ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 15, Issue 8, 2022

Online - 2455-3891
Print - 0974-2441

Review Article

A SYSTEMATIC REVIEW ON *OXALIS CORNICULATA* LINN. A CROP FIELD WEED WITH PROMISING PHARMACOLOGICAL ACTIVITIES

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Received: 23 April 2022, Revised and Accepted: 04 June 2022

ABSTRACT

Various ailments were known to being treated and cured by several herbs either as a main ingredient or being associated with different medical systems. One such clinically significant and endangered crop field weed is *Oxalis corniculata* Linn. which is generally found in subtropical and tropical regions across the globe. The medicinal significance of this weed is well evidenced in medicinal scriptures such as Ayurveda, Siddha, Unani, and compendiums of India, China, Britain, and America. The present review highlights on some of the crucial phytoconstituents such as flavonoids, tannins, glycosides, and fatty acids isolated from the said plant and their medicinal applications for treating conditions such as inflammation, anxiety, cancer, and diabetes. Further, the review stresses the future scope for therapeutic applications of these specific phytoconstituents of *O. corniculata* and the need for its research and development.

Keywords: *Oxalis corniculata*, Methoxy-flavones, Pharmacological activities, Antinociceptive, Antidiabetic.

 DOI: http://dx.doi.org/10.22159/ajpcr.2022v15i8.45017. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

In the history of humankind, several diseases, both infectious and non-infectious, have been effectively treated using herbal medicinal products. It is well documented that most herbs with curing capabilities were widely used in traditional medicines [1-4]. Countries with the lower economic growth and under developmental phase primarily rely on herbal medicines for managing health-care systems [5-7] India is a country with rich resources of medicinal herbs and plants with vivid medicinal uses in treating a variety of diseases [8-10]. Almost 1500 different plants have been reviewed scientifically and found in Ayurveda, Unani, and Siddha. However, researchers are searching for more phytochemical constituents and medicinal efficacy of such plants [11,12]. Creeping wood sorrel (*Oxalis corniculata* Linn.) is one plant that has recently gained more focus in India. As the plants have been considered to be the rich source of medicines followed by animals and marine sources, therefore, the search for the bioactive molecule is an exhaustive one. These bioactive molecules were generally the byproducts of the defense mechanism evolved by the plants, and these were explored till now to a very small part that of existed medicinal value. Therefore, the authors have tried their best to present the existing knowledge base of this plant and its therapeutic applications while simultaneously emphasizing the need for more research and development on its multiple aspects for societal benefits.

TAXONOMIC CLASSIFICATION [13-15]

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Oxalidales
Family: Oxalidaceae
Genus: *Oxalis*
Species: *O. corniculata*
Vernacular names [16,17]
Sanskrit: Ambashta, Amlalonika, Amlapatrika, Amlika, Amlotaja, Cangeri
Hindi: Seh-patti, Tinpatiya, Anboti, Chukatripati, Bhilmori, Khatari
English: Indian sorrel
Bengali: Amrul-sak, Amrulshak, Amrul, Tandichatom arak, Amrool
Odia: Ambilati, Sialthur, Siakthur, Ambo chingari

Distribution

This delicate and low-grown herb is highly available in damper and shady places over the warmer regions and Himalayas (cosmopolitan up to 8000 ft) of India [18]. Furthermore, one can easily find it in the Eastern seaport regions of the United States, while it becomes pretty plentiful in areas such as Texas and Ontario. These weeds are found throughout Florida. This plant's most common view is noticed in the South-east United States (Newfoundland to North Dakota) and south up to Mexico. Being a cosmopolitan weed *O. corniculata* is occurs in the Old World and temperate to tropical regions of North, Central, and South America and extends to the West Indies [19,20].

BOTANY

Macroscopy

These are generally tap-rooted and bushy herbs of height 0.1–0.5 m (Fig. 1). The branch at the base mostly has nodal roots, with a weakly erect upper part, smooth, or hairy [21].

a. Stem: Lengthen around 0.4–1.5 cm, the stems are more slender, terete, and pubescent and possess a typical acidic odor and taste when fresh. However, the internodal length varies between 4.5 and 8.5 cm [22,23].
b. Leaves: The trifoliate leaves are alternate, with thin heart-shaped leaf blades with distinct apical indention. Reticulate venation is present in leaflets with a 0.5–1 cm length. The upper surface blades are smooth, have slight upward folds along the central vein, and possess appressed hairs on the lower surface veins around the margins. In general, arranged alternately, these leaves have axilar long stalks.
c. Flowers: The yellow-colored flowers have a width of 7–11 mm and five petals [24].
d. Fruit: The capsulated and cylindrical fruit is generally 1–1.5 cm long, apically pointed, and cross-sectionally penta-ridged [25-27].
e. Seeds: The light brown-colored oval seeds are apically rounded, pointed basally, cross-sectionally flattened, and have distinct superficial transverse ridges [28-30].

