from 95 million worldwide in 2015 to 103 million in 2030. They represent a high social burden.

Numerous chronic diseases related to neurological system that cause severe disability among individuals are considered as neurological diseases.[⁵] Some of them are stroke, multiple...
sclerosis (MS), epilepsy, Alzheimer disease (AD) and other dementias, Parkinson disease (PD), migraine, and other neurologic disorders. Today, the purpose of health care for individuals with chronic neurological diseases is to increase the capacities of patients and their families to cope with problems, improve self-care, preserve and improve skills, meet information needs, and increase independence and quality of life.\(^9\)

Interventions for neurological disorders include preventative measures, lifestyle changes, physiotherapy or other therapy, neurorehabilitation, pain management, medication, or operations performed by neurosurgeons. To improve lifestyle changes and for preventive measures, Yoga is the best therapy which is a science as well as an art of healthy living. Yoga is a mind-body exercise effective for reducing stress, anxiety and depression, and improving brain function and mental health. In this paper, an attempt has been made to elaborate the effect of Yoga therapy in the prevention and cure of neurological disorders.

**RISK FACTORS FOR NCDS**

Several risk factors have been associated to the development of NCDs. They are categorized as follows:

**Modifiable behavioral risk factors**

Tobacco use, physical inactivity, unhealthy diet, and the harmful use of alcohol increase the risk of NCDs. These include excessive smoking, physical inactivity, alcohol, and salt intake. Scientific data reveal that around 6 million deaths every year occur due to the usage of tobacco (including from the effects of exposure to second-hand smoke) and are projected to increase to 8 million by 2030. About 3.2 million deaths annually can be attributed to insufficient physical activity.\(^6\) More than half of the 3.3 million annual deaths from harmful drinking are from NCDs.\(^3\) 1.7 million annual deaths from cardiovascular causes have been attributed to excess salt/sodium intake.\(^6\)

**Metabolic/physiological risk factors**

These behaviors lead to four key metabolic/physiological changes that increase the risk of NCDs which are raised blood pressure, overweight/obesity, hyperglycemia (high blood glucose levels), and hyperlipidemia (elevated levels of fat in the blood). In terms of attributable deaths, the leading metabolic risk factor globally is elevated blood pressure followed by overweight and obesity and raised blood glucose. Low- and middle-income countries are witnessing the fastest rise in overweight young children.

**NEUROLOGICAL DISORDERS: A HIGH SOCIETAL BURDEN**

Neurological disorders result due to structural, biochemical, or electrical abnormalities in the brain, spinal cord, nerves, or neurological junctions. It includes stroke, subcategories of AD, PD, epilepsy, MS, migraine, tension-type headache, peripheral neuropathies, and other neurologic disorders. In the present scenario, hundreds of millions of people worldwide are affected by neurological disorders. Developing countries including India are passing through a phase of epidemiological transition with increasing load of this disease. A significant burden is imposed on the society due to the burden of neurological disorders globally. Stroke is one of the leading causes of mortality and morbidity worldwide.\(^7\) Approximately 6.2 million people worldwide die because of stroke each year; over 80% of deaths take place in low- and middle-income countries. Neurologic disorders and cerebrovascular disease combined represent 7.1% of the total global burden of disease measured in DALY for all causes and ages.\(^4\)

Apart from this, the availability and access to neurological care through diagnostics and therapy are very haphazardly distributed globally. Inhabitants in high-income regions have an average of 402 neurologists available for every 100,000 while the figure is only 4.5 in low-income countries which are far below acceptable levels.\(^6\)

**YOGA IN NEUROLOGICAL DISORDERS**

Today’s lifestyle has brought in many challenges to health and has become a major cause for many ailments such as stress, obesity among people across the world. In this context, people have started looking back to the nature and that is precisely where the role of alternative medicine and therapies come into play. One of the therapies which is totally based on the principle of restoring natural balance and accompany human life back in harmony of body, mind, and spirit is Yoga. Yoga is not merely a form of physical activity for the body, but it is an ancient wisdom for a happier, healthier, and calmer way of living, which ultimately leads to union with the self. The holistic approach of Yoga is well established, and it brings harmony in all stages of life and thus, known for, health promotion disease prevention and management of many lifestyle-related disorders or NCDs.\(^9\) Yoga is very helpful to cure neurological disorders by various means as mentioned below.

**Asanas**

Postures and the asanas are the aerobic component and may stimulate the central nervous system release of endorphins, monoamines, and brain-derived neurotrophic factor in the hippocampus.

**Pranayam and dhyan**

These practices have been found to regulate the emotional responses by reducing the sympathetic tone, increasing the parasympathetic tone, improving the cognitive functioning
increasing the EEG synchrony and coherence, and causing an increase in melatonin levels (promotes sleep, stimulates immune system, and reduces blood pressure) and a decrease in cortisol (less negative effects and depression) levels.

**Mental calmness and stress reduction**

Yoga achieves voluntary control over autonomous nervous system by establishing equilibrium between sympathetic and parasympathetic through hypothalamic limbic system. It reduces stress impulses, stimulates sympathetic system, and eventually quietens mind. It also clears all negative feelings and thoughts from mind leading to the reduction of depression.

**Concentration and memory**

Yoga increases concentration and improves circulation, especially to brain leading to improved memory.

**RESEARCHERS AND STUDIES PROVING ROLE OF YOGA IN NEUROLOGICAL DISORDERS**

**Yoga in epilepsy**

A pilot study conducted by Rajesh et al. on 20 epileptic patients to assess the efficacy of Yoga meditation protocol (YMP) for the duration of 3 months period reveals a reduction in seizure frequency in 19 patients, six of which recorded a seizure reduction of 50% or more. 16 patients continued the YMP beyond 3 months and 14 patients responded at 6 months, out of which 6 were seizure free for 3 months. Eight patients of these continued the YMP beyond 6 months and responded. It was reported that three of them were seizure free for 6 months. They concluded that Yoga has magical power in curing patients. Yoga can be helpful if confirmed through randomized trials involving a larger number of patients and may become a cost-effective and adverse effect-free adjunctive treatment in patients with drug-resistant epilepsies.[10]

Another study conducted by Lundgren et al. on a randomized control trial with 18 subjects indicates that both acceptance and commitment therapy (ACT) and Yoga significantly reduce seizure index. Participants in both the ACT and Yoga groups improved their quality of life significantly as measured by one of two quality of life instruments. The results of this study suggest that complementary treatments, such as ACT and Yoga, decrease seizure index and increase quality of life.[11]

A study by Panjwani et al. on 32 subjects and patients randomly divided into three groups reveals that the reduced level of stress following meditation practice may make patients more responsive to specific stimuli. Sahaja Yoga meditation appears to bring about changes in some of the electrophysiological responses studied in epileptic patients.[12]

**Yoga in migraine**

Study of Yoga intervention and control groups on endothelial function in 42 patients with migraine by Naji-Esfahani et al. for 3 months reveals a statistically significant decrease in plasma level of vascular cell adhesion molecule in Yoga group compared with the control group (15.29 ± 2.1 ng/ml vs. 21.70 ± 3.0 ng/ml, $P < 0.05$), whereas there was no statistically significant difference in intercellular adhesion molecule level between groups (19.1 ± 1.8 ng/ml vs. 20.97 ± 1.9 ng/ml $P > 0.05$). They found that Yoga exercises, as a complementary treatment beside pharmacological treatment, can be potentially an effective way of improving vascular functions in migraineurs.[13]

**Yoga in depression**

A meta-analysis including 12 randomized controlled trials (RCTs) and 619 patients by Cramer et al. on the topic of Yoga for depression unmasks that despite methodological drawbacks of the included studies, Yoga could be considered an ancillary treatment option for patients with depressive disorders and individuals with elevated levels of depression.[14] Studies also suggest that Yoga interventions improve depression severity in patients with a comorbid disorder such as cancer or fibromyalgia.[15]

