Oxalis corniculata Linn. commonly known as creeping wood sorrel belonging to the family Oxalidaceae, is one of the most recent focus plant species in India. It is a medicinally important plant indigenous to tropical and subtropical regions of the world. The plant Oxalis corniculata Linn. has been used in different systems of traditional medicine for the treatment of diseases and ailments of human beings. The review reveals that wide ranges of phytochemical constituents have been isolated from the plant like flavonoids, tannins, phytosterols, phenol, glycosides, fatty acids, galactoglycerolipid and volatile oil. The leaves contain flavonoids, iso vitexine and vitexine-2’-O-beta-D-glucopyranoside. It is rich source of essential fatty acids like palmitic acid, oleic, linoleic, linolenic and stearic acids. It has been reported that the plant contains anti-inflammatory, antilulotic, anticonvulsant, antiulcer, antinociceptive, antitumor, antidiabetic, hepatoprotective, hypolipidemic, abortifacient, antioxidant, diuretic, antimicrobial and wound healing properties. This article briefly reviews the botany, pharmacology, phytochemistry and therapeutic application of the plant. This is an attempt to compile and document information on different aspects of Oxalis corniculata Linn. and highlight the need for research and development.

**Keywords:** Oxalis corniculata Linn. creeping wood sorrel, Phytochemicals, Pharmacology, Traditional medication.

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 [1]. 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 [2].

There exists a plethora of knowledge and information and benefits of herbal drugs in our ancient literature of Ayurvedic and Unani medicine. One of the earliest treatises of Indian medicine, the Charaka Samhita (1000 B.C) mentions the use of over 2000 herbs for medicinal purpose [3].

A large proportions of world’s population depend on traditional medicine because of scarcity, high cost of orthodox medicine and unpleasant side effects [4]. In addition, herbs have provided us some of the very important life-saving drugs used in the armamentarium of modern medicine [5]. There is a worldwide belief that herbal remedies are safer and less damaging to the human body than synthetic drugs. Therefore laboratories around the world are engaged in screening of plants for biological activities with therapeutics potential. One major criterion for the selection of plant for such a study is traditional healer’s claim for its therapeutics usefulness. The traditional Indian medicinal system mentions herbal remedies for the treatment of variety of diseases. Exploration of the chemical constituents of the plants and pharmacological screening may provide us the basis for developing the leads for development of novel agents. Ayurveda has emphasized importance of food in the management of diseases. Even practitioner of modern system has realized the significance of dietary items, in the form of nutraceutical elements, in the treatment of chronic diseases [6].

The genus Oxalis belongs to the family Oxalidaceae with about 500 species, distributed in America, Africa, Europe and Asia [7, 8].

Oxalis corniculata Linn. Oxalidaceae, a sub-tropical plant being native of India, are commonly known as creeping wood sorrel. It is a delicate-appearing, low growing, herbaceous plant and abundantly distributed in damp shady places, roadsides, plantations, lawns, nearly all regions throughout the warmer parts of India, especially in the Himalayas up to 6,000 ft- cosmopolitan [9].

Oxalis corniculata Linn. (Family: Oxalidaceae) is a well-known plant in India and is one of the most versatile medicinal plants having a wide spectrum of biological activity. It is commonly known as creeping wood sorrel, an excellent plant in the nature having composition of all the essential constituents that are required for normal and good health of humans [10]. Herb is a good appetizer, removes kapha, vata, and pitta; astringent cures dysentery and diarrhoeas, skin diseases and quarten fevers. An infusion of the leaves is externally used to remove warts and opacities of cornea. The leaves are anti-inflammatory, refrigerant and antiscorbutic [11].