Fig. 1: *Oxalis corniculata* **Linn. Whole plant**

Microscopy

Root

It has a cork of 3–4 layers of brown-colored thin-walled rectangular cells having cortex. The cortex consists of rectangular and oval and thin-walled parenchymatous cells that have starch grains. On the contrary, the inner cortical cells are small rectangular and polygonal. The cortex is followed by thin strips of phloems that have sieve tubes, companion cells, and phloem parenchyma. The cambium is in-distinct while the xylem has vessels, tracheids, fibers, and xylem parenchyma. The cylindrical and pitted vessels have a one-ended tail-like projection. Whereas, the tracheids have pitted and pointed ends. Few 3–11μ in diameter starch grains are scattered throughout the region [31].

Stem

It 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 2–3 layers of squarish and polygonal sclerenchymatous cells; vascular bundles 6–7 in number, arranged in a ring, composed of a few elements of phloem toward outer side and xylem toward inner side; xylem composed of pitted vessels, tracheids, fibers, 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, and scattered throughout the region [32].

Leaf

Petiole

It shows rounded or planoconvex 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 sclerenchymatouspericycle, less developed toward upper side of petiole; vascular bundles 5 in number, arranged in a ring, consisting of phloem toward outer side and xylem toward inner side; center occupied by a small pith; a few simple, round to oval starch grains, measuring 3–11μ in diameter, and 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; and stomata paracytic [33-35].

Stem

It 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 toward outer side and xylem toward inner side; xylem composed of pitted vessels, tracheids, fibers, 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, and scattered throughout the region [36,37].

Leaf

Petiole

It shows rounded or planoconvex 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 toward upper side of petiole; vascular bundles 5 in number, arranged in a ring, consisting of phloem toward outer side and xylem toward inner side; center occupied by a small pith; a few simple, round to oval starch grains, measuring 3–11 μ in diameter, and scattered throughout.

Lamina

It shows single-layered epidermis on the 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; and stomata paracytic [38-40].

PHYTOCHEMISTRY

The phytochemical investigations of *O. corniculata* Linn revealed the existence of several oleic, linolenic, linoleic, and stearic acids with tannins and palmitic acid. The methanolic extracts also had other constituents such as carbohydrates, glycosides, phytosterols, phenolic compounds, flavonoids, proteins (12.5%), amino acids, and volatile oil. Scientists also detected the presence of calcium and fiber in this lant. Constituents such as tartaric acid and citric acids, calcium oxalate, flavones (acacetin and 7,4'-diOMeapigenin), glycoflavones (4'-OMevitexin, 4'-OMeiso-vitexin, and 3',4'-diOMeorientin), flavonols (3',4'-diOMequercetin), 2-(3,4-dihydroxyphenyl)-5,7-dihydroxyl-8,methoxyl-4H-chrome-4-one, and phenolic acids such as p-hydroxybenzoic, vanillic, and syringic acids were also found in the leaves. Higher content of oxalates is responsible for an acidic taste of this herb. Three C glycosyl flavones in the leaves, namely, 6-C-glucosyl luteolin (isoorientin), 6-C-glucosylapigenin (isovitexin), and isovitexin 7-methyl ether (sertisin) were also investigated in the herb (Fig. 2).

ETHNOBOTANY

Dysentery is usually cured using leaf juice of this herb mixed with around 5 ml of honey twice daily for up to 5 days. Similarly, equal volumes of leaf juice, ginger juice, and honey are mixed to treat dyspepsia, and 5 ml of this mixture can be taken twice a day for 3 days. One can apply the leaf juice locally to treat warts, corns, and various skin excrescences. Warts are effectively removed on an equal portioned mixture of leaf extract and onion juice is applied. A great relief from red spots and skin eruptions is obtained when the admixture of leaf juice, black pepper powder, and ghee is used. Diabetes can be effectively cured if the fresh leaf juice mixed with cow's milk butter is given once a day for 15 consecutive days [41-43]. In villages of Nepal, the whole herb *O. corniculata* Linn. (Jujur saang) is used as medicinal herb [44-46]. For curing gastric conditions, equal amounts of plant material mixed with

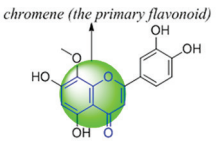

Fig. 2: The structure of flavonoid 2-(3,4-dihydroxyphenyl)-5,7-dihydroxyl-8,methoxyl-4H-chromen-4-one

equal amount *Justicia adathoda* L. leaf buds and *Maesa macrophylla* are pounded and administered 3 times a day (6 teaspoons) [46]. To treat fever and dysentery, a leaf decoction is used in Madhya Pradesh [47-49]. In Cameroon, the macerated whole plant with leaves of *Sida acuta* is administered orally for treating gonorrhea [50-52]. In Boro tribals of Assam, conjunctivitis is cured using the herb juice as an eye drop [53,54]. In the neighboring country Pakistan, skin diseases are cured by the plant sap, while the leaves serve as coolant and refrigerant for stomach disorders, fever, acute headaches, and snake bites too. Cumin seed with pounded plant is taken thrice in water for dysentery. Sensitive teeth were also being treated by this plant [55,56].

