

Critical review of Brahma Rasayana W.S.R to its immunomodulatory activity

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Abstract

Rasayana is one of the eight clinical specialties of Ayurveda. The Rasayana therapy enhance the qualities of Rasa, enhances it with nutrients, so it is useful as longevity, memory, intelligence, optimum development of physique, and sense organs. Brahma Rasayana is one of the most important Rasayana of Ayurvedic texts. It is useful to improve memory and immunity of the body. Brahma Rasayana was found to activate antibody-dependent cytotoxicity significantly. The present review is undertaken for screening herbs (ingredients) of Brahma Rasayana to evaluate their immunomodulatory properties and established the correlation between Rasayana and immunomodulatory effect. Critical review of herbs to show immunomodulatory property is compiled from various Ayurvedic texts as well as from multiple articles on the internet to justify their immunomodulatory property on the basis of data collected. Many of the herbs reviewed of Brahma Rasayana are found to act as immunomodulators as per Ayurveda. This shows their potential to act as antioxidant, anti-stress, anti-inflammatory, anti-bacterial, vaccine adjuvant, or immunity against diseases property. The ingredients of Brahma Rasayana formulation are the herbs among all reviewed in the present study found to exhibit immunomodulatory effect of formulation.

Key words: Formulation, herbs, immunomodulators, Rasayana

INTRODUCTION

The word “Rasayana” is made up of two words: “Rasa” and “Ayana.” “Rasa” primarily means essential seven vital tissues (Saptadhatu, e.g., Rasa, Rakta, Mansa, Meda, Asthi, Majja, and Shukra). “Ayana” means the path or channel. Hence, Rasayanas are those that bring about proper uptake, growth, and improvement of essential Dhatus. According to Acharya Charaka, use of Rasayanas results in disease-free long life (Dirghamaayu), Smiriti (Recapitulating power), Medha (Intellect), Aarogyam (healthy well-being), Tarun Vaya (Youthfulness), Prabha (Blaze), Varna (Complexion), Swara (Voice), and Dehaindriya Bala (Strength).^[1] According to Acharya Sharangdhara, various drugs, diet, and regimens which promote longevity by delaying aging and preventing diseases are called Rasayana such as Amrita, Guggul, and Haritaki.^[2] Literally, the word Rasayana is derived from two words “Rasa” and “Ayana.” The first word Rasa is used to denote six different objects in Ayurveda literatures. Namely, Rasa as Dhatu, Rasa as Secretion, Rasa as Oja, Rasa as Taste, Rasa as Juice, and Rasa as Parada.

The second word Ayana refers to circulation in general. Hence, the word Rasayana refers to Rasa (nutrition) and its transportation in the body.^[3] It is a state of improved nutrition lead to a series of secondary attributes such as prevention of aging and longevity, immunity against diseases, mental competence, and increased vitality of the body.

Brahma Rasayana is one of the most valuable Ayurvedic formulations made with 45 herbal ingredients, which claims to improve intelligence, memory, and immune power^[4] and for use against stress and tiredness.^[5] Brahma Rasayana is mentioned in “the Ayurvedic formulary of India” for the treatment of drowsiness, fatigue/lethargy, tiredness without exertion, mental weakness, senility/progeriasis, aging, and disturbed memory.^[6] This formulation is very important. The famous Rishies Vaikhanasa and Balkhilya

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used Brahma Rasayana and attained immeasurable life span, acquired youth replacing aged physique, endowed with great memory, intellect, concentration, and physical strength.^[7]

Rasayana drugs are believed to slow down the aging process (jara) and provide a defense against diseases (vyadhi). Rasayana improve the host resistance of an individual, helping to prevent aging and diseases. Specific diets and lifestyle changes are also advised in Rasayana therapy. Rasayana drugs act on the immune system. The immune system has connections with a number of other organs and can directly or indirectly influence the actions of many other organs. Rasayana shows myriad actions on other organs by acting on the immune system.^[8]

An immunomodulator is a drug used for its effects on the immune system. It can be defined as a substance, which can influence any component or function of the immune system in a specific or non-specific method. The concept of immunomodulation is mentioned as Rasayana in Ayurveda. Ayurveda has two aims - first one is the prevention and promotion of health and the other one is cure from disease. Rasayana are used for both aims.^[9]

