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MEDICINAL IMPORTANCE OF TRADITIONAL INDIAN HERBAL PLANT *OXALIS CORNICULATA*: A REVIEW

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ABSTRACT: *Oxalis corniculata* is a perennial weed which is found in both tropical and temperate climates, it grows in damp and shaded areas throughout the Himalayas and warmer regions of India. This herb, an invasive weed has a number of valuable secondary metabolites. Numerous research has demonstrated the advantages of *Oxalis corniculata* leaf extract. Its metabolite profile, phytochemical analysis and therapeutic potential of its leaf extract are reviewed. To find diverse research relating to the utilization of this plant extract, a bibliographic search was done. Known bioactive compounds include oleic, linolenic, linoleic, stearic and palmitic acids, tannins, volatile oil, proteins, amino acids, phenolic compounds, phytosterols, flavonoids and carbohydrates. Several reports have revealed that it is considered as a weed, yet leaf extract has a wide range of benefits because of its pharmacological actions. Several pharmaceutical actions comprise of antimicrobial, antioxidant, wound healing, antifungal, antidiabetic, anticancer, antidiarrheal, antiulcer, anti-inflammatory, antiamebic, hepatoprotective, nematocidal and cardio-protective. This review paper summarizes all the medicinal aspect and remedial uses of *Oxalis corniculata*, a traditional Indian herbal plant belonging to family Oxalidaceae which can be used to treat various maladies and explore the bioactive potential of it.

INTRODUCTION: Nature provides a huge source of medicinal composites from plant life, and a remarkable quantity of recent medications were identified. The reason behind investigation were the drugs known for its traditional remedial uses. Nearly 80% of the world's residents have habitually faith on traditional medicines for their foremost well-being. These medicines continue to play a noteworthy role in healthcare ¹.

Medicinal plants are naturally occurring active components which are utilised to treat illness or reduce pain ². Most developing nations prefer traditional medicines and medicinal plants as therapeutic agents to retain good health ³. The World Health Organization specified that homeopathic floras ought to be the finest place for a variety of medications.

Subsequently, research must be done on herbs finding more about their traits, efficacy and safety ⁴. Ayurvedic medications are made from plants and plants products. India has been using this for a very long time. By identifying the morphological and pharmacological characteristics of these medicines, we can understand their active principles and mode of action ⁵.

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Since, orthodox medicine is limited, expensive, and has adverse side effects, the world's inhabitants have faith in traditional medicine⁶. Herbal medicines are thought to be risk-free and non-hazardous to the body than manufactured pharmaceuticals on a global scale. As a result, research facilities are examining plants for potential medicinal biological processes. The traditional Indian medical system recommends using herbal treatments to cure a variety of illnesses⁷. Unique medicinal herb, *Oxalis corniculata* Linn., family Oxalidaceae, **Fig. 1** is origin of India that has a wide range of biological activities, extensively referred as creeping wood sorrel, a remarkable plant with composition of all essential components for individual's good health⁸.



FIG. 1: OXALIS CORNICULATA WHOLE PLANT

Herb creates a great opening, helps clear kapha, vata, and piles; astringent treats fevers, skin problems, diarrhoea as well as dysentery. Warts and corneal opacities are treated externally with an infusion of tiny leaves⁹. Due to a lack of

knowledge about its medical properties, its rarely consumed¹⁰. For skin eruptions, acne, and burns, there have been various medical aspects, including antibacterial qualities. Consequently, the herb is acclaimed for its uplifting qualities^{11, 12, 13, 14, 15}. All over the world, characteristically employed as antioxidant, antifungal, anthelmintic, anti-inflammatory, analgesic, astringent, anticancer, depurative, diuretic, and anti-microbial effects¹⁶. As of its capsules, gummy seeds, quick generation time and extended blossoming, shrub is known as prosperous explorer weed. In spite of the fact that it's not really a significant contender, extensive variety and richness must magnify whole outcome as a weed¹⁷.

This review paper summarizes all the medicinal aspect and remedial uses of *Oxalis corniculata*, a traditional Indian herbal plant belonging to family Oxalidaceae which can be used to treat various maladies and explore the bioactive potential of it.

Pharmacognosy of *Oxalis corniculata*:

Taxonomy of *Oxalis corniculata*^{18, 19, 20}: *O. corniculata* taxonomy can be seen in **Table 1**.

TABLE 1: TAXONOMY OF OXALIS CORNICULATA

Kingdom	:	Plantae
Class	:	Magnoliopsida
Order	:	Oxalidales
Family	:	Oxalidaceae
Genus	:	<i>Oxalis</i>
Species	:	<i>Corniculata</i>

Native Names of *Oxalis corniculata*^{21, 22}: Mentioned in **Table 2**.