Oxalis corniculata Linn. is locally used in various ailments. It is rich in niacin, vitamin C and β-carotene [12]. The juice of the plant is given in jaundice and in stomach troubles [13]. The juice of the plant, mixed with butter, is applied to muscular swellings, boils and pimples [12]. Oxalis corniculata Linn. is also used as antiseptic, refrigerant, diaphoretic, diuretic and anti diabetic [13]. It is used as complementary medicine in wound healing, anemia, dyspepsia, cancer, piles, dementia and convulsions [14, 15]. Other alternative uses are; anti-helmintic, anti-inflammatory, astringent, depurative, diuretic, emmenagogue, febrifuge, lithotrMpitic, stomacheic and styptic. It is also used in the treatment of influenza, fever, urinary tract infections, enteritis, diarrhoea, traumatic injuries and sprains [16]. It was also reported that Oxalis Corniculata Linn. have hypoglycemic, antihypertensive, antipsychotic, nervous system stimulant and have chronotropic and inotropic effect [17, 18]. Chemical characterization of Oxalis corniculata Linn. showed the presence of glyoxylic acid, oxalic acid, pyruvic acid, vitexin and isovitexin, vitexin-2’-O-beta-D-glucopyranoside, neutral lipids, glycolipids; vitamin C; phospholipids; fatty acids, 18:2, 18:3, 16:0; saturated (C10-C14) acids; alpha and beta tocopherols [18].

In Nepal village, Oxalis corniculata. Linn [Jujar saang] is used as medicinal herb [19]. The plant is mixed in equal amount with the leaf bud of Justicia budhaath L. and Muesa macrophylla is pounded and the juice about 6 tea spoons 3 times a day is given in gastric troubles [20]. The leaf decoction is used in fever and dysentery in some areas of Madhya Pradesh [21]. Maceration of the whole plant with leaves of Sida acuta is taken orally to treat gonorrhoea in Cameroon [22]. The herb juice is used as eye drop in conjunctivitis by Boro Tribals of Assam [23]. The local inhabitants of Tehsil Chakwal (Pakistan) uses Plant sap to cure skin diseases, Leaves as
cooling agent and refrigerant in stomach disorders, fever and acute headache and also in snake bite. Plant pounded with cumin seeds are taken with water thrice a day for dysentery. It is also used for sensitive teeth [24].

The present review is dealing with medicinal importance of the *Oxalis corniculata* Linn with reference to its Pharmacognosy, Phytochemistry and pharmacological activities.

**Plant profile**

**Taxonomic Classification [25]**

- **Kingdom:** Plantae
- **Division:** Magnoliophyta
- **Class:** Magnoliopsida
- **Order:** Oxalidales
- **Family:** Oxalidaceae
- **Genus:** Oxalis
- **Species:** corniculata

**Vernacular Names [25]**

- **Sanskrit:** Ambashta, Amlakoni, Amlapatika, Amlika,
- **Hindi:** Seh-patti, Tinpatiya, Anboti, Chuka tripati, Bhilmori, Khatari
- **English:** Indian sorrel
- **Urdu:** Khatti-buti
- **Assamese:** Changentenga, Saru tensesi
- **Bengali:** Amrul-shak, Amrul shak, Tandi chatom arak, Amrool
- **Kannada:** Hul-hunice, Hulhunice, Pullam-parachi-sappu, Telpuppi
- **Marathi:** Palakiri, Puliyarali,
- **Telugu:** Ambotikura, Pulichintha, Pallachintha
- **Malayalam:** Umbutira, Pulinchatha, Pallechinta
- **Oriya:** Saltthur, Siakthur, Ambo chingari
- **Arabic:** Hemendab, Henda, Homadmad

**Distribution**

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 [25]. It is also distributed in ballast about the eastern seaport town of the United States and becomes quite abundant in Texas and Ontario. These weeds are found throughout Florida. They are common in the southeastern United States; from Newfoundland to North Dakota; and southward to Mexico. *Oxalis corniculata* Linn is a cosmopolitan weed occurring in the Old World and in temperate and tropical regions of North, Central and South America and the West Indies [26].

**Botanical description**

They are tap rooted herbs, bushy or mat forming, and 0.1-0.5 m tall (Figure 1). Branching from the base and often rooted at the nodes, the upper portions are ascending or weakly erect smooth or hairy [26].

**Stem**

The stem is slender, terete and pubescent, 0.4 to 1.5 cm long. The internodes vary from 4.5 to 8.5 cm in length. Acidic odour, taste sour when fresh [26].