The word immunomodulation means the alteration of immune response which may increase or decrease the immune responsiveness. An immunomodulators may be defined as a substance, which can stimulate, suppress, or modulate any of the immune system including both innate and adaptive arms of the immune response. Immunomodulators are considered one of the most potent tools in the management of health and disease. The modulation of immune response by using Ayurvedic herbal medications as a possible therapeutic measure has now become a subject of scientific investigations. Natural adjuvant, synthetic agents, and antibody reagents are used as immunosuppressive and immunostimulative agents.^[10]

CONCEPT OF IMMUNITY AS PER AYURVEDA

Ayurveda has propounded the concept of immunity as “Vyadhikshamatwa.^[11]” Acharya Chakrapanidatta has interpreted the term Vyadhi-ksamatwa as Vyadhi bala Virodhitwa, that is, antagonistic to the strength and virulence of the disease and Vyadhyutpada Pratibandhakatwa, that is, the capacity to inhibit and bind the causes and factors of the disease.^[12] In fact, one of the therapeutic strategies in Ayurvedic medicines is to enhance the body’s overall natural resistance to the disease causing agent rather than directly neutralizing the agent itself. The use of herbs for improving the overall resistance of body against common infections and pathogens has been a guiding principle of Ayurveda.^[13]

VYADHIKSHAMATVA

The modern understanding of immunity fits in the broad concept of Vyadhikshamatva in Ayurveda. The process of prevention of disease development and capacity to resist disease are jointly known as Vyadhikshamatva.^[14]

Vyadhikshamatva which appears in Ayurvedic scriptures by the same Sleshma, Bala, and Ojas.

1. Sleshma-Sleshma in normal state is called Bala and Oja. Sleshma in abnormal state called “dosha” and “pama” diseases.^[15] Kapha in normal state provides compactness, stability, heaviness, vitality, immunity, resistance, courage, and greedlessness.^[16]
2. Oja-Ojas has been considered vital in the defense mechanism of the body; it not only resides in the heart (hridya) but also circulates all over body and maintains healthy status of the person.^[17]

According to Acharya Charaka (during embryogenesis) the Oja appeared foremost in the human body.^[18]

3. Bala-Bala imparts firm integrity to the muscles, improves the voice and complexion, and helps the person to perform his natural functions normally.^[19]

There are 3 types of Bala in Ayurved - (1) Sahaja bala, (2) Kalaja bala, and (3) Yuktikrita bala

- The constitutional strength present since birth. It depends on the healthiness of Shukra (sperms) and artava (ovum).
- (According to time, season, and age) - Encompassing to time of day, season, age, etc., factors for enhancing immunity, (according to ritu and age).
- Plans for enhancing immunity and acquiring bala, such as proper diet (ahara), performing exercise, and using different beneficial yoga.^[20]

MODERN CONCEPT OF IMMUNE SYSTEM OR IMMUNOMODULATORY

The immune system is the body’s defense against infectious organisms and other invaders. Through a step of step called the immune response, the immune system attacks organisms and substances that invade body systems and cause disease. The immune system is made up of a network of cells, tissues, and organs that work together to protect the body. Lymphocyte is the master of human immune system. Morphologically, lymphocytes are homogenous, but they are heterogeneous in functioning. Lymphocytes are of three categories - T-lymphocytes, B-lymphocytes, and Natural Killer cells (NK cells). All the three lymphocytes are formed from lymphoid precursor cells in bone marrow, which further undergo maturation and differentiation in the bone marrow (B-cells) and thymus (T-cells).

Immune system is defined as a sophisticated and highly evolved network of integrated body system including organs, tissue, cells, and cell products with a mission to provide resistance and/or retaliation to foreign agents or invaders physiologically. Immune system comprises different organs or tissues such as the primary lymphoid organs such as thymus and bone marrow, whereas the secondary lymphoid organs include the spleen, tonsils, lymph vessels, lymph nodes, adenoids, skin, and liver.^[21]