**Yoga in stroke**

Bell and Seyfer have described specific adaptations of Yoga postures that can be utilized by people with limited mobility due to neurological conditions such as MS and stroke.[16] A pilot study with 12 weeks of Kundalini Yoga practice showed improvements in aphasia as well as fine motor coordination in post-stroke patients.[17]

Another study based on asana, pranayam, and wait-listed control groups (10 weeks intervention) illustrates the positive physical and psychosocial impact, Yoga can instill in stroke victims such as greater sensation, feeling calmer, becoming connected with mind and body, improvements in perceived physical strength, range of movement, body awareness, gait, balance, energy, concentration, confidence, and stress.[18]

**Yoga and schizophrenia**

A systematic review and meta-analysis of five RCTs with a total of 337 patients on Yoga therapy for schizophrenia reported moderate evidence for short-term effects on quality of life.[19]
Yoga and post-traumatic stress disorder (PTSD)

Yoga breath intervention was observed to be more beneficial compared to wait-listed controls in reducing post-traumatic symptoms.[20] Another RCT reported decrease in sadness but no change in heart rate variability by Yoga therapy in comparison to wait-list control group of PTSD.[21]

Yoga and generalized anxiety disorder (GAD)

Not many studies are reported on GAD. However, a study on the analysis of effect of Sudarshan Kriya Yoga (SKY) on GAD reports symptomatic improvement in the cases.[22]

FUTURE PROSPECTS IN THE ROLE OF YOGA FOR ND

Yogic exercises recharge the body with cosmic energy and facilitate body to improve psychological/mental well-being. Yoga helps with anxiety and depression. It boosts memory and improves concentration and prevents the onset of mental health conditions, which are prevalent during adolescence. Yoga reduces the effects of traumatic experiences also. A review of numerous studies employing Yoga in healthy volunteers and patients reveals that eliciting relaxation through meditation is very beneficial. Yoga promotes positive effects on carotid atherosclerosis, hypertension, diabetes, and coronary artery disease (which are also identified risk factors associated with stroke) and a number of psychological problems. Thus, future prospect lies in harnessing the potential of Yoga for the prevention of NDs by sensitizing and familiarizing the practice of Yoga.

DISCUSSION AND CONCLUSION

In the present era, where everything turns from natural to artificial, communities want to go back in the natural life where they need safe, effective health care and here starts the role of Yoga. The holistic wisdom of Yoga offers the necessary wisdom, experience, and capabilities those are crucial for such transformation. Studies have proved Yoga to be beneficial in the management of various neurological disorders. It has soothing, calming, and balancing effects on the brains, nerves, and autonomic nervous system regulation. Yoga - asana, pranayama, and dhyana have immense potential for the prevention of neurological. Yoga develops our personality in a holistic and balanced way, transform the youth in leading a healthier, and stress-free life. Steps - regular daily practice, incorporation in schools, etc., should be incorporated to reduce the global burden of diseases, not only NCDs. Thus, Yoga as science of holistic living can improve the general well-being of individuals and societies and proving to be the most desirable complimentary and traditional system of health care in the present scenario.

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Significance of Yoga postures on the Marmas

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Abstract

The science of Marma is another extraordinary and dynamic Ayurvedic therapy that has tremendous value in health and disease everyday living and spiritual practice. The term “Marma” literally communicates to vulnerable parts or areas of the body. “Marma is the seat of life” Marma therapy - the art of treating specific vital points on the human body is one of the greatest healing systems of Yoga, i.e., the state of consciousness where the mind comes to silence, then can the seer experiences his own nature. Otherwise, its true nature is overshadowed by the activity of the Mind. Yoga is a philosophical system that has been in existence for thousands of years and like Ayurveda, originates from the Veda. However, Yoga is a comprehensive approach to self-discovery and includes behavior, nutrition, ethics and morality, and above all meditation. Through meditation the mental approach of Yoga that is using the mind, we experience rest in the body as well as silence in consciousness. The path of Yoga leads to the self the Atma, the basis of all Marmas. Through Yoga, we comprehensively harmonize and strengthen the secrets of Ayurveda. This article purpose is to review the important key functions of Yoga and its effect.

Key words: Consciousness, healing, Marma, mind, Yoga postures

INTRODUCTION

The term “Marma” literally communicates to vulnerable parts or areas of the body. Any trauma on the Marma region may cause loss of function of that organ or site, and even death may occur depending on the site and strength of the trauma. The knowledge of the surgery forms its foundation through anatomy, and meticulous dissection of human body can develop perfection in anatomy that consequently develops enhanced and improved surgical maneuver.

Marma science is the part of vedic science. Knowledge of Marma exists from very ancient time of Vedas, which dates back to 4000 B.C. The first reference is found in Ēgveda.[1] In Atharva-veda also we find the reference of the term kavacha or corselet for protection of chest.[2] Mahabharat was the biggest war recorded in the history of India. The weapons were in the form of arrows and sword. The time moved forward, and the arrows and swords converted into high-speed bullets that are more hazardous. The bullets and firearms required major surgical interference where extreme care is required, if Marma points are involved. The warriors and soldiers when get wounded in such battles or today’s getting injured.[3]

Naturally, Marma science has influenced all other sciences which we find in Vedas such as Yoga, Ayurveda, Dance, Music, Mantra, Martial arts, Astrology, Philosophy, and Siddha system of medicine and sexology. The development of this science took place from Saraswati culture to the time period of Caraka, Suṣruta, Aśṭāṅga hṛdaya and saṣgraha and later on Buddha religion was responsible for its spread in the neighboring countries such as China and Japan.[4]

Ayurveda is India’s traditional healing system and a profound system of mind-body medicine and natural living. Ayurveda which means “the science of life” has become recognized today for its wonderful dietary, herbal lifestyle and yogic therapies that help us live longer, happier, wiser, and more in harmony with the greater universe of life and consciousness. Maharshi Sushruta was pioneer of surgery. The Marma have been included in Sushruta samhita Sharir sthana sixth chapter in “Pratyeka Nirdesh Sharingam.”[5]

Agnive ṇha (3000 B.C.) first discovered the existence of 107 Marmas which are anatomical sites or vital spots

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(four extremities, thorax, abdomen, back and head-neck) are present within the body. Charaka Samhita, the most ancient treatise on medicine, states that among 107 Marmas, only three Marmas are of great importance and for clinical significance; they are Muladhāra (head), Hṛdaya (heart), and vasti (urinary bladder).[6]

**REVIEW OF MARMA**

“Mri- manin-jeevsthane, Sandhi sthane, tatparye ch|” (Shabdastoma)

The term Marma has its origin from the Sanskrit root word “Mri” denoting the meaning of vital parts. The word Marma is used in the sense of jeevsthana (seat of life), Sandhisthan (joints), and tatparya.[7]

“Mri- sarvadhatubhyo manin eti Marma| Sannipata Shīra-snayu-sandhimamsa-asthi sambhava.” (Halayudha kosha)

In Halayudha kosha the term Marma is defined as a combination of Sīra (veins), Snayu (ligaments), Sandhi (joint), mamsa (muscle), and Asthi (bone).

The Shabdakalpadruma also favors the description of Halayudha kosha in the context of the term “Marma.”

In Sanskrit dictionary of Monier-William and MacDonnell, etymologically the word Marma denotes mortal spot, vulnerable point, weak/sensitive point of the body or secret, mystery, and excessively painful.[9]

According to Dalhana, “Marma” letter “Ma” denotes the prana, and the word “Ra” denotes the location or seat. Hence, the word Marma means the place where the pranas are located or situated.

