REVIEW ARTICLE

An evidence-based ethnomedicinal study on *Oxalis corniculata:* Review of decade study

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Abstract

One of the most recent focal plant species in India is *Oxalis corniculata* Linn, often known as creeping woodsorrel and a member of the family Oxalidaceae. It is a native to tropical and subtropical areas of the globe and is significant in medicine. Several conventional medical practices have used the herb *O. corniculata* Linn. to cure human illnesses and afflictions. The review is designed to assess the publication based on the research review on *O. corniculata*. The literature for a decade from 2011 to 2021 was collected from scientific databases such as PubMed, PubMed Central, Scopus, Science Direct, and Google Scholar. A methodical search was performed using various keywords in order to get a deeper insight into the database. The review indicates that several phytochemical compounds, including flavonoids, tannins, phytosterols, phenol, glycosides, fatty acids, galacto-glycerolipids, and volatile oil, have been isolated from the plant. The leaves are rich in flavonoids, isovitexine, and vitexine-2"-O-beta-D-glucopyranoside. It is an abundant supply of important fatty acids such as palmitic acid, oleic acid, linoleic acid, linolenic acid, and stearic acid. The chemical structure of the identified compound given in the literature was sketched using the chem sketch freeware version, which would help the researchers to study the chemical nature of the compound in reference to identifying the lead molecule for further designing the semisynthetic derivatives with optimized activity. Also from the literature, it has been revealed that different parts of *O. corniculata* were assessed for pharmacological activities and found to possess antidiabetic activity, wound healing activity, antioxidants, anxiolytic properties, protective effect on induced nephrotoxicity, and antibacterial activity. The major focus of the review was to identify the folkloric uses of the plant that were reported in the published study. For a long time, traditional medicinal practitioners have used the plant to treat bad breath and is a rich source of Vitamin C for the treatment of Vitamin C deficiency for the treatment of stomach disorders in the area of the Cold Desert of Western Himalaya, Traditional healers from many locations reportedly used it to treat cataracts, sinusitis, conjunctivitis, and typhoid. The plant is utilized for athlete's foot, wounds, hypertension, diabetes, and hormonal imbalance; stomachache and migraine; excessive menstruation; cough; and poison antidote; as a blood tonic to be taken orally; intestinal gas; stomach discomfort; renal pain; kidney stone; and strengthening urinary tract wall; as a therapy for fractures and snakebites; as utilized to cure renal conditions; leaf paste to promote speedy healing; topically to cure worms and scorpion stings; and skin ailments; utilized to cure renal conditions; topically to cure worms; and scorpion stings; and skin ailments; therapeutic characteristics, such as astringent; and hemorrhoea.

Key words: Ethanomedicinal uses, evidence based review, folklore usage, *Oxalis corniculate*, phytochemical profile

INTRODUCTION

Natural resources have been used to make several modern medicines. In our ancient Ayurveda and medical literature by Unani, there is so much information and knowledge about herbal medicine. The Charaka Samhita is one of the ancient Indian medicinal treatises (1000 BC) that reports the use of more than 2 thousand herbs for medicinal purposes. [1] Studies of the chemical components of plants and pharmacology research can lead to the development of new active substances growing in the mycelium. The use of herbs in modern medicine is crucial

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as they have provided many life-saving medicines.[2] For several reasons, plants have been tested for biological activity with therapeutic potential in laboratories around the world. One of these is that medicinal herbs are believed to be safer and less harmful to the human body than synthetic drugs. Herbal medicines are used in traditional Indian medicine to treat various ailments. A major part of traditional medicine relies on the herbal system, as more than 80% of the world's population is mostly dependent on ethnopharmaceuticals for essential therapeutic needs, and a significant number of people rely on traditional medicine due to the scarcity and high cost of traditional medicine. Several unpleasant side effects have been reported.[3,4] In general, herbal medicines are considered safer than synthetic drugs. *O. corniculata* Linn, a member of the family Oxalidaceae, grows freely in human environments, on the sides of roads, parkland, and courtyards in practically all warmer sections of India, particularly in the Himalayas at an altitude of 2500 m. It is a common herbaceous plant that grows in wet and gloomy areas. It is a well-known plant in India, and its clinical features are well known worldwide. It includes phytonutrients that are needed for normal and healthy human health.[5,6] Other potential uses include anthelmintic, anti-inflammatory, astringent, antibacterial, diuretic, antipyretic, and stomach effects. Fever, colds, coughs, diarrhea, shock, urinary infections, and sprains are also treated with the herb. This plant includes beneficial plant chemicals such as beta-carotene, Vitamin C, and niacin. Leaf extract can help with gastrointestinal issues and jaundice.[7,8]

TAXONOMICAL CLASSIFICATION[9]

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Oxalidales
Family: Oxalidaceae
Genus: *Oxalis*
Species: *Corniculata*
Botanical Name: *Oxalis corniculata* Linn.

