

Review

The Botany, Chemistry, Pharmacological and Therapeutic Application of *Oxalis Corniculata* Linn– A Review

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Abstract

Oxalis corniculata Linn. is an endangered and medicinally important plant indigenous to tropical and subtropical regions of the world. Its medicinal usage is reported in Indian pharmaceutical codex, the Chinese, British and the American pharmacopoeias and in different traditional system of medicines such as Ayurveda, Unani and Siddha. The review reveals that wide ranges of phytochemical constituents have been isolated from the plant like flavanoids, tannins, phytosterols, phenol, glycosides, fatty acids, galactoglycerolipid and volatile oil. The leaves contain flavonoids, iso vitexine and vitexine-2''- O- beta – D- glucopyrunoside. It is rich source of essential fatty acids like palmitic acid, oleic, linoleic, linolenic and stearic acids and it possesses important activities like Antioxidant, Anticancer, anthelmintic, Anti-inflammatory, Analgesic, Steroidogenic, Antimicrobial, Antiamoebic, Antifungal, Astringent, Depurative, Diuretic, Emmenagogue, Febrifuge, Cardio relaxan, stomachic and Styptic have also been reported. These reports are very encouraging and indicate that herb should be studied more expensively for its therapeutic benefits.

This article briefly reviews the botany, pharmacology, biochemistry and therapeutic application of the plant. This is an attempt to compile and document information on different aspects of *Oxalis corniculata* and highlight the need for research and development.

Keywords: *Oxalis corniculata*, Galacto-glycerolipid, Pharmacological activities, Antioxidant, Anticancer.

Introduction

Many infectious diseases are known to be treated with herbal remedies throughout the history of mankind. Herbs are widely exploited in the traditional medicine and their curative potentials are well documented [1]. In many developing countries traditional medicine is one of the primary health care systems [2, 3]. India is a varietal emporium of medicinal plants and is one of the richest countries in the world in regard to genetic resources of medicinal plants. The agro-climatic are favourable for

introducing new exotic plant. In India, Herbal medicines have been the basis of treatment and cure for various diseases [4]. About 1500 plants are systematically used in indigenous system of medicine, like Ayurveda, Unani and Siddha. However, the ethno pharmacologists, botanists, microbiologists and natural-product chemists world over today are constantly in search of medicinal efficacy of plants and their photochemical [5]. *Oxalis corniculata* Linn. Commonly known as creeping wood sorrel, is

one of the most recent focus plant in India. This article briefly reviews the botany, photochemistry, pharmacology, biochemistry, traditional knowledge and therapeutic application of the plant. This is an attempt to compile and document information on different aspects of *Oxalis corniculata* and highlight the need for research and development.

***Oxalis corniculata* Linn. : the Plant.**

Oxalis corniculata Linn. is a sub-tropical plant being native of India, are commonly known as creeping wood sorrel [6]. It is a somewhat delicate-appearing, low-growing, herbaceous plant abundantly distributed in damp shady places, roadsides, plantations, lawns, nearly all regions throughout the warmer parts of India, especially in the Himalayas up to 8,000 ft-cosmopolitan [7,8].



Fig.1: Image of *Oxalis corniculata* Linn.

Botanical Classification:

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Order	:	Oxalidales
Family	:	Oxalidaceae
Genus	:	Oxalis
Species	:	<i>O. corniculata</i>

Synonyms:

Sanskrit	Ambashta, Amlalonika, Amlapatrika, Amlika, Amlotaja, Cangeri, Carngeri, Changeri, Chukrika, Chukrita, Shuklika
Hindi	Amili, Amrul, Amrulsak, Anboti, Chalmori, Chukatripati, Cukatripati, Seh, Seh-patti, Tinpatiya, Anboti; seh-patti, Chuka tripati, Bhilmori, Khatari, Malori, Khataro, Khataria, Khatri-buti
English	Indian sorrel
Urdu	Khatt-i-buti
Assamese	Changeritenga, Saru tengesi
Bengali	Amrul-sak, Amrul shak, Amrul, Tandichatom arak, Amrool Huli-hunice, Hulihunice, Pullampurachi-sappu, Pullampurachisappu,
Kannada	Teltuppi, Changeri gida, Hulichikka, Julihunise gida, Moorele huli
Malyalam	Poliyarala, Puliyaral, Puliyarala, Puliyarila, Pullampurachi
Marathi	Umbuti, Ambuti, Bhinsarpati, Aambotee, Ambata chukaa
Oriya	Sialthur, Siakthur, Ambo chingari
Arabic	Hememdab, Hemda, Homadmad
Tamil	Paliakiri, Puliyarai, Atacani, Puli-kirai, Puliiyarai, Puliakire, Pooliaray, Puliyaarai, Puliyarani, Puli-yarai
Telgu	Ambotikura, Anboti-kura, Anbotikura, Pallachinta, Puli-chintaku