The above-cited uses are believed due to the pharmacological activities such as wound healing, antidiabetic, antiamoebic, anti-ulcerative, anti-inflammatory, hepatoprotecitve, antifungal, and cardioprotective properties of the plant. A brief view of such activities is highlighted hereafter.

Wound healing activity

Taranalli and coworkers reported the wound healing activity of ethanolic and ether extracts of the plant. These extracts were found to increase the granuloma tissue breaking strength and hydroxyl proline content more than the control [57-59].

Anti-diabetic activity

The procaine pancreatic amylase inhibitory potential of the aqueous extract of this plant was reported by Jyothi *et al*. Further, it was observed that the aqueous extracts have better inhibitory activity than the organic extracts [60,61].

Antiamoebic activity

Manna *et al*. reported the plants' antiamoebic activity in axenic cultures of *E. histolytica*. Out of the several constituents, the Oc-3, a galacto-glycerolipid, possessed the highest activity level [62].

Anti-ulcer activity

A decreased gastric volume and reduced free and total acidity was noticed when the aqueous and ethanolic extracts of *O. corniculata* Linn. eaves were given to patients. This promised an effective anti-ulcerative property of the plant [63].

Anti-inflammatory activity

The methanol extract of the whole plant of *O. corniculata* Linn. was assessed for its antioxidant and anti-inflammatory activity, and the IC_{50} value was calculated [64].

Hepatoprotective activity

Das and coworkers reported impressive hepatoprotective activity and a dose-dependent decrease in the cellular necrosis and biochemical parameters values after consuming the ethanolic and aqueous extracts [65-67].

Antifungal activity

Verma *et al*. reported a 31% antifungal potency of this plant against A. niger and 10.7% potency against *P. theae* by the plants' aqueous extract [68-70].

Cardioprotective activity

The aqueous extracts of this plant in a pretreatment study significantly reduced the concentration of creatine phosphokinase, lactate dehydrogenase, serum total cholesterol, low-density lipids LDL cholesterol, and triglycerides [71-73]. Thus, this supported the cardioprotective function of this plant.

DISCUSSION

The plant derived products unite several countries closer by the presence of plant species and variety [74-76]. The countries of the first world joins hand with the countries pregnant with plants constituting various medicinal uses, namely, Asia, Africa, and/or America (Latin) to produce safe and effective product. The rationale behind collaboration is to produce most effective therapeutic efficacy. The analysis of countries collaborating gave a clear pitch for European countries lacking of any country cluster rather than with commercial laps [77-80]. The cluster analysis spotted for Asia along with China, Indonesia, Pakistan, and India a cluster of four, Africa along with South Africa and Cameroon; another one cluster from Latin America, led by Brazil followed by North America, led by the USA [81-84]. There is also a cluster of 20 from International Journal of Environment Resources of Public Health 2020. Therefore, the underdeveloped countries like Africa need more collaboration for effective formulations and defeating the modern world with old techniques and herbs.

The another urgent check to be applied for natural product research that habitat loss and unconstrained commercialization of wild medicinal plants is a threat to the vital resources future; additionally, the beauty, diversity, and heritage loss to the planet may also occur [48,85-88]. As the over fertilization or crop production along with manuring may destroy or degrade the wild lands which may result into harming the unique and precious species to be listed in the endangered list, starting from the base of ecosystem to the apex all get affected, which may affect the potential resources utilized to overcome the poverty, hunger, and natural disasters, the social and economic insecurity also get injured [89-92]. The future of the pharmaceutical industry could face heavy loss in curing important diseases due to the diversity loss, which we face now and in the future may emerge to harm the flora and fauna. The population has remained alert for unaffordable access to the plant resources; therefore, the commercialization should remain checked regularly [93,94].

CONCLUSION

Since time immemorial, it has been a proven fact that plants are the safest agents to cure ailments which modern medicines could only able to modifying or suppressing the disease, along with a resistance effect caused by the parent molecule. A pool of valuable information as presented in this review on the botany, phytochemistry, various ethnobotany, and promising pharmacological activities of the plant constituents will provide an impetus for further systematic evaluation of the use of the plant in medicine. This is an attempt to compile and document information on different aspects of *O. corniculata* Linn. and highlights the need for further research and development.

CONFLICT OF INTEREST

All authors have none to declare.

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