VERNACULAR NAMES[9]

Sanskrit: Ambashta, Amlapatrika, Amlika, Amlotaja, Cangeri
Hindi: Seh-patti, Tinpatiya, Anboti, Bhilmori, Khatari
English: Indian sorrel
Urdu: Khatt-i-buti
Assamese: Changeritenga, Sarutengesi
Bengali: Amrul-sak, Amrulshak, Amrul, Amrool
Kannada: Huli-huniche, Hulihunice,Teltuppi
Tamil: Palaikiri, Puliyarail
Telugu: Ambotikura, Pulichintha, Pallachintha
Marathi: Ambali, Chicha
Malayalam: Poliyarala, Puliyaral, Puliyarala,Pullampurachi
Marathi: Umbuti, Ambuti, Bhinsarpati, Ambatachukaa
Oriya: Sialthur, Siakthur, Ambo chingari
Arabic: Hememdab, Homadmad

DISTRIBUTION

Low-growing, fragile, and commonly found in humid and shady places, on roadsides, in plantations, meadows, and in many parts of India that are warmer, with a high concentration in the Himalayas at 8000 feet.[9] In addition to making its way across the eastern port cities of the United States, it also spread throughout Texas and Ontario. The weed is also found in Florida. Throughout the southeastern part of the country, this is a common sight. The northern end of Canada extends to the far south of Mexico. In addition to its native Old World range, Corniculata is an evergreen plant that grows in temperate and tropical regions of North, Central, and South America.[10]

MORPHOLOGY

Plant samples were collected and authenticated by a botanist in Bilaspur, Chhattisgarh, India for this study. 0.10.5 m in length, this is an herbaceous shrub or rooted shrub [Figure 1]. Branched from the base and usually serrated, the upper part is erect or weak, smooth or pubescent.

a) Body: The body is slender, curly and serrated, from 0.4 to 1.5 cm in length. Its length varies from 4.5 to 8.5 cm. Unpleasant smell, bitter taste when fresh.[11]
b) Leaves: Three-nodded, lamellar, cordate, opposite leaves; leaflets 0.5–1 cm long, lateral veins enlarged, plate smooth on the upper surface, slightly bent upward along main vein, with a few hairs hanging along veins on lower surface and along lower edge, folded leaves alternately along the body. A long stem grows from the axils of the leaves, which have up to three pedicels, and each pedicle has a flower.
c) Flowers: 711 mm wide, with 5 yellow petals.[11]
d) Fruit: The fruit is a capsule, 11.5 cm long, cylindrical, with a pointed apex and 5 ridges in cross section.[11]

Figure 1: *Oxalis corniculata* Linn. Plant

e) Seeds: Seeds are oval, with a rounded apex, generally pointed, flattened in cross section, light brown, with a serrated outer surface. *O. corniculata* will belarger.

Methodology

Various extracts of different parts of the plant were surveyed through the review of pharmacological investigations. The literature was collected from scientific databases like PubMed, PubMed Central, Scopus, and Science Direct. Furthermore, Google Scholar, which provides access to scientific databases, was used to search for literature and databases regarding the plant.[12-15] Reports from the last 10 years, from 2011 to 2021, were collected from these databases. Search terms included oxalis corniculate, pharmacological aspects, and chemical compositions. We use keyword search terms such as oxalis corniculate, pharmacological studies, extract and isolation of OC, ethnomedicine uses of OC, and ethnobotany uses of OC. Certain keywords can be made compulsory in search engines such as Google and Google Scholar by putting them between two double inverted commas. You can use the "+" symbol between keywords to get more specific and filtered results.

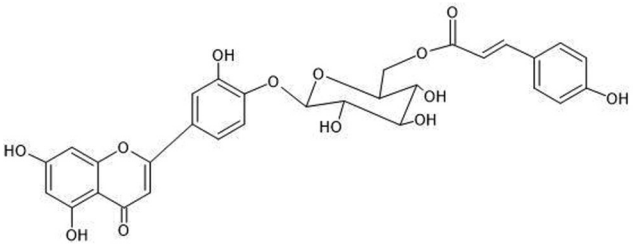
Phytochemical Profile

OC has a significant concentration of secondary metabolites. Water and alcohol were used in most of the studies to examine the plant's leaves, roots, and whole plant for its phytochemical profile. To purify the secondary metabolite, liquid-liquid fractionation was also required. People use plants as a food source in various parts of the world, and a study of the nutritional makeup of these diets showed a broad diversity. The plant can grow and develop in saline environments to a degree of 70–90%, indicating its potential. It contains a higher soluble salt and mineral content, which might be beneficial for therapeutic purposes. Each serving had 7.76 mg of gallic acid equivalents and 6.92 mg of rutin equivalents, respectively, in the total phenol content.[16-18]

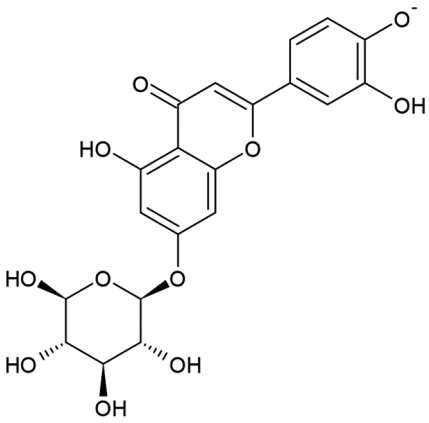
The water extracts included a high concentration of tannins, palmitic acid, and a mixture of oleic, linoleic, linolenic, and stearic acids, while the alcoholic extract contained carbohydrates, glycosides, phytosterols, phenolic compounds, amino acids, and stearic acid. The sample also included calcium, fiber, and tannin, according to the research. Proteins containing citrus acids and flavones, flavonoids, and volatile oils. In addition, calcium, fiber, and tannins have been identified. The leaves of this plant include flavones, flavanols, and phenolic acids such as syringic acid and p-hydroxybenzoic acid, as well as tartaric acid and citric acid. It also has 86.8% water, 0.8 g of fat, 8.2% carbohydrates, 150 mg of calcium, 78 mg of phosphorus, 8 mg of iron, and 6,050 µg of beta carotene. It also contains 7–12% oxalate, which can cause kidney stones.[10,19-22]

Some of the phytochemicals were isolated as pure compounds and identified for their chemical structure and properties.