“.Api ch maramkaritvan Marmaj” (As.Sa.Sh. 7/13)

“Vishamam spandanam yantra pidite ruk ch Marma tat|” (As.Hr.Sh. 4/9)

Which leads to causes of death is designated as Marma. In other context, with a view to make the concept of “Marma” more generalized that which causes death is called Marma.[9]

The first reference is found in ēgveda for the Marma.

Marmani te vermanacha dayami, somsattva rajamritenanuvastama| (Rgveda 6:6:75)

In Garbhopnishada, 107 Marmas are described. In Yogopnishada, 18 Marmas of the body are described on which by concentration one can practice dharana.

In Kshurikopanishad, the word Marma is used in connection with the description of the quality of knife, which is as strong as of Indra vajra and capable of cutting a vital part (Marma) of jangāh.[10]

**Marma and Siddha System**

According to Siddha System, the entire universe is originated from the union of Lord Shiva- Matter and his wife, Parvati-energy. Logically, Shiva itself represents both matter and energy; the Shiva is originated from Vasi, which means breathing. It is very similar to Ayurveda, that union of matter and energy is responsible for the formation of five primordial elements. In this system, all the Marmas are invisible but could be traced or located at the point where body, mind, and psychic energies are concentrated together. The Marma is nothing but blockage of vital energy (Vasi) in the body. The blockage could be due to - external physical injuries, psychological passions, and their effects through doshas. Therefore, Marmas can be controlled by psychic powers. These points are called as “maitheenda kalam.”[11]

**Marma and Yoga**

The science of Yoga explained by great sage Pātanjali in his “Yoga sutras.” Ayurveda is the science of life/longevity, and Yoga is the science of linking the individual self with the universal self. Both sciences Ayurveda and Yoga have been evolved from the same philosophy, culture, and country. The Yoga and yogic postures/Ásanas tries to expand the narrow constricted egoistic personality to the all-pervasive, eternal and blissful state of reality. There are various types of Yoga practices: The Hatha Yoga, Rāja Yoga, Bhakti Yoga, Dhyāna Yoga, Mantra Yoga, Karma Yoga, etc.[12] The Hatha Yoga (much popular) explains that there are six (Muladhāra, Svādhisthana, Manipura, Anāhat, Vishuddha, and Ajna) chakras-(nerve plexus), which are distributed throughout the body in addition to the main brain center called the Sahashraras. The sahasrāra chakra is situated in the brain, and it has been described in yogic texts as having a thousand and one petals. These chakras are connected by nĀdis or channels to different organs in the body. The Siddha system is very similar to that of Ayurveda and amalgamated the principles of Ayurveda and Yoga together.[13]

Marmas are like batteries, they become charged by Yoga postures and movement that is performed correctly. With smooth flowing movements, gentle stretching and finally the restful position at the end of each Asana, the natural flow of energy is supported in the subtle energy channels of the body, the NĀdis.[14]

**Marma in Samhitas**

Charaka, Sushruta, and Vagbhata Samhita are three major treatises mentioned as references Ayurveda. Ācharya Charaka sited important, consequential Marma from the physician
point of view for but acknowledged by 107 Marmas in the body. He described in his treatise two chapters on Trimarma (Hridaya, Shir, and Vasti) and in chikitsa sthana and another in Siddhi Sthana.

Marmas situated in trunk region are comparatively more important than Marmas of Shakhra Acharya Charaka considered these three Marmas are in ten pranayatana, i.e. Murtha, Hridya, Vasti, Kantha, Shonit, Shukra, Oja, Guda, Nabhi, and Mamsa.\[15\]

Marma in Sanskrit means hidden or secret. By definition, a Marma point is a junction on body where two or more types of tissue meet, such as (Mamsa-Sira-Snayu-Asthi-Sandidh) muscles, veins, ligaments, bones, or joints.

MaharÖi SuÖruta was pioneer of surgery. Marma in Sanskrit means hidden or secret. By definition, Ácharya SuÖruta defines Marma point as a junction as well as the anatomical site where muscles (MaPs), blood vessels (Sira), ligaments (Snayu), bones (Ashti), and joints (Sandhi) meet together. Marmas are specially seats of the concentration of prÁnic currents by virtue of their nature. Therefore, any injury to any Marma invariably produces characteristics features. (Su Sh.6/22).\[16\] Áyurveda is a part of the older spiritual heritage of humanity that contains secret knowledge and profound wisdom. The Marmas are certain vital points or places where the prÁna (life force) is said to be situated. The Marmas, definition of Marmas, and their treatment are described by nearly all Áyurvedic texts especially “Trimarmiya Siddhi,” “Trimarmiya Cikisita” chapters in Caraka SaPhita, “Marma Vibhaga” chapter in AÁtÁnga Ságraha, and “Shareer Vicaya Sharti”\[17\] chapter in KÁshyapa SaPhita. In Áyurveda, a 107 points Marmas system was developed by the ancient Indian surgeon Susruta for helping a surgeon to safely operate on the human body.

Ácharya SuÖruta (1000 B.C.) has been realized the separate surgical values of all 107 Marmas and describing them by giving their classification, measurement, effect of injury, surgical importance, and clinical instructions in details.

Classification of Marmas

Ácharya SuÖruta describes that 107 anatomical locations known as Marmas. These are of some types as under given:

**Structural Classification**

a. MaÁsa Marmas - 11,  
b. Sira Marmas - 41,  
c. Snayu Marmas - 27,  
d. Ashti Marmas - 08,  
e. Sandhi Marmas - 20.

**Regional Classification**

a. Sakthi (Lower extremity) – 22  
b. Ura and Udara (Thorax and Abdomen) - 12

c. Baha (Upper extremity – 22,  
d. PrÁstha (Back) – 14,  

According to Size- (Anguli Pramana)

a. One fingerbreadth,  
b. Two fingerbreadth  
c. Three fingerbreadth  
d. Fist size or four fingerbreadth,  
e. One and half fingerbreadth.

Based on Prognosis (when injured)

a. Sadyha PrÁnaha Marma (instantly fatal) - 19,  
b. KÁÁntara PrÁnaha Marma (gradually fatal) - 33,  
c. ViDalyaghna Marma (fatal on extraction of foreign body) - 03,  
d. Vaikalyakara Marma (causes disability) - 44  
e. RujÁkara Marma (painful) - 08.

Fatal Period of Marma

The prognosis of the Marma is variable depending on the intensity of trauma, the type of weapon used, and the depth of the wound and the loss of type of tissue. According to Sushruta and other ancient scholars that fatal period of Sadyha Pranahara Marma in 7 days; The KÁÁntara PrÁnaha Marma bears 15 days or 30 days and Vishalyaghna Marma and Vaikalyakara Marma sometimes causes death when greatly injured.\[18\]

The word Marma comes from Sanskrit origin word “mÁi” meaning death. The Sanskrit phrase, “MÁryante Iti MarmÁni,” also means death or serious damage to body or health after infliction to the point of their situation. Hence, these areas are called Marma. In Siddhi system of medicine, they are called Varma.\[19\]

Yoga is a philosophical system that has been in existence for thousands of years and like Áyurveda, originates from the Veda. Yoga keeps us young and fit, gives us new energy and refines our perception of the energies of our mind and body and the silent intelligence that underlies nature and cosmos. The best time for Yoga is when you have some peace and quiet for the practice hence in the morning before breakfast or in the evening before dinner. There are different schools of Yoga, which often have quite different views on the selection of Ásanas, the nature of their executions and the aim of exercises. The proper exercise of Ásanas stimulates, opens and strengthen different Marmas depending on the body postures and movements.