An immunomodulator can be defined as a substance, which can influence any constituent or function of the immune system in a specific or non-specific manner including either innate or adaptive arms of the immune response.^[2] They are a diverse array of recombinant, synthetic and natural preparations, often cytokines. Some of these substances, such as granulocyte colony-stimulating factor, interferon's, imiquimod, and cellular membrane fractions from bacteria are already licensed for use in patients. Others including interleukin-2 (IL-2), IL-7, IL-12, various chemokines, synthetic cytosine phosphate-guanosine, oligodeoxynucleotides, and glucans are currently being investigated extensively in the clinical and pre-clinical studies. Immunomodulatory regimens offer an attractive approach as they often have fewer side effects than existing drugs, including less potential for creating resistance in microbial diseases.^[22]

ACTIVE CHEMICAL CONSTITUENTS OR IMMUNOMODULATORY PROPERTIES OF HERBS OF BRAHMA RASAYANA

Brahma Rasayana has 45 ingredients; many of them have very important immunomodulatory property. By virtue of the substances being immunomodulators, the Brahma Rasayana itself possesses immunomodulator properties. Here, the immunomodulatory properties of the components of the Brahma Rasayana are being described.

Amalaki (*Embllica officinalis*)

E. officinalis (Amalaki) has been known in Ayurvedic medicine for its tonifying, antiaging, and immune enhancing properties as it provides a superior source of Vitamin C. It possesses a number of active compounds such as ellagic acid, gallic acid, quercetin, flavonoids, glycosides, and proanthocyanidins. Quercetin present in it is responsible for its hepatoprotective effect.^[23] Due to its antibacterial property, it stimulates polymorphonuclear (PMN) cells and RE system and also enhances NK cell and antibody-dependent cellular cytotoxicity (ADCC). Due to its rejuvenant property, it inhibits PMN activity induced by leukotriene B4 (LTB4) and FMLP means N-formyl-methionyl-leucyl-phenylalanine a neutrophil-stimulating bacterial peptide^[24] It improves vitality to protects against pancreatitis, induces positive nitrogen balance, protects against toxic effects of metals, enhances

NK cell and antibody-dependent cellular, and cytotoxicity against Dalton's lymphoma ascites tumor.^[25]

Amalaki is well known for its antioxidant and detoxification properties along with tonifying and antiaging effect. As an adaptogen, Amalaki improves immunity and augments both cell mediated and humoral response. It enhances IL-2 and gamma-IFN production and inhibits apoptosis. It enhance NK cell activity and ADCC.^[26]

Haritaki (*Terminalia chebula*)

T. chebula popularly known as "Myrobalan" or "Haritaki." Fruits of Haritaki are an important source of tannins. It is mainly used as an astringent, laxative, stomachic, and tonic. *Chebula* has been investigated for its effect on cell-mediated and humoral components of the immune system.^[27] Due to its wound healing property and as antiasthmatic it increases HA titer and delayed-type-hypersensitivity (DTH) reaction.^[24]

Bilva (*Aegle marmelos*)

A. marmelos is a rich source of coumarins, Vitamin C, and riboflavin. It possesses potent microfilarial, radioprotective, analgesic, antihyperglycemic, antidyslipidemic, anticancer, and antidiabetic activity. Literature survey has revealed that leaves of *A. marmelos* are prescribed in the treatment of immunological disorders. The leaves of *A. marmelos* showed significant immunostimulant activity on both the specific and non-specific immune mechanism.^[28] Its methanolic extract effectively stimulated cell-mediated and antibody-mediated immune response than ethanolic extract.^[24]

Agnimanth (*Clerodendrum phlomidis*)

Oral administration of methanol extracts of *C. phlomidis* root has significantly increases in hemagglutinating antibody titer. *C. phlomidis* showed higher specific immune activity. It enhances the non-specific immune response in carbon clearance test and showed significant immunoprophylactic effect. It increases in humoral antibody (HA) titer.^[29]

Shyonak (*Oroxylum indicum*)

On preliminary phytochemical screening, the *n*-butanol extract of *O. indicum* showed the presence of alkaloids, tannins, flavonoids, and anthraquinones. In pre-treatment with *n*-butanol extract, significantly reversed the rise in malondialdehyde content along with significant rise in superoxide dismutase, catalase, and reduced glutathione levels as compared to the stress-induced control group. The *n*-butanol extract of *O. indicum* root bark has previously revealed the presence of alkaloids, tannins, flavonoids, and anthraquinones. It presents flavonoid baicalein, an agent reported to possess immunomodulatory activity

stress-induced oxidative stress. Thus, the *n*-butanol extract of *O. indicum* attenuated the stress-induced immunosuppression through antioxidant mechanism.^[30]