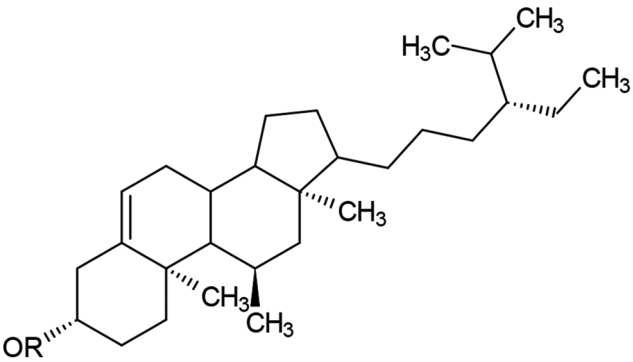
In addition to luteolin, luteolin-7-O—D-glucoside, and sitosterol-3-O—D-glucoside, corniculatin A, a novel flavonoid glucoside, was extracted from the section of the plant that was soluble in ethyl acetate. Corniculatin A was isolated from the ethyl acetate-soluble region of the complete plant.[23]



Corniculatin A

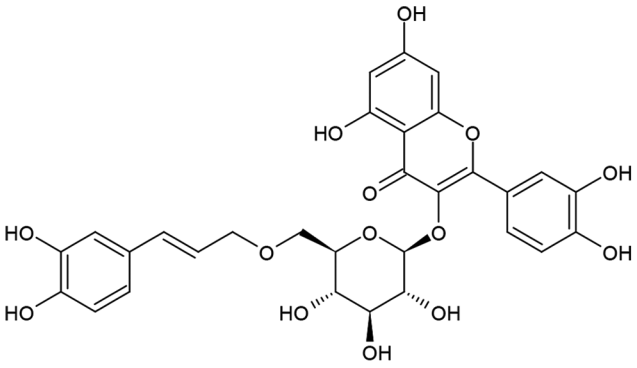


luteolin-7- O-β-D-glucoside

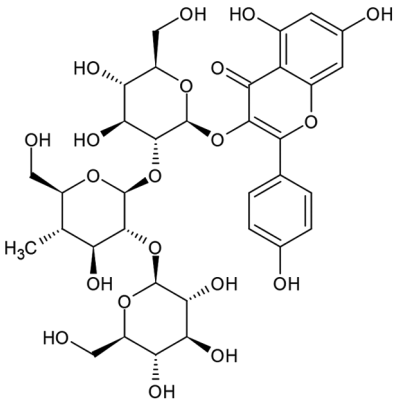


β-sitosterol-3-O-β-D-glucoside

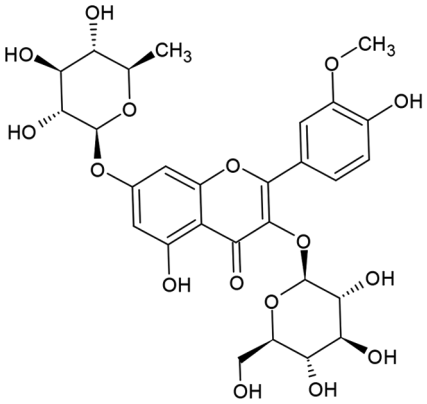
The existence of Kaempferol-3-sophorotrioside, quercetin-3-(caffeoyldiglucoside)-7-glucoside, isorhamnetin-3-caffeoyl-7-glucoside, and p-coumaric acid was reported by Zeb A and Imran M.[23]



quercetin-3-(caffeoyldiglucoside)-7-glucoside



Kaempferol-3-sophorotrioside

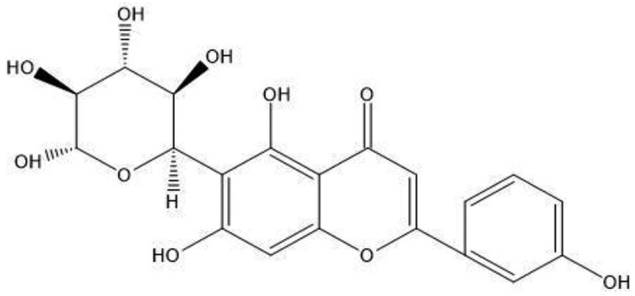


isorhamnetin-3-caffeoyl-7-glucoside

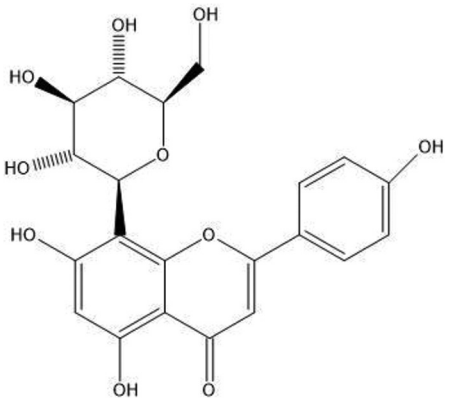
Khan *et al.* also reported the OCME was found to include flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, phlobatannins, and steroids, but no tannins. The estimated total phenolic content was 7.76 ± 0.36 mg gallic acid equivalents per gram of extract, whereas the total flavonoid content was 6.92 ± 0.52 mg rutin equivalents per gram of extract.[24]