Description

a) Macroscopy:

Root: Dark brownish, thin, about 1-2 mm thick, branched, rough, soft; no odour and taste.

Stem: Creeping, brownish-red, soft, very thin, easily breakable; no odour and taste.

Leaf: Palmately compound, trifoliate; petiole-green, thin, about 3-9 cm long, cylindrical, pubescent; leaflet-green, 1-2 cm long, obcordate, glabrous, sessile or sub sessile; taste, somewhat sour.

Flower: Yellow, axillary, sub-umbellate.

Fruit: Capsules cylindrical, tomentose.

Seed: Tiny, dark brown, numerous, broadly ovoid transversely striate.

b) Microscopy:

Root: Shows 3-4 layers of cork, composed of thin-walled rectangular cells, brownish in appearance; cortex, a wide zone, consisting of rectangular and oval, thin-walled parenchymatous cells filled with simple starch grains, yellowish pigment and tannin; inner cortical cells rectangular and polygonal, smaller in size than miter ones; cortex followed by thin strips of phloem consisting of sieve tubes, companion cells and phloem parenchyma, cambium not distinct; xylem consists of vessels, tracheids, fibres and xylem parenchyma; vessels cylindrical, pitted some with tail-like projection at one end; tracheids pitted with pointed ends; a few starch grains simple, round to oval measuring 3-11 μ in diameter, present scattered throughout the region.

Stem: Shows single layered epidermis, composed of rectangular to oval cells, some of which are elongated to become unicellular covering trichomes; cortex consists of 4-5 layers of thin-walled, circular and polyhedral parenchymatous cells; endodermis single layered of thin-walled rectangular cells; pericycle composed of two or three layers of squarish and polygonal sclerenchymatous cells; vascular bundles 6-7 in number, arranged in a ring, composed of a few elements of phloem towards outer side and xylem towards inner side; xylem composed of pitted vessels, tracheids, fibres and xylem parenchyma; central region occupied by pith composed of thin-walled, parenchymatous cells, a few simple, round to oval starch grains measuring 3-11 μ in diameter, scattered throughout the region.

Leaf:

Petiole: Shows rounded or plano-convex outline consisting of single layered epidermis of rectangular or circular, thin-walled cells; cortex 3-4 layers of thin-walled, circular, oval or polygonal parenchymatous cells, generally filled with green pigment; endodermis single layered followed by 2-3 layers of

sclerenchymatous pericycle, less developed towards upper side of petiole; vascular bundles 5 in number, arranged in a ring, consisting of phloem towards outer side and xylem towards inner side; centre occupied by a small pith; a few simple, round to oval starch grains, measuring 3-11 μ in diameter, scattered throughout.

Lamina: Shows single layered epidermis on upper and lower surfaces, composed of rectangular cells; covering trichomes unicellular; palisade single layered composed of thin-walled, columnar cells, filled with green pigment; below palisade 2-3 layers of thin walled, spongy parenchyma consisting of circular to oval cells filled with green pigment; stomata paracytic [9,10,11].

Chemical constituents:

Photochemical investigation of plant *Oxalis corniculata* Linn. have revealed the presence of flavanoids, tannins, phytosterol, phenol, glycosides, fatty acids and volatile oil. The leaves contain flavonoids, iso vitexine and vitexine-2''- O- beta – D- glucopyrunoside. It is rich source of essential fatty acids like palmitic acid,oleic, linoleic, linolenic and stearic acids. They are good source of vitamin C (125 mg/100g), carotene (3.6 mg/100g), but contain a high content of oxalates (12% of dry material). The leaves and stem contain tartaric and citric acid; stem contains malic acid [12, 13, 14].