Patala (*Stereospermum suaveolens*)

Phytochemical analysis of *S. suaveolens* root extract (SSRE) showed the presence of flavonoids, terpenoids, saponins, alkaloids, tannins, carbohydrates, steroids, and gums. Dehydro- α -lapachone and lapachol are the most active constituents of *S. suaveolens* root. Lapachol and its derivatives dehydro- α -lapachone are the principle active constituents; it also has immunosuppressive activity in high-dose concentration. SSRE increased the thin-layer chromatography (TLC), monocyte, and neutrophil population while decreased the eosinophil, basophil, and lymphocyte populations. Thus, the increase of TLC, neutrophil, and monocyte counts suggesting an uplift of non-specific immune status in low doses.^[31]

Gambhari (*Gmelina arborea*)

The plant shows the presence of flavonoids (apigenin), which is reported to exhibit immunomodulatory activity. Administration of methanolic extract of *Gmelina arborea* (MEGA) and ethyl acetate fraction MEGA Linn. were found to increase the total white blood cell (WBC) count.^[32] Its methanol extract and its ethyl acetate soluble fraction of root increases in HA titer, DTH response and increase in total WBC.^[24]

Shalparni (*Desmodium gangeticum*)

D. gangeticum possesses a strong antioxidant activity, which might be responsible for its anti-arthritis activity. Caffeic acid and chlorogenic acid could be useful as antioxidants in experimental animal models and might be responsible for the antioxidant activity of the plant. *D. gangeticum* has also been reported to contain alkaloids, flavone, and isoflavonoid glycosides. Total alkaloids of this species showed anticholinesterase, smooth muscle stimulant, central nervous system (CNS) stimulant, and depressant responses. Antiviral, antiasthmatic, property of *D. gangeticum* tonic of whole plant provides resistance against *Leishmania donovani*.^[33]

Kantakari (*Solanum xanthocarpum*)

The immunomodulatory potency of the methanol extract of fruit of the *S. xanthocarpum* using cyclophosphamide (CP)-induced immunosuppression and neutrophil adhesion. CP is an alkylating agent widely used in antineoplastic therapy. It is effective against a variety of cancers such as lymphoma, myeloma, and chronic lymphocytic leukemia. CP-induced immunosuppression is reported to prompt various types of infection. The methanol extract of fruits

of *S. xanthocarpum* have protected the animal against CP-induced immunosuppression indicating its profound immunomodulatory activity.^[34]

Gokshura (*Tribulus terrestris* [TT])

The result of PMN (peripheral blood mononuclear cells [PBMCs]) function test showed a significant increase in the percentage phagocytosis. This indicates that the saponins obtained from TT enhance the phagocytic efficacy of the PMN cells by causing more engulfment of the yeast cells, thereby stimulating a non-specific immune response. The immunostimulant potential of saponins, isolated from fruits of TT increasing the activities of macrophages, T-lymphocytes, and B-lymphocytes.^[35]

Bala (*Sida cordifolia*)

S. cordifolia root possess anti-stress and adaptogenic activity. It also has been reported to possess analgesic, anti-inflammatory, and hypoglycemic activities as well as hepatoprotective activity. Ethanolic extract of root or whole plant of *S. cordifolia* has free-radical scavenging by DPPH. It has anti-lipid peroxidation, free-radical scavenging, reducing power, nitric oxide (NO), superoxide, and scavenging antioxidant assay.^[36]

Punarnava (*Boerhavia diffusa*)

The root of *B. diffusa* (Punarnava) has anti-inflammatory, anti-stress, adaptogenic, and antiaging property which inhibits production of NO, IL-2, and tumor necrosis factor- α (TNF- α). It possesses immunomodulatory effects due to the immunosuppressive action.^[24] Extracts of *B. diffusa* roots inhibited human NK cell cytotoxicity *in vitro*, production of NO, IL-2, and TNF- α , in human PBMCs, demonstrating its immunosuppressive potential effect. It also exhibits antidiabetic, anti-metastatic, antioxidant, antiproliferative and antiestrogenic, analgesic, anti-inflammatory, and antibacterial activity.^[26]

Erand (*Ricinus communis*)