With promising rich in mindral sources as it was found to be grow in salty areas extract of OC was found to contains the quantities of Zn, 18.03 µg/g; Fe, 161.71 µg/g; and Cu, 34.32 µg/g.[25]

Three C-glycosylflavones were found as 6-C-glucosylluteolin (isoorientin), 6-C-glucosylapigenin (isovitexin), and isovitexin 7-methyl ether in the leaves of *O. corniculata*.[26]



6- C-glucosylapigenin (Isovitexin)



8-β-D glucopyranosylapigenin (Vitexin)

Scientifically Reported Medicinal Uses

Antidiabetic activity

It is important to note that pancreatic amylase inhibitors for lowering hyperglycemia can be effectively used by manipulating starch metabolism. These fractions are proven to work by inhibiting HPA, reducing glucose levels postprandial.[27]

An evaluation of *O. corniculata*'s hypoglycemic potential was conducted in 2007 by comparing the aqueous and organic extracts. According to the study, the extract of the herb had an inhibitory effect of up to 89.27% at a dose of 100 mg/mL (IC = 50 of 68.08 ± 0.06). The result would be a hypoglycemic effect.[28]

A previous research on swine pancreatic-amylase explored the inhibitory activities of *O. corniculata*, *Basella alba*, and *Cocculus hirsutus*. A total of 15 extracts were evaluated for their ability to inhibit swine pancreatic -amylase using both aqueous and organic solvent extraction techniques. *O. corniculata*'s

aqueous extract was 89.87% effective (100 g/mL, IC_{50}-68.08 ± 0.06), *C. hirsutus*'s extract was 83.33% effective (60 g/mL, IC_{50}-70.48 18.39), and Pseudococcusurticae's extract was 79.10% effective (100 g/mL, IC_{50}-80).[29]

Wound Healing Activity

O. corniculata Linn leaves were used to study the effects of extracts of its entire plant containing alcoholic and petroleum ether fluids on wound healing. A 300- and 500-mg/kg oral dose of both extracts significantly increased wound contraction, wound breaking, and epithelization length. Compared to the control group, these two extracts made granuloma tissue much stronger and increased the amount of hydroxyl proline in the tissue by a large amount.

The increased wound healing strength of the extract-treated group may be a consequence of increased epithelialization, which is a result of collaboration. Dead space wounds can be used to study how healing impacts granulation and collagen production. Because cross-linking causes more collagen to be made, granulomas are often used to study both the quantity and quality of wound healing because of their ability to stretch.[30]

Antioxidants

In a study focusing on antioxidant characteristics, *O. corniculata* extracts and subfractions were evaluated for their antioxidant properties in methanol, chloroform, ethyl acetate, n-butanol, and water. Phytocol content was estimated at 21.0, 28.2, 34.5, 162.0, 70.0, and 49.2 in methanolic, hexane, chloroform, ethyl acetate, and n-butanol fractions, respectively; flavonoid content was 362.4, 214.1, 317.1, 177.1, 98.8, and 53.5 per mg of dried mass. According to the DPPH experiment, ethyl acetate had the highest free radical scavenging activity, with 24.0% at 1 mg/mL concentration. Chloroform had the second-highest free radical scavenging activity (21.5%). The EC50 and TEC50 values for methanolic extract were 3.63 mg/mL and 23 min, respectively. Ascorbic acid equivalents per mg of dried mass were measured by weight for these solvents with FRAP values of 288.0, 1705.3, 437.1, 72.0, 28.0, and 44.0 g, and phosphomolybdate antioxidant capacity was measured by weight with values of 50.0, 117.0, 78.6, 57.8, 3.4, and 8.3 g, respectively. When compared to regular butylated hydroxyanisole, all of the samples showed a big improvement in how well they stopped peroxidation.[31]

Anxiolytic Properties

The predictive validity of the raised plus maze is explained as the extent to which the dependent measure predicts behavior in a group. We found that rats with enhanced open arm activity also have a more central entry in a highly illuminated open field. In the raised plus maze, plasma corticosterone is higher when the arms are open, and this is strongly linked to risk-management behavior (i.e., stretch-attend postures).[32]

The anxiolytic effect of an alcoholic extract of *O. corniculata* was investigated in an elevated plus-maze model and an antifighting test. *O. corniculata* ethanolic extract (100 and 300 mg/kg) significantly increased the number of squares crossed (controls = 24.33 ± 3.48), but significantly decreased immobility (controls = 47.17 ± 4.29 s) and fecal pellets (controls = 13.50 ± 0.96 fecal pellets) in the open-field test; they significantly increased the number of entries (controls = 53.00 ± 2.67 s) and decreased both the number of entries (control it was also shown that *O. corniculata* extract (100 mg/kg) considerably reduced fighting episodes (controls = 9.50 ± 0.62) compared to the controls. In addition, the CNS activity of the extract was found to be dose-dependent. Phytochemicals such as glycosides, carbohydrates, tannins, phenolic compounds, phytosterols, flavonoids, amino acids, proteins, volatile oils, and phenolic compounds may have affected the study.[33]