Methanolic and ethanolic extracts of this plant show the presence of carbohydrate, glycosides, phytosterols, phenolic compounds, flavanoids, proteins (12.5%), amino acids and volatile oil [15]. Leaves contain carbohydrate (1.36 \pm 0.3%), fatty acids(13.2 \pm 0.7%:. Palmitic acid 1.8%, mixture of oleic, linoleic and lenolenic acid 3.8%), protein (12.5 \pm 0.5%), fiber (6.2 \pm 0.3%), tannin (0.62 \pm 0.3%), moisture (92.3 \pm 2.8%) [16]. Whole plant extract suspected to contains phytoestrogens [17]. *Oxalis corniculata*

identified several compounds that were characterized by nuclear magnetic resonance, infrared, and mass spectrometry as (i) Oc-1, a mixture of saturated fatty acids C₂₄ to C₂₈; (ii) Oc-2, a mixture of long-chain alcohols C₁₈ to C₂₈; and (iii) Oc-3, a single compound that was a galacto-glycerolipid [18].

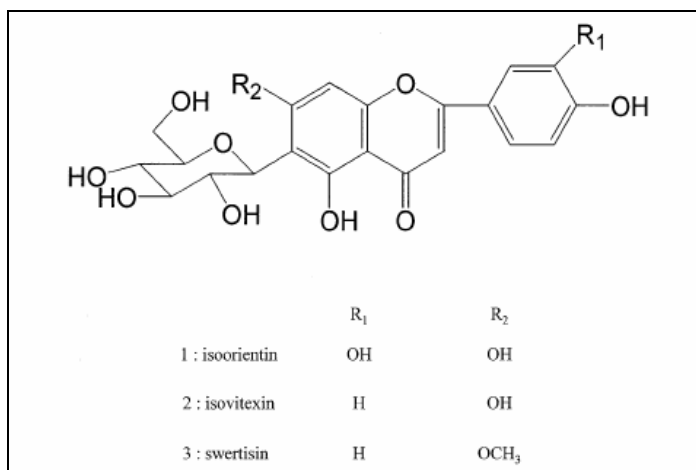


Fig. 2: The structures of flavonoids [1:luteolin 6 -C-glucoside (isoorientin), 2 :apigenin 6 -C- glucoside (isovitexin), 3: isovitexin 7- methylether (swertisin)] isolated from the shoots of *O. corniculata*[19].

Nutritional value of *O. corniculata*:

The leaves have been found to be rich in moisture, total carbohydrate, crude protein, crude lipid hence it can be alternative vegetable during emergency. The leaves of *Oxalis corniculata* exhibit rich in mineral contents like Sodium (1.12+0.02%), Potassium (2.17+0.31%), Calcium (2.51+0.08%), Nitrogen (3.56+0.70%) and Magnesium (0.25+0.03%), these mineral components are vital in regulating various metabolic pathways in human body [20].

Ethnomedicinal / Tradinal Uses:

Traditionally *O. corniculata* Linn. are having several medicinal uses. In **Ayurvedic** medicine, it is used for liver and digestive problems. In **Nepal**, it is used for stomachaches; the leaves for ritual source. In **Zairean** pharmacopoeia, it is used as antivenom: (1) paste of whole plant of *O. corniculata* rubbed on the wound; swallow

the juice of the masticated plant (2) make paste with a salted mixture of *O. corniculata* and *Aframomum sanguineum*, and cover the bite [21]. The plant is well known for its medicinal value as a good appetizer and as a remover of Kapa, vata, anaemia, dyspepsia, cancer, dementia, convulsion and piles [22, 23].

Plant boiled with butter milk is a home reedy for indigestion and diarrhoea in children. The leaf paste is applied over forehead to cure headache [14]. The juice of the plant is given to relieve the intoxication produced by *Datura* [24, 25]. Leaves are well masticated and the juice is kept in mouth for some time to get relief from aphthae. The extract of the plant is applied in case of scorpion sting; fresh leaves of *Oxalis corniculata* are crushed and are used to stop bleeding from wounds [26].