Plant products of *R. communis* such as polysaccharides, lectins, peptides, flavonoids, and tannins have been used for the immune response or immune system in various *in vitro* models. *R. communis* leaf extract was tested for the presence of tannins, alkaloids, carbohydrates, steroids, and flavonoids separately. *R. communis* leaves significantly increased the phagocytic function of human neutrophils when compared to control, indicating the possible immunostimulating effect. The isolated compound (tannin) stimulated the neutrophils to phagocytic activity & stimulated the phagocytosis of killed *Candida albicans*. The isolated compound of Tannins obtained from the leaves were found to possess

anti-inflammatory and immunomodulatory properties. Thus, it can be also concluded that immunomodulatory activity may be due to the presence of tannins in the *R. communis*.^[37]

Jivanti (*Leptadenia reticulata*)

Chemical constituents of *L. reticulata* (Jivanti) are α -amyrin, β -amyrin, stigmasterol, ferulic acid, β -sitosterol, luteolin, hentriacontanol, apigenin, tocopherol, saponin, flavonoids, lupanol-o-diglucoside. Medicinal uses. It is in used sexual disorders. Pharmacological activity. It is galactagogue and anti-bacterial. Mechanism. It exhibits immunostimulatory effects by enhancing antibody titer and phagocytosis.^[38] Its stem extract has tonic or antiaging property which is used as anti anaphylactic effect on mast cell degranulation.^[24]

Satavari (*Asparagus racemosus*)

A. racemosus (Satavari) Willd (family Liliaceae) is an important medicinal plant commonly known as *Shatavari*. Aqueous extract of *A. racemosus* acts as a potential antioxidant by decreasing lipid peroxidation and increasing glutathione content. It also acted as an immunomodulator as was ascertained by increased activity of macrophages and proliferation of lymphocytes. *A. racemosus* may be effective against free radical mediated diseases and exhibit immunomodulatory potential.^[39] Anti-stress, Anti-cancer The root extract of *A. racemosus* has anti-stress and anti-cancer property which stimulates RE system and PMN cells Prevents leucopenia induced by CP.^[24] It act as Antiseptic to Prevents leucopenia induced by CP and as immunostimulant to inhibits ochratoxin A induced suppression of IL-1, TNF and it has Antiageing and marcophage chemotaxis.^[25] A steroid sapogenin acid from the roots of *A. racemosus* is having potent immunomodulating property. Its immunomodulatory action is by significant increase of CD³⁺ and CD4/CD⁸⁺ %T cell activation and immunoadjuvant action is by significant up-regulation of Th1 (IL-2) and Th2 (IL-4) cytokines.^[26]

Kusha (*Desmostachys bipinnata*)

The hydroalcoholic extract of root has *in vivo* and *in vitro* H₂O₂ radical scavenging assay.^[36]

Kasa (*Saccharum spontaneum*)

The methanolic extract of root has thiocyanate, DPPH, NO radical scavenging, reduction potential.^[36]

Darbha (*Imperata cylindrica* [ICL])

The methanolic extract of root has hydrogen peroxide and reducing power capacity and has NO scavenging.^[36] The extracts from ICL also inhibited cell proliferation and induced

apoptosis in various human cancer cell lines. The ICL extract obtained from ICL can be developed into a potential anticancer therapeutic agent to manage/treat human oral cancers.^[40] Biochemical analysis of the roots of ICL indicated the presence of glycosides, alkaloids and flavonoids.^[41]

Ikshu (*Saccharum officinarum*)

S. officinarum chemical constituents: Carotene, thiamine, ascorbic acid, riboflavin, glucose, flavone C. Its Pharmacological activity - It is antimicrobial, anticancer, antidiarrheal, laxative, stomachic and antiinflammatory. Mechanism: Hikosaka *et al.* reported that polyphenol-rich fraction of sugar cane exhibits immunostimulating effects in chickens. Phenol-rich fraction of *S. officinarum* exhibits immune-stimulatory effect by enhancing the phagocytic activity of peripheral blood leukocytes.^[38]

Twak (*Cinnamomum zeylanicum*)

C. zeylanicum essential oil exhibits significant antioxidant activity and it has appreciable immunostimulatory activity. Cinnamom bark extract and its polyphenol content are reported to have potent anti-oxidant activities.^[41]