Protective Effect on Induced Nephrotoxicity

By altering urine, creatinine, and uric acid levels, CCl4 causes nephrotoxicity. CCl4 treatment is likely to cause damage to the liver and kidneys with these pathological changes.[34]

It changes the antioxidant enzyme defense system in various tissues, causing oxidative stress. In the current study, *O. corniculata* methanol extract (OCME) was investigated for its chemical composition and protective role against CCl_4-induced nephrotoxicity in rats. OCME is a source of flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides, phlobatannins, and steroids, but tannins are absent. There were 7.76 mg of phenolic compounds per gram of extract and 6.92 mg of flavonoids per gram of extract (mg of rutin equivalents per gram of extract).

The results of a 7-day intraperitoneal administration of CCl_4 (1 mL/kg of body weight, 20% in olive oil) demonstrated nephrotoxicity, as evident by increases in urine specific gravity, red blood cells, white blood cells, creatinine, protein, urobilinogen, and nitrite concentrations. When CCl_4 was used, the levels of serum creatinine, urea, and blood urea nitrogen in kidney samples went up, while protein and creatinine were lost at a slower rate.

An increase in glutathione level was found, along with increased histopathological damage, lipid peroxidation, and protein content, as well as decreased antioxidant enzyme functions, such as catalase, peroxidase, superoxide dismutase, glutathione peroxidase, glutathione-S-transferase, glutathione reductase, and glutathione reductase.[24]

Antibacterial Activity

O. corniculata (EtOc, AqOc) and *Artemisia annua* (EtAa, AqAa) were investigated for their antibacterial effects against methicillin-resistant *Escherichia coli* (MRSA), as was the essential oil of

A. annua (EoAa). Microdilution and agar well diffusion were used to determine the MIC, MBC, and inhibition zone.

EoAa can substitute for 13 commonly prescribed antibiotics, including oxacillin, amoxicillin, ampicillin, amoxicillin-clavulanic acid, tetracycline, streptomycin, ciprofloxacin, ceftriaxone, cefazolin, cefuroxime, cefotaxime, ceftazidime, and cefixime. Terpenoids, catechin flavonoids, quercetin, and chlorogenic acid polyphenol were all found in EoAa, and both *O. corniculata* and *Oryza sativa* provided chlorogenic acid polyphenol. These compounds have the potential to replace antibiotics and preservatives in the battle against multidrug-resistant (MDR) *E. coli* since they are more effective at killing bacteria and can be consumed by the human body.[35]

O. corniculata, *Artemisia vulgaris*, *Cinnamomum tamala*, and *Ageratina adenophora* were tested for their antibacterial properties in methanolic extracts using the agar well diffusion technique. Findings indicated that most extracts exhibited antimicrobial activity. The zone of inhibition (ZOI) values for *E. coli* (17 mm), *Salmonella typhi* (13 mm), MDR *S. typhi* (16 mm), *Klebsiella pneumonia* (11 mm), and *Citrobacter koseri* (12 mm) were all greatest for the Leaves corniculata extract. Furthermore, the minimum inhibitory concentration (MIC) values for the microorganisms tested were greatest for *O. corniculata*. *A. vulgaris*, *C. tamala*, and *A. adenophora* all had potent methanolic extracts against *Staphylococcus aureus*. Furthermore, *A. adenophora* has been demonstrated to be antifungal against Rhizopus species. The procedures demonstrated the viability of using plant extracts as alternatives to antibiotics and as components of medications for the treatment of infectious disorders caused by the bacteria under investigation.[36]

Semisynthetic Formulation

The word "nanoparticle" refers to a nano-object whose outside dimensions are all measured in nanometers and whose longest dimension and shortest dimension do not change by much.[37]

In many facets of human life, the diagnosis, treatment, and prevention of sickness have all been profoundly revolutionized as a result of advancements in nanoscience and nanotechnology. The use of silver nanoparticles, often known as AgNPs, is one of the most important and fascinating uses of nanomaterials discovered in biological fields. Due to their unique properties, they were used in many different ways, including as antibacterial agents, in industrial, household, and healthcare products, in consumer products, medical device coatings, imaging devices, and beauty products, in the pharmaceutical and food industries, in diagnostic tests, in orthopedics and drug delivery, and as cytotoxic agents.[38]

There was photosynthesis of silver nanoparticles from an aqueous extract. Transmission electron microscopy and X-ray diffraction were used to examine the production of AgNPs. The antioxidant, antibacterial, cytotoxic, and apoptotic effects of phytosynthesis AgNPs on human colon cancer (HT29) and normal fibroblast cells were studied (L929). Based on the information collected, the nanoparticles made are round and have an average size of 30 nm.