**ROLE OF MARMA**

There are three basic purposes of Marma:
1. It removes blocks in energy channels called shrotas.
2. It pacifies vÁta doÁha, (air and space elements), bringing it to its normal path - especially vyana vÁta,
(a sub- doOha which controls the autonomic nervous system)

3. It creates physical, mental and emotional flexibility. Because of Áma (toxins) and because of Ñta, human beings after 35 or 40 years of age become rigid - and this happens to animals and plants as well. As vÁta increases in the body, it leads to degeneration. This rigidity means becoming fixed in ideas, emotions, and physical movements.[20]

The study of Marmas point and effect of Yoga posture can be summarized to the following points.

**Principal Marma Points Centre**

Marmas are not the anatomical structures - they are areas in anatomy where consciousness connects with the body and coordinates its functions or to put in another way, Marmas are the places where the intelligence transforms into matter, into the body. This means that all the information of one Marma is also present in all the others. Since a Marma is more of an area than a single point, it often includes several smaller Marmas and then acts as a coordinating center, monitoring all the signals emanating from the smaller points. Furthermore, several meridians (called NÁdis in Íyurveda) always merge with the main Marma which acts as a reservoir of energy.

**The Marma House**

A Marma is like a house in which all the residents have their own rooms and tasks. Here again, we find the all Íyurvedic principles; the three DoOas as bioregulators, the five elements as components of the Marmas, the metabolic energy agni, the happiness and nutrient substances Ojas, the seven types of DhÁtus (tissue), and the mental characteristics (Sattva, Rajas, and Tamas). They all indicates the individual activity of the field and significance of a Marma, and on this basis, we can make a meaningful classification of Marmas.[22]

**Marmas and Three Doñhas**

The three main Marmas are closely related to the three DoOhas (bio-regulators) which also have their principal seat in the same regions. Though all aap (Kapha), vayu (Vata) and agni (Pitta) are present in Marmas. It is due to predominance of agni are called as agneya in nature. The particularly agni and vayu (Pitta and Vata) are responsible for pain but aap (Kapha) also does as pain and observed in kaphaj wound. The three DoOhas are like a (musical) triad in the personality. When they are in balance, they create a unified togetherness, a mental and physical harmony, making us feel happy, powerful and full of positive energy and enthusiasm. If, however, one DoOha is out of tune like one string of an instrument, then disharmony is created. With the continued imbalance of Dosha, physical and mental symptoms arise resulting in what we commonly call diseases. The three Doshas characterize the functions of a Marma. In some VÁta is predominant, for example, in Marmas located in the joints. Their job is to control and coordinate motion and orientation in space. Marmas ruled by pitta are responsible for metabolism and the generation of energy and heat. Kapha Marmas provide stability and endurance, maintain the physical structure.[21]

**Different Yoga ásanas: set for all marmas**

In India, traditional food consists of six tastes, sweet, sour, pungent, astringent, bitter, and salt. A lot of Indians say that when sitting down to eat, the stomach gets pressed and digestion is stimulated.

In Marma Sáshtra, NÁbhi Marma (navel point), and BÁihati Marma (sides of the shoulder blades) are important yogic points for better acid secretion. This increases digestive fire, detoxification, reducing Áma (toxins), promotes energy, and rejuvenation. Proper digestion leads to good utilization of food and better absorption of nutrients. This is a good cure for even obesity when samÁna vÁyu (balanced air for better bowel moments) has to be maintained. If it is not in balance, the stomach would bulge; this shows samÁna vÁyu imbalance in the solar plexus (Manipura Chakra).

Postures such as Yoga Mudra, PavanamuktÁsana, DhamurÁsana, and Ardhá MatsyendrÁsana can stimulate this Point. Breathing such as KaphÁlabathy and BastrikÁwould also stimulate this point. Even practices such as Nauli, and UddiyÁna BÁndha can stimulate it and eliminate excess gases. This NÁbhi Marma becomes a trigger point for Manipura chakra where crystal healing and reiki healing can be done to balance the energy in these chakras.[26]
If you are a beginner and are learning the Ásanas for the first time, then do not pay attention to every detail of each posture. Make sure that you do not involuntarily hold your breath. Do not worry about practicing the Ásanas perfectly, just take it easy and start at a point. If you do it right, then you will notice that your inward and outward breathing will initiate the outward and inward movements of Ásanas.

**Become Aware of Oneself**

Bringing the attention back to the body has a calming and balancing effect on all the Marmas and stimulates the flow of energy in the Nádis. Sit comfortably in a posture that directs your attention inward and let your body and mind come to rest.[25]

**Enlivening Exercise – Samvahana**

The hands and their Marmas come into physical contact with the entire body and bring lymphatic and other fluids and energies to the heart. Almost all the Marmas are gently massaged in the direction of the heart, starting at the forehead and face and proceed downward.

**Rolling – Vellan**

It is relaxing and loosening especially on the Marmas of the spine and the muscles of the back. Hold your knees with clasped hands and breathe in. As you exhale slowly roll to the side and stay there for a moment, as you then inhale roll back finally exhale again and roll to the other side.[24]

**Diamond Posture – Vajr Ásana**

This posture increases self-confidence and strengthens the back. It clarifies the mind and opens the chest and the breathing. It also opens Gulpha and other Marmas. It reduces tension in the extensor muscles of the legs and facilitates the flow of energy in the Nádis of the spine up to the head Marmas. The Gulpha, the ankle Marma on foot, is opened by the stretch and stimulation by the gentle pressure of the weight of the body. The counterpart of Indrabasti on the extensor side of the lower leg is also stretched and opened, as also in Janu, the knee Marma. The Talahridaya of the hand is on the Ani Marma on the thighs. It strengthens and soothes it, and in addition the stretching of the knee also opens the Ani Marma. The energy in the spinal cord, Nádis Ida, Pingula, and SuOumna can flow freely then.

**Sitting Forward Bend – Janu Shirshana**

The forward bend stretches and relaxes the lower back which makes energy flow into the pelvic area and especially into the root Chakra and Guda Marma. In the movement sequence, all the back Marmas are opened from bottom to top. In the restful end position, the SuOumna energy starts flowing upwards and collects in the Pituitary gland and the third eye (Sthapani Marma). The Guda Marma is addressed by the pressure of the heel and the Marmas of the lower back by stretching. It is also a beneficial exercise for Brihati Marma which is gently stretched and charged. The physical contact of JÁnu Marma also has a soothing effect on Sthapani and promotes inner silence and concentration in resting position.[23]

**Shoulder stand – Sarv Ángasana**

In Sarvangasana or shoulder stand asana many variations of the shoulder stand exist, the likely most common to be taught is supported shoulder stand. Sarvangasana is nicknamed “queen” or “mother” of all the asanas. By compressing the anterior neck and increasing blood pressure in the head, the neck and head Marmas are particularly stimulated Adhipati and Simanta included.

**Cobra – Bhujang Ásana**

The stretching of the neck opens the throat Marmas and the expansion of the chest Marmas. The Lumbar and Gluteal muscle are contracted, and therefore the Marmas in this region are stimulated.[24]

**Locust – Shalabh Ásana**

In this posture, the Lohitaksha and Vitapa Marmas are opened and vitalized by the stretching in the groin area. The tension in the buttocks and the Lumbar muscles stimulates all the Marmas of the pelvis and the lower back.[25]

**Bow – DhanurÁsana**

In this posture, the groin region Marmas Lohitaksha and Vitapa, in particular, are stretched and freed of tension. Furthermore, the ankle Marma, Gulpha and thigh Marmas are opened. In contrast, the Marmas of the whole back are strengthened by the muscular tension and the position of the spine while the Marmas of the chest are enlivened through stretches. The abdominal (Ura and Udara) Marmas are also stimulated by rolling on the floor.