Ela (*Elatteria cardamomum*)

E. cardamomum, also known as “Queen of Spices” is a well known aromatic spice used in Eastern, Arab and Scandinavian cuisines. Cardamom is known to play a wide range of health promoting roles. Anti-inflammatory, antiproliferative, proapoptotic and antioxidative activities have been proposed as mechanisms underlying the anti-cancer properties of cardamom. Higher concentrations of extract of cardamom may impede macrophage pro-inflammatory responsiveness,^[37] oral administration of the aqueous extract of cardamom is accompanied by a significant reduction in cyclooxygenase-2 and inhibitory NO synthase expression in murine models of colon cancer.^[41]

Haridra (*Curcuma longa*)

C. longa is used as a general tonic, immunostimulant and blood purifier. It possesses anti-inflammatory activity and antioxidant activity. Anti-cancer properties of curcumin may be mediated, at least in part by inhibition of inducible form of NO synthase. It is also an anti-alzheimer’s agent. It also acts as HIV-1 and HIV-2 protease inhibitor, hepatoprotective, hypoglycemic and hypolipidemic agent.^[26] *C. longa* was found to provide significant protection against a CCl₄- induced increase in level of serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase and serum bilirubin.^[43] The rhizome of *C. longa* has antiseptic and anti-inflammatory tonic property which increases mitogenic response of lymphocytes and helps in rheumatoid arthritis and cancer.^[24]

Pippali (*Piper longum*)

The fruits of *P. longum* has tonic and anti-viral property which increases total WBC count, bone marrow cellularity and total antibody production.^[24] It has immunomodulatory and anti-inflammatory activities by suppressing the pro-inflammatory cytokines. It can also act as a bio-enhancer and anti-tumor agent.^[26] Pipemic acid of *P. longum* exhibits immunomodulation through suppression of proinflammatory cytokines.^[38]

Chandana (*Santalum album*)

Sandal wood oil effect was a dose-dependent effect and more pronounced against HSV-1. The plant extracts demonstrated direct dose dependant scavenging on NO and exhibited significant activity.^[44]

Mandukaparni (*Centella asiatica*)

Water extract of *C. asiatica* also increased the production of IL-2 and TNF- α in human PBMCs. IL-2 enhances the proliferation of activated T lymphocytes and activates B lymphocytes stimulating the proliferation and secretion of immunoglobulin. The water extract of *C. asiatica* exerted immunostimulating activity on mitogenstimulated proliferation of human PBMCs. *C. asiatica* has been used in the treatment of conditions such as inflammation, rheumatism, asthma and immune system deficiencies.^[45] The leaves extract of *C. asiatica* increases the phagocytic index and total WBC count.^[24] and inhibited human PBMC.^[27]

Sankhapushpi (*Convovulus pluricaulis*)

Ethanol extract of *C. pluricaulis* (Sankhapushpin) possesses significant antioxidant activity when tested *in vitro*. The assay was based on the capacity of the samples to inhibit blue formazan formation by scavenging the superoxide radicals generated in riboflavinlight-NBT system. This plant has been shown to have scientific potential for CNS depression for its anxiolytic, tranquillizing, antidepressant, antistress, neurodegenerative, anti-amnesic, antioxidant, hypolipidemic, immunomodulatory, analgesic, antifungal, antibacterial, antidiabetic, antiulcer, anticatatonc and cardiovascular activity. It is reported to contain several types of alkaloids, flavanoids and coumarins as active chemicals that bring about its biological effects.^[46]

Vacha (*Acorus calamus*)

A. calamus leaves, volatile oil, petroleum ether and alcoholic extracts has stimulated the neutrophils phagocytic activity. It is proved for anti-inflammatory, hepatoprotective, antibacterial, antiulcer and anti-oxidant. The immunostimulant activity may be due to the presence of flavonoids, tannins, carbohydrate and proteins present in alcoholic extract and volatile oil principle

present in volatile oil, and petroleum ether extract.^[47] Ethanol extract of *A. calamus* rhizome is having immunosuppressant action which inhibited proliferation of mitogen and antigen stimulated human peripheral blood mononuclear cells (PBMCs). It also inhibited production of NO, IL-2 and TNF- α .^[26]

Yashtimadhu (*Glycerrhiza glabra*)