The leaves are effective in certain skin disease like warts, corns and other excrescences of the skin. They can be locally applied in these conditions. The juice of whole plant mixed with onion is also applied to remove warts. A poultice of the leaves applied over an inflammation relieves pain, and when applied over boils, ripens them. The juice mixed with black pepper and ghee, gives relief from red spot and eruptions on the skin caused by biliousness.

The juice of the leaves mixed with castor oil is a useful remedy in insomnia. The juice should mix in an equal quantity of castor oil and heated to remove the watery content. It should then be cooled and stored in bottle. When the scalp is massaged with this oil before going to bed, it will induce good sleep and also provides coolness to the eyes. Indian sorrel is beneficial in the treatment of jaundice. A table spoon of fresh juice mixed with buttermilk made of cow's milk can be taken once daily in the treatment of jaundice [27].

Pharmacological activities:

Oxalis Corniculata plant is anthelmintic, anti-inflammatory, analgesic, astringent, depurative, diuretic, emmenagogue, febrifuge, relaxant, lithontripic, stomachic and styptic. It is used in the treatment of influenza, fever, urinary tract infections, enteritis, diarrhoea, traumatic injuries, sprains and poisonous snake bites. An infusion can be used as a wash to rid children of hookworms. The plant is used as an antiscorbutic in the treatment of scurvy. The leaves are used as an antidote to poisoning by the seeds of *Datura*, arsenic and mercury. The leaf juice is applied to insect bites, burns and skin eruptions. It has an antibacterial activity. An infusion of leaves is used to remove opacities of the cornea and is dropped into the eyes for itching lids. A decoction of leaves is used as a gargle.

Wound-healing activity:

The alcoholic and petroleum ether extract of whole plant of *Oxalis corniculata* has been evaluated for its wound healing activity by using excision, resutured incision and dead space wound models in rats. Both the extracts at the dose of 300 and 500 mg per kg. The result showed significant wound healing activity by producing an increase in wound contraction rate, wound breaking and significant decreases in epithelization period [28].

Cardio relaxant activity:

A methanol extract of *Oxalis corniculata* showed relaxant activity on isolated rabbit ileum resulted by dose-dependant study. The plant extract was also showed cardio relaxant activity on isolated rabbit heart. In anaesthetized rats, a fall in diastolic pressure, with a lesser fall in systolic pressure, was also observed [29].

Nematocidal activity:

The ethanolic extract of *Oxalis corniculata* plant having nematotoxic activity against phytoparasitic nematodes [30,31]. In another research has revealed ethanolic extract of *Oxalis corniculata* having the same activity detected on

Meloidogyne incognita. After 7 days of incubation period the immobility of the nematode was observed under the light microscope and that conform the nematocidal activity of this plant [32].

Anti cancer activity:

Ethanolic extract of *Oxalis corniculata* Linn. Evaluated for its anticancer activity in Ehrlich ascites carcinoma (EAC) induced in swiss albino mice. Results conclude that the ethanolic extract of *Oxalis corniculata* Linn. Was effective in inhibiting the tumor growth in ascitic and solid tumor models [12].

Antimicrobial activity:

Methanolic and ethanolic extracts of *Oxalis corniculata* plant showed significant antibacterial activity against *Xanthomonas* and fourteen human pathogenic bacteria. Interestingly, among the extracts, Methanol extract showed highly significant activity as compared to K-cycline and Bact-805 against plant pathogenic bacteria. In case of human pathogenic bacteria methanol extract showed moderately significant antibacterial activity when compared with standard streptomycin [15].

In vitro antibacterial activity assay of few medicinal plants has carried out against 14 important human pathogenic bacteria employing cup diffusion method. MIC was determined for aqueous extracts of the plants that recorded antibacterial activity. It was indicated that only twelve plants (26%) exhibited antibacterial activity against test pathogens and the spectrum of activity was varied among the pathogens. The inhibitory activity was highly significant in the aqueous extracts of *Acacia nilotica*, *Oxalis corniculata* and *Lawsonia inermis*. Most of the plant extracts showed significant antibacterial activity than bacitracin. MIC of aqueous extract of twelve plants varied between 4-50 μ l [33].