**Leaves**

The trifoliate leaves are alternate, with thin, heart-shaped, leaflet blades having a distinct apical indentation. Leaflets 0.5 to 1 cm long with reticulate venation. The blades are smooth on the upper surface, slightly folded upward lengthwise along the major vein, and have a few appressed hairs along the veins on the lower surface and along the lower portion of the margins. The leaves are arranged alternately along the stems. A single long stalk arises from the axils of the leaf, from which extend three flower stalks, each with a single flower.

**Flowers**

The flowers are 7-11 mm wide and have 5 yellow petals [26].

**Fruit**

The fruit is a capsule, 1-1.5 cm long, cylindrical, pointed apically, and 5-ridged in cross section [26].

**Seeds**

The seeds are oval in outline, apically rounded, basally pointed, flattened in cross section, light brown, and have a surface distinctly transversely ridged. *Oxalis corniculata* Linn. will have stolons [26].

![Fig. 1: Leaves and flowers of Oxalis corniculata Linn.](image)

**Phytochemistry**

Phytochemical investigations of *Oxalis corniculata* Linn. have revealed the presence of tannins, palmitic acid, a mixture of 8 oleic, linoleic, linolenic and stearic acids. Methanolic and ethanolic extracts of this plant show the presence of carbohydrate, glycosides, phytosterols, phenolic compounds, flavonoids, proteins (12.5%), amino acids and volatile oil.

![Fig. 2: The structures of flavonoids](image)

It also showed the presence of calcium, fiber and tannin. Leaves contain tartaric acid and citric acids, calcium oxalate, flavones (acacetin and 7,4'-diOMe apigenin), glycosflavones (4'-OMe vitexin, 4'-O Meisco-vitexin and 3',4'-diOMe orientin), flavonols (3', 4'-diOMe quercetin) and phenolic acids such as p-hydroxybenzoic, vanillic and syringic acids. 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 glycosylflavones in the leaves namely 6-C-glucosyl luteolin (isorientin), 6-C-glucosylapigenin (isovitexin) and isovitexin 7-methyl ether (sertisin) (Figure 2).

Ferritin was detected in the integumentary cells of the *Oxalis corniculata* Linn. 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. 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 [10].

During photosynthesis, an oxalic acid is produced by carbon dioxide fixation both in light and in darkness but the rate of its photosynthetic formation is much higher in darkness. Identified several compounds that were characterized by nuclear magnetic resonance, infrared, and mass spectrometry as (i) Oc-c1 to Oc-c3, (ii) Oc-c2, a mixture of long-chain alcohols Oc-c3 to Oc-c5 and (iii) Oc-c3, a single compound that was a galacto-glycerolipid [27].

β-sitosterol (1), betulin (2), 4-hydroxybenzoic acid (3), ethyl gallate (4), 5-hydroxy-7,8-dimethoxyflavone (5), 5-hydroxy-3’, 4’, 6, 7, 8-pentamethoxyflavone (6), 7, 5’-dimethoxy-3, 5, 2’-trihydroxyflavone (7), 5-hydroxy-3, 6, 7, 4’-tetramethoxyflavone (8), 4’, 5-hydroxy-3, 6, 7-trimethoxyflavone (9), 5-hydroxy-3, 6, 7, 4’-tetra-methoxyflavone (10), apigenin 7-O-β-D-glucoside (11) and 3’, 3’, 5, 7-tetrahydroxyflavone 7-O-β-D-glucopyranoside (12), has been isolated from the *Oxalis corniculata* Linn.[28], (Figure 3).

**Fig. 3: Structures of compounds 1-12 isolated from Oxalis corniculata Linn.**

Corniculatin A, a new flavonoid glucoside, was isolated from the ethyl acetate soluble fraction of the whole plant along with luteolin, luteolin-7-O-β-D-glucoside and β-sitosterol-3-O-β-D-glucoside, this is the first report of these compounds from this species. Their structures were elucidated on the basis of spectral data including mass and 2D NMR experiments [29].