Aqueous root extract of *G. glabra* (Yashtimadhu) has shown the immunomodulatory activity in cellular arm response (cellular immunity), phagocytic response and anaphylactic reaction. *G. glabra* in combination with zinc has shown potentiation of immunomodulatory activity in both humoral as well as cellular arms of the immune system, suggesting its therapeutics usefulness in immune compromised patients on long term basis.^[48]

The bark and root of *G. glabra* has anti-inflammatory, antibacterial, antiviral, Tonic property which stimulates immune cells by CD69 expression on CD4 and CD8 T cells and macrophage function.^[24] It has hepatoprotective property, modulatory effect on the complement system and inhibits replication of severe acute respiratory syndrome associated virus. Glycyrrhizic acid and its aglycone have actions like modulation of NF-Kb and IL-10 production which explains reduction of inflammation in liver.^[26]

Sugar (*S. officinarum*)

Significantly higher anti-SRBC antibody titers in experimental groups indicated the higher humoral response suggesting that both AE and EE had immunological properties to enhance the antibody production. This enhanced humoral response might be due to sugar cane factor.^[49]

A wide range of biological effects of sugar cane have been reported such as immunostimulatory, anti-thrombosis, anti-inflammatory, vaccine adjuvant, anti-oxidant, modulation of acetylcholine release and anti-stress activities.^[50]

Madhu (Honey)

Honey proteins inhibited the phagocytosis latex bead macrophages, the production of pro-inflammatory cytokines IL-1 β and TNF- α by human monocytic cell line in the presence of honey proteins was analyzed. Honey proteins did not affect the production of IL-1 β ; however, TNF- α production was significantly suppressed. Honey glycoproteins and glycopeptides significantly interfere with molecules of the innate immune system.^[51]

Ghrita (Clarified butter)

When ghee was fed at levels >2.5%, there was a significant decrease in the secretion of LTB₄, LTC₄, and LTD₄ by

peritoneal macrophages activated with calcium ionophore. Ghee contains conjugated linoleic acid which has been shown to reduce the formation of inflammatory mediators such as LT, prostaglandin and ILs.^[52]

FUTURE PERSPECTIVE

In most human diseases the oxidative stress is the secondary phenomena, for e.g., Activated neutrophils produce O_2^- , H_2O_2 and HOCl to kill phagogens. If a large number of phagocytes become activated in a localized area they can produce tissue damage. e.g., synovial fluid in sole and knee joints of Rheumatoid arthritis contain large number of activated neutrophils. Some human diseases may be caused by oxidative stress. e.g., excess radiation to biological system causes free radical damage to protein, DNA and lipids. Neurological disorders by dietary difference of tocopherol are mediative by oxidative stress. It also produces intracellular free Ca^{2+} damage to membrane ion transporters and other specific protein and peroxidation of lipids.

Hence, to protect from damage cells produce enzymes, or by intake of free radical scavenger substances to neutralized or detoxify the free radical are known as antioxidant. Thus, the imbalance between free radical and anti-oxidant resulting diseases. In biological systems two types of antioxidants are proved useful against pathogenesis. Endogenous antioxidant and exogenous antioxidant. Brahma Rasayana contain both endogenous and exogenous antioxidant. The immune system has connections with a number of other organs and can directly or indirectly influence the actions of these organs. The function of the immune system is to protect our bodies against foreign invaders. It is plays a pivotal role in the pathogenesis of immune deficient diseases, autoimmunity, and in allergy. In Ayurveda, immunity was described by Acharya Charaka in the form of Vyadhikshamatva. Ayurveda says pure treatment is that which cures the disease and which also provides physical, mental as well as social health. Rasayana are health promoting and rejuvenating agents which by their empirical effects produce resistance against disease both physically and mentally. Brahma Rasayana accelerated the recovery of the haemopoetic system by a rapid rise in total leukocytes. Both lymphocytes and neutrophils were significantly increased by Rasayana treatment.

CONCLUSION

Thus, here it is seen that the components found in Brahma Rasayana contain immunomodulatory properties. On the basis of this disease resistance property or immunomodulatory property is also found in Brahma Rasayana. It is an important Rasayana in itself. On the study of each substances, it is found that most of these substances have immunomodulatory properties. Which is beneficial for physical and mental health and at the same time it gives the ability to fight diseases.

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