The study was conducted on various biochemical parameters and also to investigate

antibacterial potentiality of some traditional medicinal plants of North East India viz. *Leucas aspera*, *Murraya koengigii*, *Oxalis corniculata*, *Alternanthera sessilis*, *Pagostemon benghalensis*, *Hydrocotyl rotundifolia*, *Cyathula prostrata*, *Piper peepuloides*, *Potentilla mooniana*. It was observed that aqueous extracts of all the above plants showed more or less antibacterial activity against *E. coli* by measuring the zone of inhibition. But the highest zone of showed by *Oxalis corniculata* aqueous extract (60 mm) [34]. The aqueous extract of *Oxalis corniculata* at 50 μ L concentration showed highly significant antibacterial activity against *S. flexneri* among 48 plants extract belonging to 33 different families[35].

Antifungal activity:

The aqueous extract of four various plants were evaluated for antifungal activity against various pathogens. All the four plants showed different activities against all the pathogenic fungi. Among them *Oxalis corniculata* showed the significant antifungal activity against *A. niger* by suppressed the fungal mycelial growth by 71 to 86% after three days of incubation [36]. The aqueous extract of *Oxalis corniculata* showed the 31 % antifungal potency against *A. niger* and 10.7% against *P. theae* [37].

Antiamoebic activity:

Oxalis corniculata identified several compounds that showed antiamoebic activity in axenic cultures of *E. histolytica*. These were characterized by nuclear magnetic resonance, infrared, and mass spectrometry as (i) Oc-1, a mixture of saturated fatty acids C₂₄ to C₂₈; (ii) Oc-2, a mixture of long-chain alcohols C₁₈ to C₂₈; and (iii) Oc-3, a single compound that was a galacto-glycerolipid (GGL). Of the different compounds that were obtained, the strongest antiamoebic activity was found in GGL [18].

Antiimplantation and Abortifacient:

Petroleum ether and ethanol extracts of the whole plant of *Oxalis corniculata* were

administered orally at the dose level of 100 and 200 mg/kg body weight from day 1 to 7 of pregnancy. The result showed significant antiimplantation activity after laprotomise antiimplantation d on day 10. Further pregnant rats that received the treatment from day 8 to 14 of pregnancy, showed significant abortifacient activity [38].

Allelopathic activity:

The allelopathic activity of the exudate of dry leaf from 53 plant species including *Oxalis* plant were assayed by the "Sandwich Method" (S W Method) using lettuce (*Lactuca sativa* L. var. Great Lakes 366) as a receptor plant. A wide interspecific variation in the allelopathic activity was recognized and result revealed *Oxalis corniculata* L. and *Begonia* spp. inhibited the elongation of the lettuce radicle and hypocotyl at less than about 10% of the control. Finally they also conclude that the chemical forms of oxalates and other unknown inhibitory substances might also be involved in the allelopathic activity of these oxalate-rich plants [39].

Antioxidant activity:

The study revealed that ethanolic extract of *Oxalis corniculata* at different doses level showed significant antioxidant activity mice [12]. Methanolic extract of *oxalis corniculata* showed potent antioxidant activity compare to reference standard ascorbic acid. The concentration of plant extract required for 50% inhibition of DPPH radical scavenging effect (IC₅₀) were recorded as 30 mg/ml and 37 mg/ml for MEOC and standard ascorbic acid. These results suggest that the MEOC possess antioxidant activity compared to ascorbic acid [40].

Steroidogenic activity:

The study proved that the *oxalis corniculata* has steroidogenic activity and this natural chemical can be safely used as it does not alters the functioning of organs which is proved by its action on one of the endocrine organ-adrenal

gland, which functions normally in the extract treated female albino rats[41].

Conclusion:

This article briefly reviews the botany, photochemistry, biochemistry, tradinal knowledge, pharmacological and therapeutic application of the plant *Oxalis corniculata* Linn. This is an attempt to compile and document information on different aspects of *Oxalis corniculata* and highlight the need for research and development.

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