**Nutritional Value of Oxalis corniculata Linn.**

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 Linn.* exhibit rich in mineral contents like Sodium (1.12±0.02%), Potassium (2.17±0.31%), Calcium (2.510.08%), Nitrogen (3.56±0.70%) and Magnesium (0.25±0.03%), these mineral components are vital in regulating various metabolic pathways in human body [30].

**Antibacterial activity**

Methanolic and ethanolic extracts of *Oxalis corniculata* Linn. 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 [31].

**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* Linn. showed the significant antifungal activity against *A. niger* by suppressing the fungal mycelial growth by 71 to 86% and moderately against *P. these, R. solani* after three days of incubation [32].

**Pharmacological activities of oxalis corniculata linn.**

**Anti-helminthic activity**

This study aimed at the in vitro comparative study of anti-helminthic activity of petroleum ether, ethyl acetate and methanol extracts of whole plant of *Oxalis corniculata* Linn. using *Eisenia fetida* at three different concentrations (100, 200 and 400 mg/ml) respectively. The study involved the determination of time of paralysis (P) and time of death (D) of the worms. At the concentration of 400 mg/ml all the extracts showed very significant activities as compared to the standard drug levamisole (0.55 mg/ml). Each extract with the dose 100, 200 and 400 mg/ml produced dose dependent paralysis ranging from loss of motility to loss of response to external stimuli which gradually progressed to death. In case of methanol extract which was found to be most potent, the time of paralysis and death time was observed as 11.33 and 41.33, respectively [33].

**Nematocidal activity**

Chitwood (2002) [34] and Silamar and Leandro (2004) [35] have reviewed the ethanolic extract of *Oxalis corniculata* Linn. plant that having nematotoxic activity against stytopyrastatic nematodes. In another research has revealed ethanolic extract of *Oxalis corniculata* Linn. 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 [36].

**Other activities**

**Wound healing activity**

The alcoholic and petroleum ether extract of whole plant of *Oxalis corniculata Linn.* 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.showed significant wound healing activity by producing an increase in wound contraction rate, wound breaking and significant decreases in epithelization period. In this study both the extracts significantly increased the granuloma tissue breaking strength and hydroxyl proline content as compared to control [37].

**Anti-implantation and abortifacient activity**

Petroleum ether and ethanol extracts of the whole plant of *Oxalis corniculata* Linn. were administered orally at the dose level of 100 and 200 mg/kg body weight from day 1 to 7 of pregnancy to evaluate the anti-implantation activity. Though all the treated groups showed significant anti-implantation activity when laparotomised on day 10, it was maximum (76.42%) with the high dose of petroleum ether extract. Upon withdrawal of the treatments the rats which retained the implantation continued pregnancy. The pregnant rats which received the treatment from day 8 to 14 of pregnancy showed abortifacient activity and it was maximum (78.55%) with high dose of petroleum ether extract [38].

**Gastroprotective activity**

The objective of this study was to investigate the antiulcer activity of methanol extract of *Oxalis corniculata* Linn. [whole plant] using pylorus ligation and indomethacin-induced gastric ulceration in Wistar rats. The extract was preliminary evaluated for acute oral toxicity test using Organisation for Economic Co-operation and Development guidelines 423. Further, it was studied for antiulcer potential at the dose levels of 125, 250 and 500 mg/kg. Ranitidine was used as a standard drug [100 mg/kg]. Acid secretory parameters like gastric volume, pH, total acidity and free acidity were measured in pylorus ligation model, whereas numbers of ulcers, ulcers score and ulcer index was measured in pylorus ligated and indomethacin treated rats. Pretreatment of test extract significantly (p<0.05) decreased the gastric volume, total acidity, free acidity and increase in the pH of the gastric fluid in pylorus-ligated rats. It also showed significant (p<0.05) decrease in number of ulcers, ulcers score and ulcer index in pylorus ligated and indomethacin treated rats. Results of the study suggest that, the methanol extract of *Oxalis corniculata* Linn. possesses significant antisecretory and antiulcer effects and justify the traditional usage of this herb to treat peptic ulcers [39].