**Half spinal Twist – Matsyendry Ásana**

The rotation of the spine and stretching of all the muscles of the trunk massages the internal organs and stimulates all the Marmas of the back, abdomen, and chest. In addition, the Marmas of the arm, Manibandha, Indrabasti, Kurpara, Ani, U⁺vi, LohitÁksha, and KakṣhAdhara are involved when the arm supports the posture. The half spine twist promotes elasticity of the spine and prevents the sciatica and muscular discomfort in the legs while internal organs such as the liver, spleen, pancreas, urinary bladder, kidneys,
and adrenals are compressed and massaged and increase blood flow. [24]

**Standing Forward Bend – Uttásana**

The increased blood flow to the head addresses all the head Marmas (Vidhur, Phana, Áwarta, Shankha, Utkshepa, Sthañpani, Sthmantra, ShrangaÔaka, and Adhipati), and all the back Marmas (KāÌktaruna, Kukundara, Nitamba, PÀrÀdhva-sandhi, Vihati, Àpshaphalaka, and Àpsha) are stretched and opened. The process starts with feet together and hands by the sides of the body (Samasthiti). Inhale, raise and stretch both arms above the head keeping them shoulder-width apart, Bend the head, arms and the upper trunk slightly backward and stay for a few breaths, exhale, and come back to Samasthiti. [23]

**CONCLUSION**

The Marma points can be treated in very different ways. There are many ways to treat the Marmas such as pure attention without touching, touching with attention, oil baths, basti, aromatherapy, vedic ceremonies to strengthen positive influences, and breathing exercises: Pranayama and Yoga exercises: Æsanas. [23] The physical Yoga exercises and its Æsanas give the Marmas room to breathe. They reconnect the Marmas with the state of unity, the inner self, the Àrma. When they are reconnected in this way the Marmas are enlivened, they expand and can fully express their inner qualities. Yoga Æsanas charge the Marmas with energy and support physical and mental reprocessing of the pattern of experience stored in the Marmas, in addition, certain finger postures or Mudras can be used to harmonize the Marmas. [23]

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Non-communicable diseases: A review on the current role and future prospects of yoga

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Abstract

Non-communicable diseases are fastest growing public health problems in the world; these conditions are difficult to treat and expensive to manage because these are chronic diseases or diseases of long duration and generally slow progression. Cardiovascular diseases, chronic respiratory diseases, diabetes, and cancer are topmost killers in the South-East Asia sphere, claiming an approximated 8.5 million lives each year. Fortunately, because the causative factors are modifiable, disease manifestation from these factors is largely preventable. Less physical activity and stress are the major factors now linked to a wide range of Non-communicable diseases. It is now well recognized that less physical activity and stress weakens our immune system and threshold of our body. Scientific research in several recent studies has shown that the yoga practices have the good impact on physical, physiological, psychological, and biochemical changes in the human body, yoga practices are of anti-stress in nature. Various yoga practices can be of great help in not only preventing but also controlling non-communicable diseases.

Key words: Control, non-communicable diseases, prevention, yoga

INTRODUCTION

Non-communicable diseases are fastest growing public health problems in the world; these conditions are difficult to treat and expensive to manage because these are chronic diseases or diseases of long duration and generally slow progression. The WHO¹ stated that cardiovascular diseases (CVD), chronic respiratory diseases, diabetes, and cancer are top killers in the South-East Asia Region, claiming an estimated 8.5 million lives each year. Fortunately, because the causative factors are modifiable, disease manifestation from these factors is largely preventable. Less physical activity and stress are the major factors now linked to a wide range of non-communicable diseases.

It is now well recognized that less physical activity and stress weakens our immune system and threshold of our body. Scientific research in several recent studies has shown that the yoga practices have the good impact on physical, physiological, psychological, and biochemical changes in the human body, yoga practices are of anti-stress in nature. The WHO² has been advocating yoga as one of the effective therapeutic system and yoga is believed to offer means for the actualization of human potential to perfection through its three-dimensional approach to health – physical, mental, and spiritual. Various yoga practices can be of great help in not only preventing but also controlling non-communicable diseases.

Yoga is finding an increasing approval as a non-pharmacological intervention for the prevention and treatment of diseases. A peaceful mind is conducive to healing and happiness is now accepted by the contemporary medicine science. They have also started recognizing the effects the psyche has on the soma and have integrated the concept in the fields of psychoneuroimmunology. This is the reason modern medical science is also accepting the importance of peace, joy, love, positive thinking,³ relaxation, hope, etc.,

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and accepting them as therapeutic tools. Yoga integrates these effects in the practitioner by helping the individual to reconcile with the self and various situations and lead total health to the individual and peace and happiness globally.

Based on the above rationales, yoga has been utilized in the management of some non-communicable diseases. This paper presents the scientific studies with the aim to highlights the importance and role of yoga in the current time to have an approach toward complete therapy and to utilize yoga therapy in non-communicable diseases.

**REVIEW METHODOLOGY**

The electronic databases of Google Scholar, PubMed, and Scopus were searched with the various combinations and permutations of the keywords “yoga, non-communicable diseases, prevention, management, cardiovascular disorders, obesity, hypertension, cancer, diabetes mellitus (DM), and scientific researches.” English language abstracts and full-text articles were considered for the review and saved to a folder. The matter was then analyzed and presented in a systemic manner.

**THE THERAPEUTICS OF YOGA**

Yoga is though not a therapeutic tool but the practice of yoga brings about various changes in the human body. Some of the important changes observed and documented by the scientists through researches are improved cognitive functions, alteration in brain blood flow and brain metabolism, modulation of the neuroendocrine axis, harmonious balance of autonomic function, increase in alpha rhythm, interhemispheric coherence and homogeneity in the brain, improved sleep quality, improvement in cardiopulmonary efficiency, improvement in exercise tolerance, improvement in agility, strength, stability, endurance, flexibility, tenacity, and neuromusculoskeletal coordination.

Various postulates have been described for explaining the mechanism of action of yoga and its benefits such as restoration of autonomic balance, improvement in the capacity of rehabilitation and regeneration and overall anti-stress effect on the individual. A theory proposed by Streeter et al. to explain the benefits of yoga practices in diverse and frequently comorbid medical conditions hypothesized that stress produces an increased allostatic load and develops a disparity of the autonomic nervous system with increased sympathetic and decreased parasympathetic activity. Yoga-based practices correct this under activity through the stimulation of the vagus nerves and reduce the allostatic load.

The human emotions of stress, anger, happiness, pleasure, joy, and sorrow are difficult to measure, but they provide a solid scientific foundation of mind-body relationship and emergence of psychoneuroimmunology. Although these emotions cannot be quantified, their effect on body system can be assessed to some extent by measuring certain biomarkers such as cytokine levels or measurement of natural killer cells. Science quests for quantifiable evidence. Providing substantiation for the effects of emotions on biological responses may prove to be a great significance to the health and disease. The evidence spawned has made the contemporary science accept the positive emotions, positive thinking, relaxation, hope, etc., as therapeutic tools. The acceptability of yoga as a potent instrument for influencing the mind positively is based on the lines of above-mentioned mechanisms.

**YOGA IN OBESITY AND CARDIOVASCULAR DISEASE**

Obesity has been researched extensively, and it has been revealed that a state of low-to-mild grade of inflammation is associated in it which may lead to the development of a number of chronic diseases. Studies have suggested evidence for the contributory role of inflammation in the causation and progression of CVD. The current approach focuses on pharmacological management, weight reduction along with attention on nutritional interventions and increased physical activity. Scientific studies have shown that lifestyle intervention has a very promising role in patients with CVD or those at an increased risk of CVD. Therefore, lifestyle modifications the practice of yoga have a very specific role in the management as well as in the prevention of these diseases.