In a radical-scavenging assay using DPPH and ABST radicals, AgNPs had the highest antioxidant activity compared to the aqueous extract. The MTT assay demonstrated that biologically generated AgNPs had a concentration-dependent effect on the viability of HT29 and L929 cells. Dot plots of Annexin-V/PI detection tests validated the induction of apoptosis. It was also found that the biosynthesized AgNPs killed both Gram-positive and Gram-negative bacteria very well.[17]

Ethanomedicinal Uses

O. corniculata is a plant given by several practitioners of traditional folk medicine for the treatment of a variety of diseases. In this research, a variety of ethanomedicinal applications in diverse countries are listed. According to a study conducted in Manoor Valley, Lesser Himalaya, Pakistan, 240 mL of fresh Oxalis corniculate leaves cooked in water for 2 h and consumed twice a day is recommended. The folk remedy is used for the treatment of bad breath and is a rich source of Vitamin C for the treatment of Vitamin C deficiency. The fidelity level of traditional healer practitioners in the research region is 74.19%.[39]

The fresh juice of the leaf is used for the treatment of stomach disorders in the area of the cold desert of the Western Himalayas. The same applications were also described in the literature for the nations of the United States of America, India, and Mexico. It was also said that the plant not only had significant therapeutic value but also had a rich profile of nutritional elements. This was one of the claims made about the plant.[25]

According to an ethnopharmacological study of the plants used by ethnic groups in Kavrepalanchok District, Central Nepal, *O. corniculata* is used for the treatment of joint discomfort and internal fever. The herb is combined with other indigenous plants to create a traditional dish. Traditional healers from many locations reportedly used it to treat cataracts, sinusitis, conjunctivitis, and typhoid, according to earlier literature.[40]

According to published sources, *O. corniculata* is used for its wound-healing capabilities among the plants used in rural Uganda for the treatment of cancer. Also, according to reports, the herb is used to cure skin and uterine cancer. According to other published worldwide research, the plant is used for athlete's foot, wounds, hypertension, diabetes, and hormonal imbalance, stomachaches and migraines, excessive menstruation, cough, and poison antidote, antifungal, and antioxidative activity.[41]

According to other research, traditional medicinal practitioners in the Sathyamangalam wildlife sanctuary, Tamil Nadu, India, suggest a cooked paste of the leaf and root of oxalis corniculat for the treatment of fever and as a blood tonic to be taken orally.[42]

In a separate investigation, the anticataract capabilities of *O. corniculata* leaf extract were reported for ethanomedicine.[43]

The residents of lower Kurram, Kurram agency, Pakistan, according to quantitative ethanobotanical research, employ *O. corniculata* for its many therapeutic characteristics, such as intestinal gas, stomach discomfort, renal pain, kidney stone, and strengthening of the urinary tract wall. The degree of fidelity for the plant's usage was determined to be 50%. The dried powder of the plant's roots is utilized for its anthelmintic effects.[44]

The Buyi people in eastern Yunnan have been reported to utilize crushed *O. corniculata* plant as a therapy for fractures and snakebites.[45]

According to reports, the Gujjars of the Churah subdivision of the Chamba region utilize the root of *O. corniculata* to alleviate dyspepsia. In this study, the different ways that *O. corniculata* has been used in the past to treat things such as piles, diarrhea, toothaches, coughs, scorpion stings, and skin problems were looked at.[46]

In the Koh-e-Safaid Range, Kurram, Pakistan, OC aerial bits are utilized to cure renal conditions.[47]

Traditional medicinal practitioners of Wayanad District, Kerala, use OC leaf paste on cuts, and injuries to promote speedy healing.[48]

Fresh leaf paste is used topically to cure worms and scorpion stings in the area of the lower Himalayas (Pakistan).[49]

According to separate research, non-institutionalized Siddha practitioners in the Tamil Nadu district of Tiruvallur employ OC for its many therapeutic characteristics, such as astringent, diarrhea, bleeding from the anus, and hemorrhoids. Also noted was the use of OC in the treatment of hypertension and sleeplessness.[50]

CONCLUSION

The plant was chosen based on its extensive usage as food and its traditional folkloric applications in and around Chhattisgarh, since it is an herbal state of India that preserves a wide range of plant cultures with medicinal potential. The plant was found to possess a range of secondary metabolites and an abundance of minerals. In this review, the chemical structures of discovered substances are listed. In addition, the article described the ethanomedicinal usage of various regions. This provides substantial scientific data for the phytochemical profile and medicinal usage of the plant. Planned study is recommended to produce phytosynthetic derivatives with enhanced therapeutic usefulness.

