

# *Oxalis corniculata* Linn. -The Plant of Indian subtropics

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## Abstract

*Oxalis corniculata* Linn. commonly known as creeping woodsorrel (Oxalidaceae), is one of the most recent focus plant species in India. The Phytochemical investigations have revealed the presence of tannins, palmitic acid, a mixture of various fatty acids, calcium, fiber, calcium oxalate, flavones (acacetin and 7,4'-di-O-Me apigenin), glycoflavones(4'-O-Me vitexin, 4'-O-Meiso-vitexin and 3',4'-di-O-Me orientin), flavonols (3',4'-di-O-Me quercetin) and phenolic acids such as p-hydroxybenzoic, vanillic and syringic acids. Traditional uses of this plant were enlisted as an antiscorbutic in the treatment of scurvy, in stomach trouble, in case of scorpion sting, to stop bleeding from wounds, to get relief from aphthae, to treat giddiness, diarrhoea and dysentery. Apart from, various pharmacological investigations enumerate its antimicrobial, antifungal, wound healing, antiimplantation, abortifacient, cardiorelaxant and nematocidal activities. However, some more activities of this plant needs to be evaluated, which are already reported traditionally in literature but no such research evidences are listed out. Keeping this in view, an attempt has been made to understand in details about the plant with its newer medicinal uses, various pharmacological uses, future aspect of this plants for the researchers to develop the new drug molecule.

Key words: Distribution, Chemical constituents, medicinal uses, *Oxalis corniculata*, pharmacological activity

## Introduction

Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been isolated from natural sources. Many of these isolations were based on the uses of the agents in traditional medicines<sup>1</sup>. The plant-based traditional medicine system continues to play an essential role in health care with about 80% of the world's inhabitants relying mainly on traditional medicines for their primary healthcare<sup>2</sup>.

Of late, *Oxalis* plant is one of the most demandable plant species in India that are having several gray areas which are the focus to the future researchers. *Oxalis corniculata* is a sub-tropical plant and it is originated from India<sup>3</sup>. The plant having most diversified genus and consist of about 900 species<sup>4</sup>. *Oxalis corniculata* Linn. is commonly known as creeping woodsorrel, belongs to the family Oxalidaceae. It is a somewhat delicate-appearing, low growing, herbaceous plant. Some varieties have green leaves, while others have purple leaves, like the *Oxalis corniculata* var.

*atropurpurea*<sup>5</sup>. It is distributed as a weed in damp shady places, roadsides, plantations, lawns, nearly all regions throughout the warmer parts of India and Ceylon, in the Himalayas up to 8,000



Whole plant of *Oxalis corniculata*

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Leaves with flower

ft- cosmopolitan<sup>3,6</sup>. Even though it is also distributed in ballast about the Eastern seaport towns of the United States and becomes quite abundant in Texas & Ontario<sup>7</sup>. The plant is a small procumbent herb; stems rooting and having pubescent with appressed hairs<sup>3</sup>. Leaves are trifoliate, with three small heart-shaped leaflets. The petioles are 5 cm long and sessile. Flowers are yellow, subumbellately disposed, nearly 1 cm long and the petals are obcordate. Fruits are like capsules, tomentose, subcylindric, 1 to 1.8 cm long, divided into minute segments with numerous black seeds the size of sand grains<sup>8</sup>.

Traditionally the plants are having several medicinal uses viz. the juice of the plant is given in stomach trouble, used to relieve the intoxication produced by *Datura*, as a refrigerant<sup>9</sup>, decoction of roots is useful for worms, giddiness, diarrhea and dysentery<sup>3</sup>. The leaves are useful for cough, cold, fever, stomach ache and as antihelmintic<sup>10</sup>. In spite of several uses, there are some more beneficial activities are revealed recently which it show the further demand of this plant in world wide especially in India. Hence the present paper has reviewed with respect to modern uses and highlighted the contribution of *Oxalis corniculata* Linn. in modern system of herbal medicine for new drug development. Further the correlation also established between the active constituents and their uses in different fields.

#### Chemical Constituents

Phytochemical investigations of *Oxalis corniculata* Linn. have revealed the presence of tannins, palmitic acid, a mixture of oleic, linoleic, linolenic and stearic acids<sup>8</sup>. 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<sup>11</sup>. It also showed the presence of calcium, fiber and tannin<sup>10</sup>. Leaves contain tartaric acid and citric acids, calcium oxalate, flavones

(acacetin and 7,4'-diOMe apigenin), glycoflavones (4'-OMe vitexin, 4'-OMeiso-vitexin and 3',4'-diOMe orientin), flavonols (3',4'-diOMe quercetin) and phenolic acids such as p-hydroxybenzoic, vanillic and syringic acids<sup>12</sup>. This herb is well known to have an acid taste due to the high content of oxalate in its leaves and stems. Study revealed the presence of three C-glycosylflavones in the leaves namely 6-C-glucosyl luteolin (isoorientin), 6-C-glucosylapigenin (isovitexin) and isovitexin 7-methylether (sertisin)<sup>13</sup>.

Ferritin was detected in the integumentary cells of the *Oxalis corniculata* ovule that was confirmed by an electron microscope x-ray microanalysis; it occurs in immature plastids & in amyloplasts in the form of paracrystalline aggregates which have round profiles or which may be intended by the surrounding starch grains. Integumentary ferritin aggregates are regarded as an iron source for the embryo<sup>14</sup>. The leaves contain about 86% water, 0.8% fat, 8.2% carbohydrate, 150mg calcium, 78 mg phosphorus, 8mg iron, 0.6mg niacin, 78mg vitamin C, 6050 microgram beta carotene and between 7-12% oxalate<sup>15</sup>.