Many studies have tried to explore the mechanisms by which yoga modifies the risk factors for coronary artery diseases. Ornish et al., Manchanda et al. and Yogendra et al. have angiographically proven though prospective, randomized, and controlled trials that CAD patient with yoga-based lifestyle modification helped in the regression of coronary lesions and improvement in myocardial perfusion.

Further, a review investigating the effects of yoga on risk indices associated with insulin CVD, resistance syndrome, and possible protection with yoga reported that most of the participants had a reduction of systolic and/or diastolic blood pressure (BP). Even short-term yoga-based general lifestyle intervention led to a remarkable reduction in BP, body mass index, and blood glucose with a clinically significant improvement in lipid profile. A reduction in all lipid profile parameters except high-density lipoproteins was reported in a yoga-based lifestyle intervention study which started from 4 weeks and lasted for 14 weeks. A study on Surya Namaskar revealed improved cardio-respiratory fitness in the participants. Another literature review on varying periods of yoga training on young subjects reported significant improvements in overall cardiovascular endurance, increased physical and better cardiopulmonary endurance. All these results indicate that a yogic lifestyle interference may have
an effect on some adaptable risk factors, which could make clear the protective and therapeutic valuable impact of yoga in CVD. Overall, lifestyle intervention can transform the evolution of the CVD.

**YOGA IN DM**

The pathogenesis of DM and its aftermaths has been linked to chronic stress, anxiety, depression, and also to an abnormal increase in sympathetic tone and reduction in parasympathetic activity. Despite the best glycemic controls, a number of complications are seen to develop in the patients leading to considerable disability and discomfort. Lifestyle modification has been observed as a component in the management of diabetes. The practice of yoga is directly associated to improve insulin sensitivity to glucose signals in Type 2 DM and attenuate the negative relationship between factors causing insulin resistance such as obesity, increased waist circumference, and dyslipidemia. Studies and reviews on effect of yoga intervention in Type 2 DM have clearly disclosed the positive effects of yoga on glycemic control, BP, lipid profile, stress, anxiety, and depression, but have not recognized the mechanisms of the action of yoga. Manjunatha et al. and Sahay have reported that there is diminution in the brisk release of insulin when glucose level tends to fall whereas the insulin release is increased when there is a rise of glucose in blood. Yoga augments the secretion of insulin as per bodily requirement through its neuroendocrinal effects and thereby brings about normalcy in the insulin/glucose ratio, which is evocative of better peripheral utilization of insulin and reduced insulin resistance. A few RCTs suggest that yoga and meditation practices act on the hypothalamic–pituitary–adrenal axis to reduce the sympathetic nervous system tone, decrease cortisol levels in plasma and elevate brain gamma-Aminobutyric acid (GABA) levels. The psychoneuroendocrine and immune mechanisms of the action of yoga in Type 2 DM epitomize a conceivable line to accept its holistic effects on disease modulation. It is very difficult to recognize any sole physiological mechanism of action of yoga in Type 2 DM as the risk factors and etiologies of Type 2 DM are multifactorial. Yoga produces multi-systemic effect through multitude mechanisms of action.

**YOGA IN HYPERTENSION**

Hypertension is a disease affecting a large portion of the adult population worldwide. It is a major modifiable risk factor for other cardiac diseases and stroke. The origin of hypertension has been suggested to a number of factors as stress, imbalance in autonomic performance, overactivity of the sympathetic nervous system which ultimately desensitizes cardiopulmonary and arterial baroreceptor reflex and chemoreceptor reflex, leading to a resetting of threshold BP values at which regulatory signals are triggered. Various complex pathways were suggested by Smith and Pukalito. They explain the positive outcomes of yoga practices which enmesh relaxation, acceptance, self-efficiency, and coping strategies. Increase in number of natural killer cells was reported by Kochupillai et al. in cancer patients who were practicing Sudarshan Kriya and

Researches have suggested that efficient BP management is multifactorial and includes expanding patient and healthcare provider awareness, appropriate lifestyle and food habit modifications, access to care, appropriate treatment, a high level of medication adherence, adequate follow–up and observation.

Various yogic techniques have been found to be very effective in the management and control of BP and its aftermaths. It is difficult to elucidate the mechanism underlying the BP-lowering effect. Controlled breathing with prolonged breath cycles as practiced in Pranayam may positively alter the chemoreceptor sensitivity thereby reducing arterial baroreceptor lassitude and sympathetic outflow. Other potential mechanisms postulate that amplification of tidal volume activates the Hering–Breuer reflex mediated by pulmonary stretch receptors which reduces the chemoreflex sensitivity and upregulates the baroreflex receptor sensitivity and thereby decreases arterial BP. It has also been suggested that pranayama practices entrain central nervous system nuclei (in which respiratory and cardiovascular system centers cross) thus positively altering the sympathetic outlay to the blood vessels.

A decrease in systemic vascular resistance and better total arterial compliance has also been suggested as some other probable mechanisms of action. However, the overall biological mechanism and the integrated neural pathways involved in lowering BP by slow deep breathing have yet to be completely elucidated.

**YOGA IN CANCER**

A comprising meta-analysis on the effect of yoga in cancer as compared to waitlist or supportive therapy class reveals improvements in psychological health along with the overall quality of life. A study on systematic review and meta-analysis on the physical and psychosocial betterment of yoga in cancer patients and survivors by Buffart and colleagues find out that yoga may be an advantageous intervention as valuable effects on several physical and psychosocial symptoms were reported. They presented that strong beneficial effects are observed by the practice of yoga on distress, anxiety, and depression, while moderate effects are perceived on fatigue, general health-related quality of life, emotional, and social function. They also observed the little beneficial effects on functional well-being. They suggested that yoga practices can be an advantageous form of exercise for cancer patients and survivors.
Pranayam (breathing techniques) of yoga after complete in their standard therapy.

**THE FUTURE PROSPECTS**

Stress has been well accepted as the major culprit for the non-communicable diseases as it weakens the immune system (neuroimmune axis and psychoneuroimmunology), disturbs the hypothalamic–pituitary–axis (neuroimmunoendocrine axis) and up-regulate the sympathetic tone of the body. Scientific research in several recent scientific studies has shown that the physical, physiological, psychological, and biochemical consequences of yoga are of anti-stress in nature. Mechanisms hypothesized and postulated are the re-establishment of autonomic function balance as well as a progress in healing, regenerative, and curative capacity of the individuals which enables us to move from a state of ill health and sickness to the one of fitness and well-being.

The need of the current time is to have an integrated approach toward complete therapy and to utilize yoga therapy in harmonization, cooperation, and collaboration with other systems of medicine such as modern medicine, Ayurveda, and naturopathy. Advice on diet and lifestyle is very important, irrespective of the mode of therapy that is employed for a particular patient.

**CONCLUSION**

Yoga has prodigious potential in the control, preventing, and managing lifestyle disorders and diseases. The integration of active yogic lifestyle can make a distinguishable contribution to the enhancement of general health globally. Yoga has the strength to shunt the progression of non-communicable disease and if initiated early, may also exhibit significant cure to the disease and its sequel. The majority of studies on yoga and cardiovascular health show positive trends and this augurs well for the future of healthcare in general and the use of yoga as part of integrative health-care system in particular. The major benefit of yoga may occur due to the psychosomatic harmonizing effect and restoration of physical, mental, emotional, and spiritual balance which has been proven in numerous scientific short- and long-term studies.

With no considerable side effects and several collateral benefits yoga can be practiced by all, even ill, elderly, or disabled individuals and should be recommended as a beneficial adjuvant for patients of various non-communicable disorders as it is a safe, simple, and economical therapy. Yoga can be practiced anywhere by people of all age groups, irrespective of their socio-economic status, it fits in very well with the healthy lifestyle, due to all these unique qualities of yoga, the WHO has been strongly advocating throughout the life cycle - from childhood to healthy aging.