REFERENCES

1. Pan SY, Litscher G, Gao SH, Zhou SF, Yu ZL, Chen HQ, *et al*. Historical perspective of traditional indigenous medical practices: The current renaissance and conservation of herbal resources. Evid Based Complement Alternat Med 2014;2014:525340.
2. Ekor M. The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. Front Pharmacol 2014;4:177.
3. Wang X, Wu F, Sun H, Zhang A, Wei W. Identification of the absorbed constituents of schisandra lignans by serum pharmacochemistry of TCM. In: Serum Pharmacochemistry of Traditional Chinese Medicine. Netherlands: Elsevier Science; 2017. p. 337-50.
4. Anand U, Jacobo-Herrera N, Altemimi A, Lakhssassi N. A comprehensive review on medicinal plants as antimicrobial therapeutics: Potential avenues of biocompatible drug discovery. Metabolites 2019;9:258.
5. Tanaka JC, Silva CC, Oliveira AJ, Nakamura CV, Dias Filho BP. Antibacterial activity of indole alkaloids from *Aspidosperma ramiflorum*. Braz J Med Biol Res 2006;39:387-91.
6. Dev S. Ethnotherapeutics and modern drug development: The potential of Ayurveda. Curr Sci 1997;73:909-28.
7. Hussain K, Shahazad A, Zia-ul-Hussnain S. An ethnobotanical survey of important wild medicinal plants of Hattar district Haripur, Pakistan. Ethnobotanical Lealf 2008;12:29-35.
8. Kirtikar KR, Basu BD. Indian Medicinal Plants. Allahabad: Lalit Mohan Basu; 1918.
9. Badwaik H, Singh MK, Thakur D, Giri TK, Tripathi DK. The botany, chemistry, pharmacological and therapeutic application of *Oxalis corniculata* Linn-a review. Int J Phytomed 2011;3:1-8.
10. Srikanth M, Swetha T, Veeresh B. Phytochemistry and pharmacology of *Oxalis corniculata* Linn.: A review. Int J Pharm Sci Res 2012;3:4077.
11. Mary Z, Kumar KG, Pasupathy S, Bikshapathi T. Pharmacognostical studies on Changeri *Oxalis corniculata* linn. (*Oxalidaceae*). Anc Sci Life 2001;21:120-7.
12. Sharma A, Bachheti A, Sharma P, Bachheti RK, Husen A. Phytochemistry, pharmacological activities, nanoparticle fabrication, commercial products and waste utilization of *Carica papaya* L.: A comprehensive review. Curr Res Biotechnol 2020;2:145-60.
13. Pandey A, Negi PS. Traditional uses, phytochemistry and pharmacological properties of *Neolamarckia cadamba*: A review. J Ethnopharmacol 2016;181:118-35.
14. Brimson JM, Brimson S, Prasanth MI, Thitilertdecha P,

Malar DS, Tencomnao T. The effectiveness of *Bacopa monnieri* (Linn.) Wettst. As a nootropic, neuroprotective, or antidepressant supplement: Analysis of the available clinical data. Sci Rep 2021;11:596.
15. Sadeghi Z, Akaberi M, Valizadeh J. *Otostegia persica* (*Lamiaceae*): A review on its ethnopharmacology, phytochemistry, and pharmacology. Avicenna J Phytomed 2014;4:79-88.
16. Imran M, Irfan A, Ibrahim M, Assiri MA, Khalid N, Ullah S, *et al*. Carbonic anhydrase and cholinesterase inhibitory activities of isolated flavonoids from *Oxalis corniculata* L. and their first-principles investigations. Ind Crops Prod 2020;148:112285.
17. Karimzadeh K, Bakhshi N, Ramzanpoor M. Biogenic silver nanoparticles using *Oxalis corniculata* characterization and their clinical implications. J Drug Deliv Sci Technol 2019;54:101263.
18. Pandey BP, Pradhan SP, Adhikari K. LC-ESI-QTOF-MS for the Profiling of the Metabolites and *in vitro* enzymes inhibition activity of *Bryophyllum pinnatum* and *Oxalis corniculata* collected from Ramechhap district of Nepal. Chem Biodivers 2020;17:e2000155.
19. Aruna K, Rajeswari PD, Prabu K, Ramkumar M, Chidambaram R, Sankar SR. Quantitative phytochemical analysis of *Oxalis corniculata* L. (*Oxalidaceae*). World J Pharm Sci 2014;3:711-6.
20. Sharma RA, Kumari A. Phytochemistry, pharmacology and therapeutic application of *Oxalis corniculata* Linn.-a review. Int J Pharm Pharm Sci 2014;6:6-12.
21. Raghavendra MP, Satish S, Raveesha KA. Phytochemical analysis and antibacterial activity of *Oxalis corniculata*; A known medicinal plant. mySCience 2006;1:72-8.
22. Zeb A, Imran M. Carotenoids, pigments, phenolic composition and antioxidant activity of *Oxalis corniculata* leaves. Food Biosci 2019;32:100472.
23. Ibrahim M, Hussain I, Imran M, Hussain N, Hussain A, Hussain A, *et al*. Corniculatin A, a new flavonoidal glucoside from *Oxalis corniculata*. Rev Bras Farmacogn 2013;23:630-4.
24. Khan MR, Zehra H. Amelioration of CCl(4)-induced nephrotoxicity by *Oxalis corniculata* in rat. Exp Toxicol Pathol 2013;65:327-34.
25. Kumar M, Puri S, Pundir A, Bangar SP, Changan S, *et al*. Evaluation of nutritional, phytochemical, and mineral composition of selected medicinal plants for therapeutic uses from cold desert of Western Himalaya. Plants (Basel) 2021;10:1429.
26. Mizokami H, Tomita-Yokotani K, Yoshitama K. Flavonoids in the leaves of *Oxalis corniculata* and sequestration of the flavonoids in the wing scales of the pale grass blue butterfly, *Pseudozizeeria maha*. J Plant Res 2008;121:133-6.
27. Ponnusamy S, Ravindran R, Zinjarde S, Bhargava S, Kumar AR. Evaluation of traditional Indian antidiabetic medicinal plants for human pancreatic amylase inhibitory effect *in vitro*. Evid Based Complement Alternat Med 2011;2011:515647.
28. Sharangouda K, Patil SB. Anti-implantation and abortifacient activities of *Oxalis corniculata* in albino rats. Niger J Nat Prod Med 2007;11:58-60.
29. Jyothi KS, Hemalatha P, Challa S. Evaluation of α-amylase inhibitory potential of three medicinally important traditional wild food plants of India. Int J Green Pharm 2011;5:95.
30. Taranalli AD, Tipare SV, Kumar S, Torgal SS. Wound healing activity of *Oxalis corniculata* whole plant extract in rats. Indian J Pharm Sci 2004;66:444.
31. Altemimi A, Lakhssassi N, Baharlouei A, Watson DG, Lightfoot DA. Phytochemicals: Extraction, isolation, and identification of bioactive compounds from plant extracts. Plants (Basel) 2017;6:42.
32. Walf AA, Frye CA. The use of the elevated plus maze as an assay of anxiety-related behavior in rodents. Nat Protoc 2007;2:322-8.
33. Gupta G, Kazmi I, Afzal M, Rahman M, Anwar F. Anxiolytic effect of *Oxalis corniculata* (*Oxalidaceae*) in mice. Asian Pac J Trop Dis 2012;2:S837-40.
34. Makni M, Chtourou Y, Garoui EM, Boudawara T, Fetoui H. Carbon tetrachloride-induced nephrotoxicity and DNA damage in rats: Protective role of vanillin. Hum Exp Toxicol 2012;31:844-52.
35. Golbarg H, Mehdipour Moghaddam MJ. Antibacterial potency of medicinal plants including *Artemisia annua* and *Oxalis corniculata* against multi-drug resistance *E. coil*. Biomed Res Int 2021;2021:9981915.
36. Manandhar S, Luitel S, Dahal RK. *In vitro* antimicrobial activity of some medicinal plants against human pathogenic bacteria. J Trop Med 2019;2019:1895340.
37. Zhang XF, Liu ZG, Shen W, Gurunathan S. Silver nanoparticles: Synthesis, characterization, properties, applications, and therapeutic approaches. Int J Mol Sci 2016;17:1534.
38. Calderón-Jiménez B, Johnson ME, Montoro Bustos AR, Murphy KE, Winchester MR, Vega Baudrit JR. Silver nanoparticles: Technological advances, societal impacts, and metrological challenges. Front Chem 2017;5:6.
39. Rahman IU, Afzal A, Iqbal Z, Hart R, Abd Allah EF, Hashem A, *et al*. Herbal teas and drinks: Folk medicine of the Manoor Valley, Lesser Himalaya, Pakistan. Plants (Basel) 2019;8:581.
40. Ambu G, Chaudhary RP, Mariotti M, Cornara L. Traditional uses of medicinal plants by ethnic people in the Kavrepalanchok District, Central Nepal. Plants (Basel) 2020;9:759.
41. Omara T, Kiprop AK, Ramkat RC, Cherutoi J, Kagoya S, Nyangena DM, *et al*. Medicinal plants used in traditional management of cancer in Uganda: A review of ethnobotanical surveys, phytochemistry, and anticancer studies. Evid Based Complement Alternat Med 2020;2020:3529081.
42. Chinnasamy P, Arumugam R, Ariyan S. *In silico* validation of the indigenous knowledge of the herbal medicines among tribal communities in Sathyamangalam wildlife sanctuary, India. J Tradit Complement Med