**Anti-diabetic activity**

The aqueous extract of the *Oxalis corniculata* Linn. plant has been tested for the inhibitory potential against procaine pancreatic amylase. At a concentration of 100 μg/ml exhibited a maximum inhibition of 89.27% (IC50 value 68.08±0.06). The organic extracts did not show any significant inhibition in this study which might suggest that the active principle possessing amylase inhibitory potential is extracted only in the aqueous extract [40].

**Anti-amoebic Activity**

*Oxalis corniculata* Linn. identified several compounds that showed anti-amoebic activity in axenic cultures of *E. histolytica*. These were characterized by nuclear magnetic resonance, infrared, and mass spectrometry as (i) Oc-C1, a mixture of saturated fatty acids C16 to C20; (i) Oc-C2, a mixture of long chain alcohols C20 to C24; and (iii) Oc-S, a single compound that was a galacto-glycerolipid (GGL). Of the different compounds that were obtained, the strongest anti-amoebic activity was found in GGL [27].

**Anti-cancer Activity**

Ethanol extract of *Oxalis corniculata* Linn. evaluated for its antitumour activity in Ehrlich ascites carcinoma (EAC) induced in Swiss albino mice. Results conclude that the ethanol extract of *Oxalis corniculata* Linn. was effective in inhibiting the tumor growth in ascitic and solid tumor models [41].

**Anti-nociceptive Activity**

Ethanol extract of *Oxalis corniculata* Linn. at doses of 200 and 400 mg/kg body weight evaluated for its anti-nociceptive activity in diabetic neuropathy rats. Diabetic rats were showed significant reduction in tail flick latency by 49% in hot water tail immersion test and decreased paw withdrawal by 40% in hot plate test by the end of 5th week [42].

**Anti-diarrhoeal activity**

The anti-diarrhoeal activity of aqueous and methanolic extracts of *Oxalis corniculata* Linn. was evaluated on castor oil induced diarrhoea in rats and on small muscle intestinal transit. At orally administered doses of 160,320 and 640 mg/kg of body weight. The two plant extracts significantly (p<0.05) prolonged the time of onset of diarrhoea and inhibited the frequency of defecation. These extracts also reduced the wetness of faecal droppings in castor oil induced diarrhoea and decreased the propulsion of charcoal meal through the small intestine. At all doses the aqueous extract appeared to be more effective than the methanolic extract [43].

**Anti-epileptic activity**

Methanolic extract of *Oxalis corniculata* Linn. leaves at doses of 200 and 400 mg/kg body weight were screened for antiepileptic activity on Maximal Electroshock (MES) and Pentylentetrazole (PTZ) induced seizures models in Albino Wistar rats. In MES model, MEOC showed significant reduction in duration of hind leg extension with 200 mg/kg dose and was dramatically reduced with 400 mg/kg. Similar dose dependent results were obtained in PTZ model by delaying the onset of clonic convulsions. The complete protective effect against mortality was reported in both the tests. In conclusion, our present results indicate that *Oxalis corniculata* Linn. has anti-epileptic effects on MES and PTZ induced convulsions and its mechanisms might relate to potentiation of the activity of GABA receptors and their signal transduction process [44].

A study was conducted to investigate the effect of methanolic extract of *Oxalis corniculata* Linn. on antioxidant enzymes in rat brain after induction of seizures by MES and PTZ. The levels of antioxidant enzymes Superoxide dismutase, glutathione peroxidase, glutathione reductase and catalase was decreased in rat brain due to seizure and it was restored significantly by administration of ethanol extract of *Oxalis corniculata* Linn. treated rats. Similar dose dependent results were obtained in PTZ model also, Whereas MEOC significantly decreased lipid peroxidation in both models. The anticonvulsant activity of MEOC might be presents of antioxidant properties and it delays the generation of free radical in MES & PTZ induced epilepsy [45].

**Anti-ulcer activity**

The aqueous and ethanolic extract of *Oxalis corniculata* Linn. leaves at a doses of 200 and 400 mg/kg body weight were screened for anti-ulcer activity by using ethanolic induced gastric mucosal ulcers and pylorus ligated ulcers. There was a decrease in gastric volume and reduction in free and total acidity treated with both extracts and the catalase and SOD levels was increased and lipid peroxide was decreased in both extracts [46].