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Phytochemistry and pharmacology of *Swertia corymbosa*

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**ABSTRACT**

*Swertia corymbosa* belonging to family Gentianaceae is a stout erect herb, found Western Ghats from Maharashtra to South Kanara at 1200 m. Its medicinal usage is well documented in Indian traditional medicine such as the Ayurveda, Unani, Siddha, and other conventional medical systems. In India, local healers have practiced this plant as a substitute of *Swertia chirayita* for the management of fever, diarrhea, jaundice, hyperglycemia, inflammation, and neurological diseases. The phytochemical study had led to the isolation of flavonoids, triterpenes, alkaloids, glycosides, etc. Pharmacological activities (*in vitro* and *in vivo*) of various parts of the plant summarized include anxiolytic, sedative, anticonvulsant, antioxidant, analgesic, anti-inflammatory, antipyretic, antimicrobial, antidiabetic, antihyperlipidemic, and antiproliferative activity. *S. corymbosa* developed as a great source of folkloric medicine for the treatment of pain, diabetes, infectious diseases, neurological, and inflammatory disorders. Further, research is required in the field of pharmacokinetics, efficacy, toxicology, and clinical importance of the plant as well as its bioactive chemical constituents.

**Keywords:** Anticonvulsant, antiproliferative, pharmacokinetics, *Swertia corymbosa*

**INTRODUCTION**

*Swertia corymbosa* (Gentianaceae), is stout erect herbs, located Western Ghats from Maharashtra to South Kanara at 1200 m.[1] Plants are distinguished by solid erect herbs; 30–40 cm high; stem four-angled, extensively branched. Leaves of the plant are identified by 2–3 cm ovate, acute, and subamplexicaul at the base with three-ribbed. The cymes are terminal along with corymbose. The flowers are tightly arranged with 1 cm long bracts, lanceolate pedicel 13 mm long, lanceolate free calyx lobes 11 mm X 1.5 mm, white corolla 12 mm X 4 mm with bluish spots, lobes 4, connate at base only; nectary chamber at the base of corolla, covered with an orbicular lid, rim of the chamber with scabrous bristle; stamens 4, all fertile; ovoid ovary with short style; and stigma capitate. Capsules oblong, 5–6 mm long, dehiscing by two valves; seeds many, reticulate. Beneath leaves are more packed than top leaves and usually falling short. Stems are with four different angles. Petals are a single dot-like honey gland at the base which is incorporated with a minute fimbriate rough appendix and uncommon nature.[2] Roots of the *S. corymbosa* are used for the treatment of venereal diseases, skin diseases, sores, injuries, and ulcer. The roots of *S. corymbosa* are used for the treatment of soreness and pains in the lower limbs. The whole plant of *S. corymbosa* has been applied for the cure of diarrhea, fever, jaundice, and diabetic. Particularly in the area of Tirunelveli district and Vellingiri hills of Coimbatore, tribal’s *S. corymbosa* was usually used to control diabetes and nervous diseases.[3] *S. corymbosa* recommended that aerial parts are used as the main ingredient for the manufacture of Ayurvedic herbal medicines against diabetics.[4] In the Unani system, *S. corymbosa* is used as an astringent tonic, stomachic, reduces inflammation, a sedative to the pregnant uterus, and chronic fevers.[5] *S. corymbosa* leaves traditionally used in Indian medicine as an antidote for poisoning, diarrhea, and as stomach wash in cattle.[6] Due to bitterness quality, this plant is used as substitute of *Swertia chirayita*.[1]

**ETHNOPHARMACOLOGY**

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PHYTOCHEMISTRY

Phytochemical investigation on aerial parts of *S. corymbosa* led to the isolation of decussating (1), gentiacaulein (2), swertianin (3), methylswertianin (4), 8-hydroxy-1,2,4,6-tetramethoxyxanthone (5), 1,2-dihydroxy-6-methoxyxanthone-8-O-β-D-xylpyranosyl (6), loganic acid (7), swertiamarin (8), sweroside (9), gentiopicroside (10), isovitexin (11), amoroswertin (12), amarogentin (13), from its aerial parts[8] 1, 2, 8-trihydroxy-6-methoxy xanthone (14),[9] 3-allyl-2, 8dihydroxy-1, 6-dimethoxy-9H-xanthen-9-one (15), norswertianin (16), 1,3,6,8-tetrahydroxyxanthone (17), 1,3 dihydroxyxanthone (18), allyloxy xanthone (19), isolated from chloroform fraction of aerial parts of *S. corymbosa*[10] friedelin (20), epi-friedelinol (21), mangiferin (22), α-amyrin (23), lupeol (24), oleanolic acid (25), ursolic acid (26),[11] and 1, 5, 8-trihydroxy-3-methoxyxanthone (27) was isolated from whole plant of methanol extract of *S. corymbosa*.[12]
Antioxidant Activity

In vitro, the antioxidant activity of isolated compound from the aerial part of *S. corymbosa* was performed. Compound 6 found that strong scavenging effects on 2,2-diphenyl-1-picrylhydrazyl (DPPH), ABTS, superoxide anion, nitric oxide, hydroxyl radical scavenging activities, ferric reducing antioxidant power, metal chelating, and lipid peroxidation with IC$_{50}$ were found to be 07.19 ± 4.56 mol/mL, 42.62 ± 0.25 mmol/L TE/g, 57.89 ± 3.45 mol/mL, 18.45 ± 1.23 mol/mL, 12.13 ± 2.76 mol/mL, 14.76 ± 0.10 molar Fe (II)/g, 213.85 ± 27.18 EDTA mg/g, and 19.21 ± 3.45 mol/mL, respectively.[7]

The antioxidant activity of methanol extract of aerial parts and root of *S. corymbosa* was evaluated in alloxan-induced diabetic rats. The diabetic rats were administered with methanol extract of *S. corymbosa* at a dose of 150 mg/kg, i.p. body weight for 14 days. The antioxidant activity of the methanol extract of *S. corymbosa* was analyzed by estimating the levels of catalase, glutathione peroxidase, and superoxide dismutase with the normal and diabetic-treated albino rats. A highly significant reduction in the activity of scavenging mitochondria enzymes is observed in alloxan-induced rats. The methanol extract of *S. corymbosa* has enhanced mitochondrial enzymatic antioxidant activity and suppressed lipid peroxidation and the reduction in the activities of SOD, CAT, and GPX in alloxan-induced rats.[13]

In vitro, the antioxidant activity of mega extract (petroleum ether, chloroform, ethyl acetate, methanol, and hot water) of aerial parts of *S. corymbosa* was performed. The methanol extract of aerial part was showed active scavenging effects on DPPH free radicals, radical cation scavenging, ferric reducing, superoxide radicals, metal chelating, hydroxyl radical scavenging, and nitric oxide with IC$_{50}$ 23.54 μg/mL, 32711.05 ± 339.94 μmol TAA/g extract, 1955.29 ± 35.14 mmol Fe (II)/mg extract, 75.74% at a level of 100 μg, 79.81 ± 5.13 mg EDTA/g extract, 52.42%, and 70.15%, respectively.[14]

The antioxidant activities of methanol extracts from non-embryonic callus, globular stage of somatic embryos, heart-shaped stage of somatic embryos, and cotyledonary embryos of *S. corymbosa* were evaluated in vitro assays, i.e., DPPH, ABTS, and ferric reducing antioxidant. The methanol extract of *S. corymbosa* was found good antioxidant activity.[15]