2019;9:143-55.
43. Tewari D, Samoilă O, Gocan D, Mocan A, Moldovan C, Devkota HP, *et al*. Medicinal plants and natural products used in cataract management. Front Pharmacol 2019;10:466.
44. Hussain W, Ullah M, Dastagir G, Badshah L. Quantitative ethnobotanical appraisal of medicinal plants used by inhabitants of lower Kurram, Kurram agency, Pakistan. Avicenna J Phytomed 2018;8:313-29.
45. Xiong Y, Sui X, Ahmed S, Wang Z, Long C. Ethnobotany and diversity of medicinal plants used by the Buyi in eastern Yunnan, China. Plant Divers 2020;42:401-14.
46. Rana D, Bhatt A, Lal B. Ethnobotanical knowledge among the semi-pastoral Gujjar tribe in the high altitude (Adhwari's) of Churah subdivision, district Chamba, Western Himalaya. J Ethnobiol Ethnomed 2019;15:10.
47. Hussain W, Badshah L, Ullah M, Ali M, Ali A, Hussain F. Quantitative study of medicinal plants used by the communities residing in Koh-e-Safaid Range, northern Pakistani-Afghan borders. J Ethnobiol Ethnomed 2018;14:30.
48. Thomas B, Arumugam R, Veerasamy A, Ramamoorthy S. Ethnomedicinal plants used for the treatment of cuts and wounds by Kuruma tribes, Wayanadu districts of Kerala, India. Asian Pac J Trop Biomed 2014;4:S488-91.
49. Abbasi AM, Khan MA, Shah MH, Shah MM, Pervez A, Ahmad M. Ethnobotanical appraisal and cultural values of medicinally important wild edible vegetables of Lesser Himalayas-Pakistan. J Ethnobiol Ethnomed 2013;9:66.
50. Esakkimuthu S, Sylvester Darvin S, Mutheeswaran S, Gabriel Paulraj M, Pandikumar P, Ignacimuthu S, *et al*. A study on food-medicine continuum among the non-institutionally trained siddha practitioners of Tiruvallur district, Tamil Nadu, India. J Ethnobiol Ethnomed 2018;14:45.

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