**Anti-inflammatory activity**

Methanol extract of whole plant of *Oxalis corniculata* Linn. (Family: Oxalidaceae) was assessed for its antioxidant and anti-inflammatory activity by in-vitro methods. In-vitro anti-inflammatory activity was evaluated using albumin denaturation assay, membrane stabilization assay and proteinase inhibitory activity at different concentrations. Aspirin was used as a standard drug for the study of anti-inflammatory activity. Linear regression analysis was used to calculate IC50 value. Results showed that, the extract exhibited significant DPPH and nitric oxide radical scavenging activity with IC50 value of 302.93±4.17 and 73.07±6.29μg/ml respectively. Lipid peroxidation induced by the Fe3+ was inhibited by the extract with IC50 value 58.71±2.55μg/ml. Total phenol content was estimated as 25.6±0.10mg of gallic acid equivalents of dry extract. Total flavonoids and flavonols were found to be 150.88±12.61 and 150.16±2.16 mg of rutin equivalents per gram of dry extract respectively. Extract also showed in-vitro anti-inflammatory activity by inhibiting the heat induced albumen denaturation and Red Blood Cells membrane stabilization with the IC50 values of 288.04±2.78 and 467.14±9.56μg/ml respectively. Proteinase activity was also
significantly inhibited by the extract \([IC_{50}=435.28\pm5.82\,\text{mg/ml}]\). From the results, it is concluded that flavonoids and related polyphenols present in the Oxalis corniculata Linn. extract may be responsible for the activity [47].

### Anxiolytic activity

The anxiolytic effect of Ethanol extract of Oxalis corniculata Linn. \((100 \text{ and } 300 \text{ mg/kg})\) produced a significant increase in the number of squares crossed \((\text{controls}=24.33\pm3.48)\), but significantly decreased both the immobility \((\text{controls}=47.17\pm4.29 \, \text{sec})\) and fecal pellets \((\text{controls}=13.50\pm0.96 \, \text{fecal pellets})\) when compared with control mice in the open-field test; they significantly increased the number of entries \((\text{controls}=53.00\pm2.67 \, \text{sec})\) in the open arms, but decreased both the number of entries \((\text{controls}=29.33\pm1.05 \, \text{entries})\) and time spent \((\text{controls}=166.7\pm4.30 \, \text{sec})\) when compared with the control mice in the closed arms of the elevated plus-maze test. Furthermore, ethanol extract of Oxalis corniculata Linn. \((100 \text{ and } 300 \text{ mg/kg})\) decreased the fighting episodes significantly \((\text{controls}=9.50\pm0.62 \, \text{fighting episodes})\) when compared with control mice. In addition these results were found to be consistent with anxiolytic effect produced by diazepam [48].

The study is to evaluate anxiolytic effect of Ethanol extract of Oxalis corniculata Linn. \((200 \text{mg/kg} \text{ and } 400 \text{mg/kg P.O})\) on male mice using various paradigms of anxiety. In elevated plus maze, extract \((200 \text{mg/kg} \text{ and } 400 \text{mg/kg})\) had shown a dose dependent increase in time spent and number of entries into open arms compared to control group. The number of central squares, peripheral squares crossed and rearings were stepped up significantly in open field paradigm. The treated groups had shown accession in time spent in light compartment, number of crossings, latency compared to control group in light dark exploration test. In Hole board model, number of head dips were minified in mice that received Ethanol extract of Oxalis corniculata Linn. \((200 \text{mg/kg} \text{ and } 400 \text{mg/kg})\) [49].