The whole plant of aqueous extract of *S. corymbosa* showed scavenging results on DPPH free radicals and ferric reducing antioxidant power with 33.82% RSA and 1.07 mg AEAC/g, respectively.[16]
compounds (50 mg/kg b.w.) showed the utmost reduction of 83% in the level of blood glucose of diabetic rats. At the dose level of 50 mg/kg, oral administration of both compounds showed significant decrease in blood glucose, glycosylated hemoglobin, serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, serum alkaline phosphatase, serum urea, and creatinine with a significant increase in plasma insulin level in streptozotocin-induced diabetic rats. For OGTT, the compound showed a significant decrease in blood glucose levels at 120 and 180 min.\[9]\n
In vitro antidiabetic activity of the methanol extracts of aerial parts of *S. corymbosa* was investigated using α-amylase and α-glucosidase enzyme inhibitory activity. At the oral dose level of 125, 250, and 500 mg/kg, extract was given in streptozotocin-induced diabetic rats for 28 days. Hypoglycemic outcomes, OGTT, body weight, lipid profile, biochemical, and histopathological analysis were evaluated. The methanol extract was found good inhibitor of α-glucosidase and α-amylase. The methanol extract significantly reduced in the concentrations level of blood glucose, total cholesterol, low-density lipoprotein cholesterol, malondialdehyde, serum triglycerides and the vital increase in the concentrations of high-density lipoprotein cholesterol, and serum insulin, along with body weight. Histopathological study revealed the regeneration of β-cells in the pancreas that was beginning necrosed by streptozotocin. In the OGTT, the extract enhanced the glucose tolerance.\[9] The aqueous extract of *S. corymbosa* showed less antihyperglycemic and antiglycation activity against OGTT.\[10\]

### ANTIMICROBIAL ACTIVITY

The isolated compound 6 was evaluated against *Staphylococcus aureus* and *Streptococcus pneumoniae* (pathogenic Gram-positive bacteria) and *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Bacillus subtilis* (Gram-negative bacteria) by the paper disc method and minimum inhibitory concentration. At 25 µg/mL concentration, isolated compound showed antibacterial activity toward *S. pneumoniae* and *E. coli* with MIC value of 3.90 µg/mL, and inhibition zone was found to be 21.21 ± 0.25 and 20.27 ± 0.11 mm, respectively. However, compound was found inadequate activity against the other examined bacteria.\[7]\n
The aqueous, methanol, chloroform, and hexane extracts of the whole plant of *S. corymbosa* were tested for *in vitro* antimicrobial activity against *Salmonella enterica*, *Salmonella typhi*, *Aeromonas hydrophila*, *B. subtilis*, *Chromobacterium violaceum*, *P. aeruginosa*, and *Vibrio cholerae*. The aqueous extract of *S. corymbosa* showed maximum inhibitory activity against *S. aureus*. The methanol and chloroform extract of *S. corymbosa* inhibited *S. typhi*. The modest inhibitory activity was found against *V. cholerae*, *P. aeruginosa*, *A. hydrophila*, *C. violaceum*, *S. aureus*, and *B. subtilis*.\[11\]

### ANTIHYPERLIPIDEMIC ACTIVITY

The isolated compounds 6 and 14 were performed in streptozotocin-induced diabetic rats for antihyperlipidemic activity. At the dose level of 60 mg/kg, diabetes was induced by intraperitoneal injection of streptozotocin. The isolated compound at the dose level of 50 mg/kg exhibited a significant reduction in serum triglycerides, cholesterol, and low-density lipoprotein, in diabetic-treated rats when compared to control rats which indicated the protective role against liver and kidney damage. The histopathological examination showed protected tissues of liver, kidney, and pancreas, against peroxidation damage and reported tissue prolife. No significant results were obtained in the normoglycemic rats.\[9]\n
### MOLECULAR DOCKING STUDY

The molecular interaction of compound 6 and 14 and glibenclamide was investigated with numerous diabetes mellitus-associated protein targets (fructose-1, 6-bisphosphatase 1, glucokinase, and 11-β-hydroxysteroid dehydrogenase). The reduced protein sulfonlurea receptor 1 revealed that both ligands hold binding affinity with whole protein targets but for 11-β-hydroxysteroid dehydrogenase target protein for which ligand 1 was found no interaction and the ligand provided the binding formation. Consequently, both compounds can be recognized for developing into a potent antihyperglycemic drug.\[9]\n
### Analgesic Activity

Analgesic effects of compounds 3 and 6 were performed in albino mice by hot plate and acetic acid-induced writhing methods. The hot plate reaction time for both compounds was found to be 9.88 and 11.78 s which showed significant exhibition. The Compound 3 and 6 showed diminish writhing sign (70.60, 76.85%) in acetic acid-induced test respectively.\[17] Methanol extract (200 mg/kg, for 240 min) showed better analgesic activity compared with standard drug pentazocine for hot plate reaction time. Pretreatment with methanol extract of *S. corymbosa* (100 and 200 mg/kg, body weight) reduced pain 55.64% and 75.01%, respectively, while 71.91% inhibition was found for indomethacin (standard drug, 25 mg/kg, body weight).\[18]\n
### Anxiolytic Activity

Anxiolytic activity of methanol extract of the aerial parts of *S. corymbosa* was studied in albino mice using the elevated plus maze, open field test models. Administration of methanol extract of *S. corymbosa* (125–500 mg/kg) to the rats showed the significant improvement in the incidence of the open arm and minimum number of entries in the closed arm. The methanol extract and diazepam showed noteworthy improvements in the entries of total number into the two
arms. In open field test, methanol extract of *S. corymbosa* causes the significantly reduced number of central motor and ambulation in the mice.\(^{[19]}\)

**Anticonvulsant Activity**

The methanol extract of the aerial parts of *S. corymbosa* was evaluated for anticonvulsant potential by pentylenetetrazole, maximal electroshock (MES), and isoniazid-induced convulsions models. In pentylenetetrazole model, at a dose of 125, 250, and 500 mg/kg of methanol extract of *S. corymbosa* protected 33.33%, 50.0%, and 100%, respectively, of the animals against seizures. The convulsion and latency period were found to be 89.20 ± 4.24 s in control group. The methanol extract significantly prolonged the span of induced seizures at each three-dose levels and showed a dose-dependent improvement in the anticonvulsant activity. The methanol extract revealed a dose-dependent increase in hindrance of the origin time of seizures caused by MES-induced convulsion moreover reduced the duration of tonic hindlimb extension.\(^{[19]}\)

**Sedative Activity**

The sedative activity of methanol extract of the aerial parts of *S. corymbosa* was performed in albino mice using the spontaneous motor and rotord performance model. The protective effect of methanol extract of *S. corymbosa* (500 mg/kg, b.w.) standard drug diazepam (2 mg/kg, b.w.) on locomotor activity in rats was found to be 55.38% and 49.59%, respectively, after 1 h of drug administration. At the dose level of 500 mg/kg, methanol extract administered rats maintained on the rotating rod for more than 276.35 ± 7.58 s.\(^ {[19]}\)

**Antipyretic Activity**

The antipyretic activity of methanol extract of the aerial parts of *S. corymbosa* was examined on yeast-induced pyrexia in albino rats. Yeast suspension (10 mg/kg) enhanced rectal temperature 24 h following subcutaneous injection. Methanol extract (100 and 200 mg/kg) exhibited the significant reduction in yeast-induced raised temperature in a dose-dependent manner. The effect extended up to 5 h after the drug treatment. The antipyretic effect of methanol extract was got significant to paracetamol (standard drug, 150 mg/kg, p.o.).\(^{[18]}\)

**CONCLUSION**

The comprehensive literature review showed *S. corymbosa* to be valuable remedial plant used for the ethnomedical treatment of pain, diarrhea, ulcer, diabetes, jaundice, fever, etc., in India. Pharmacological investigations carried out on the aerial parts of plant extract and the isolated compound of *S. corymbosa* provides a logical support for its various folkloric uses. Phytochemistry investigations carried out on *S. corymbosa* had pointed to the isolation of some groups of plant metabolites.

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