#### Mode of Production of Oxalic Acid In Oxalis Corniculata

Oxalic acid is one of the most important chemical constituent that is produced in the plant by the mechanism called as Photosynthesis. During photosynthesis, an oxalic acid is produced by CO<sub>2</sub> fixation both in light and in darkness but the rate of its photosynthetic formation is much higher in darkness. Looking at that, one of the biosynthesis research has been carried out to know the proper mechanism action for production of oxalic acid in this plant by utilization of standard radioactive compounds (glyoxalic acid). The results revealed <sup>14</sup>C was detected in oxalic acid within 5 second, but <sup>14</sup>C fixed in the 70% ethanol soluble fraction can be located in this compound after 5 minutes<sup>16</sup>. Some more research needs to develop to understand the proper biosynthesis of oxalic acid in this plant using radioisotopes that having minimal half life.

#### Traditional Uses

The plant is a good source of vitamin C and is used as an antiscorbutic in the treatment of scurvy<sup>17</sup>. In the folk medicines, the juice of the plant is given in stomach trouble, decoction of roots is useful for worms, used to clean rusted vessels. The extract of the plant is applied in case of scorpion sting, fresh leaves of *Oxalis carniculata* are crushed and are used to stop bleeding from wounds<sup>9</sup>. Leaves are well masticated and the juice is kept in mouth for sometime to get relief from aphthae<sup>18</sup>. The raw fresh leaves are crushed and directly applied on skin to treat eczema<sup>19</sup>. Ground leaves are eaten as a chutney that act as blood purifier<sup>3</sup>. It is also used for giddiness, diarrhea and dysentery, juice of leaves applied to open wound relieves pain,

paste of ground leaves and raw onions applied to forehead for intense headache<sup>20</sup>. The plant is also used for amenorrhea<sup>21</sup>, bile diseases and as diuretics<sup>22</sup>. Leaf decoction is used in treating cough, dysentery and as an astringent. It is also as antidote against datura poisoning<sup>23</sup>. This plant is used to develop muscle fasciculation, cramping, pupil dilatation, and seizures<sup>24</sup>. The plant is well known for its medicinal value as a good appetizer and as a remover of Kapa, vata and piles<sup>11</sup>. Sumei *et al.*, (2006)<sup>25</sup> have reported the aqueous extract of whole plant can eliminate the evil wetness, urethritis, neurasthenic, injuries from falls, skin ulcer, foot ringworm, eczema, scald, ringworm on feet. This plant when used in combination with other plant extract it gives synergist effects to cure rheumatism<sup>26</sup>. The plant is used as a tonic and in bronchitis, asthma, gastric, kidney troubles and dropsy<sup>10</sup>. It is recommended to use in urinary inflammation and suggested to use as carminative<sup>27</sup>.

Gene Level Study: Scanty investigations are available on gene level study on *Oxalis corniculata* Linn to understand the gene construct and their mode of action in different uses. Shibaik *et al* (1995)<sup>28</sup> have reported the reproductive biological system by interdelated style length polymorphism and breeding systems. Further the effect of breeding system of *Oxalis corniculata* Linn on the levels of genetic differentiation among population by two and one level hierarchical variance partitionings, was determined by RAPD analysis method (Random Amplified Polymorphic DNA)<sup>29</sup>. Still more literature supports are required to establish the proper gene level study of the same to develop new drug molecule.

#### Recent Medicinal/Pharmacological Activities

##### Antimicrobial activities:

Different concentrations (25, 12.5, 6.25 and 1.56 mg/ml ) of 80% ethanol extracts of *Oxalis corniculata* were tested against four bacteria viz. *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* by the agar dilution method against standard Streptomycin (0.5 mg/ml). Zone of inhibition was measured and results concluded that it showed the inhibition of bacteria at concentration of 12.5 mg/ml against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and with concentration of 6.25 mg/ml against *Pseudomonas aeruginosa*<sup>30</sup>.

Raghvendra *et al* (2006)<sup>11</sup> have reported the antibacterial activity of various extracts of *Oxalis corniculata* plant and showed significant antibacterial activity of methanolic and ethanolic extracts of the same against *Xanthomonas* and fourteen human pathogenic bacteria. The results due to presence of phenolic compound present in the plant. 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. Among plant pathogens *Xanthomonas* was highly sensitive where as among human pathogens *S.flexneri*, *Salmonella paratyphi B*, *Streptococcus faecalis* and *S. aureus* were highly sensitive to methanol and ethanol extracts.

*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<sup>31</sup>.

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 rotendifolia*, *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 inhibition showed by *Oxalis corniculata* aqueous extract (60 mm) which reconfirmed the earlier reported literature<sup>10</sup>.

##### 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<sup>32</sup>.

##### 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, p.o. The result showed significant wound healing activity by producing an increase in wound contraction rate, wound breaking and significant decreases in epithelization period<sup>33</sup>.

## Review

### 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 laprotomised on day 10. Further pregnant rats that received the treatment from day 8 to 14 of pregnancy, showed significant abortifacient activity<sup>34</sup>.

### Cardiorelaxant 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<sup>35</sup>.

### 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<sup>36</sup>.

### Nematocidal activity

Chitwood (2002)<sup>37</sup> and Silamar and Leandro (2004)<sup>38</sup> have reviewed the ethanolic extract of *Oxalis corniculata* plant that having nematotoxic activity against phytoparasitic nematodes. 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<sup>39</sup>.

## Conclusion

From the above review, it can be concluded that *Oxalis corniculata* is used traditionally since many years as reported in various literature. However, after detected of various newer compounds from the plant, several new activities were reported by the researchers and hence the plant is now gaining importance to develop some more new search for the future development by understanding the gene level study. Therefore, considering its versatile medicinal uses, there is an ample scope

for future research on *Oxalis corniculata* and hence further pharmacological investigations are warranted.

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