### Hepatoprotective activity

The hepatoprotective activity of aqueous and ethanolic leaves extracts of Oxalis corniculata Linn. \((200 \text{ and } 400 \text{mg/kg})\) were evaluated against thioacetamide-induced hepatotoxicity. Oral administration of Oxalis corniculata Linn. aqueous and ethanolic leaves extract at 400 mg/kg resulted in a significant reduction in SGOT \((146.42\pm2.54 \, 136.75\pm1.37 \, \text{IU/L})\) and SGPT \((81.96\pm3.15 \, 72.05\pm2.33 \, \text{IU/L})\). Glutathione reductase and glutathione concentration was decreased by CCl_4 treatment in kidney samples. Histopathology of heart of ISO administered rat pretreated with OCE showed normal myocardium with very little evidence of inflammatory infiltration. Results of our in vitro findings also confirmed that OCE exhibits significant antioxidant and radical scavenging activity against DPPH, superoxide and nitric oxide radicals [53].

### Nephrotoxicity

### Diuretic activity

This study was under taken to investigate diuretic effect of methanolic extract of whole plant of Oxalis corniculata Linn. in albino wistar rats. The methanolic extract of Oxalis corniculata Linn. was administered to experimental rats overall at doses of 200 mg/kg, 400mg/kg, p.o. furosemide \((20mg/kg)\) was used as standard control in this study. The diuretic effect of the extracts was evaluated by measuring urine volume, sodium, and potassium content using flame photometry. Urine volume was significantly increased by the two doses of MEOC is comparison to control group. Excretion of electrolytes Na+, K+ increased by both doses. The diuretic effect of the extracts was comparable to that of standard furosemide. We can conclude the MEOC produced notable diuretic effect which appeared to comparable to that produced by the reference diuretic furosemide. The present study provides a quantitative basis for explaining the folkloric use of Oxalis corniculata Linn. as a diuretic agent [55].

### Antioxidant and hepatoprotective activity

The study revealed that ethanolic extract of Oxalis corniculata Linn. at different doses level showed significant antioxidant activity in mice [40]. Methanolic extract of Oxalis corniculata Linn. showed potent antioxidant activity compared to reference standard ascorbic acid \((50 \% \text{ inhibition})\). The concentration of plant extract required for 50% inhibition of DPPH radical scavenging effect \([IC_{50}]\) 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 [56]. The whole plant of Oxalis corniculata Linn. in
three different solvent systems was tested for antioxidant capacity by phosphomolybdate method. The radical scavenging activity of plant extracts was studied by different standard in vitro methods. The quantitative estimation of major antioxidant constituents was carried out by standard method and contained total crude phenolics contents (6.424 mg gallic acid eqvt./gm dry weight of sample), phenolic acid (0.738 mg gallic acid eqvt./gm dry wt.), total flavonoids (0.814 mg rutin eqvt./gm dry wt.) and glutathione (948.143 μg/mg fresh wt.). The antioxidant vitamins of the plant were also estimated. The vitamin C content was found to be 0.414 mg/gm fresh wt. and vitamin E was found to be 137.36 mg/gm fresh wt. [57]

Many human diseases are caused due to oxidative stress involving excessive production of free radicals that can be ameliorated by the antioxidant activities of plant extracts. Present study was designed to characterize the chemical composition of *Oxalis corniculata* Linn. methanol extract (OCME) and its various fractions; *Oxalis corniculata* n-hexane (OCHE), *O. corniculata* ethyl acetate (OCCE), *O. corniculata* chloroform (OCCE) and *O. corniculata* aqueous (OCAE); and to determine the antioxidant potential by different in vitro assays. OCME was also evaluated for its antioxidant capacity against hepatotoxicity induced with carbon tetrachloride (CCl4). Treatment with OCME significantly increased the levels of glutathione (GSH) and activities of antioxidant enzymes; catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), glutathione-S-transferase (GST), glutathione reductase (GSR) and quinone reductase (QR) whereas elevated the thiobarbituric acid reactive substances (TBARS) contents, and hepatic lesions. All the parameters were brought back to control levels by the supplement of OCME. The results of the study suggest the antioxidant potential of OCME and its fractions as evidenced by scavenging of free radicals and hepatoprotective capacity [58].

CONCLUSION

From the above review, it can be concluded that *Oxalis corniculata* Linn. 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 ample scope for future research on *Oxalis corniculata* Linn and hence further pharmacological investigations are warranted.

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