TABLE 2: NATIVE NAMES OF OXALIS CORNICULATA

Hindi	Seh-patti, Tinpatiya, Anboti, Chukatripati, Bhilmori, Khatari
Sanskrit	Ambashta, Amlalonika, Amlapatrika, Amlika, Amlotaja
English	Indian sorrel
Marathi	Ambali, Chicha Umbuti, Ambuti, Bhinsarpati, Aambotee, Ambatachukaa
Urdu	Khatt-i-buti
Kannada	Huli-hunice, Hulihunice, Pullam-purachi-sappu, Teltuppi
Tamil	Palaikiri, Puliyaarail
Telugu	Ambotikura, Pulichintha, Pallachintha
Arabic	Hememdab, Hemda, Homadmad

Distribution: One such comparatively tiny, slow-growing herb occurs extensively in damp as well as shaded areas all the way through Himalayas and warmer regions of India, nurtures in both humid and mild climates, usually appearing in parks, hedgerows and other similar areas. Moreover, located in Eastern seaport areas of the United

States, rather commonly in Texas as well as Ontario. This weed can be found all around Florida, Southeast United States and down to Mexico. *O. corniculata* is an extensive weed that grows in moderate to humid areas of West Indies, North, Central and South America as well^{23, 24}.

Morphology²⁵: Typically plant is tap-rooted, bushy and 0.1–0.5m tall. The branch primarily

consists of root nodes, with a feebly upright top portion and an even or furry stalk²⁶ **Fig. 2.**

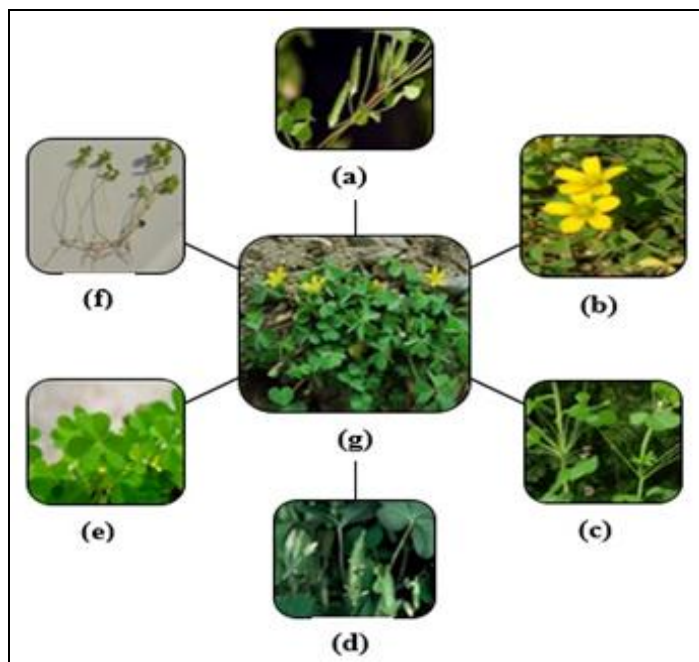


FIG. 2: PLANT PARTS OF *OXALIS CORNICULATA* (A) FRUIT, (B) FLOWER, (C) STEM, (D) SEED, (E) LEAF, (F) ROOT, (G) WHOLE PLANT

Roots: Dark brown in color, soft, branched and thin (approximately 1-2mm), with no flavor or odour²⁷.

It tastes sour and has an acidic odour²⁸.

Stem: Creeping stem brownish-red in color, has short hairs and is soft, extremely thin, slender in shape, and breakable.

Leaf: Trifoliate; its petiole is green, slender, and heart-shaped and leaflets are 1-2cm long with reticulate venation, sour taste and alternately placed along the stalk²⁹ **Fig. 3 and Fig. 4.**



FIG. 3: MACROSCOPIC OBSERVATION OF *OXALIS CORNICULATA*

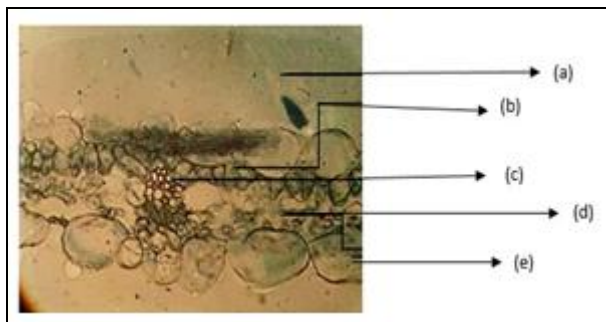


FIG. 4: TRANSVERSE SECTION OF *OXALIS CORNICULATA* LEAFLET (A) UPPER EPIDERMIS; (B) PALISADE MESOPHYLL; (C) VASCULAR BUNDLE; (D) SPONGY MESOPHYLL; (E) LOWER EPIDERMIS³⁰

Flower: Axillary, 6-12mm wide and have 5 yellow petals²⁹.

Seed: Small, light brown, oval-shaped, rounded and basally pointed²⁹.

Fruit: Capsules are cylindrical in shape, 1-1.5cm length, pointed and ribbed, coated with densely matted filaments²⁹.

Phytochemistry: The phytonutrient examination of *O. corniculata* identified quite a lot of oleic, linolenic, linoleic, and stearic acids along with tannins and palmitic acid. Methanol extracts contained volatile oil, proteins (12.5%), amino acids, phenolic compounds, phytosterols and carbohydrates. Additionally, fiber and calcium are found in this herb. The leaves contain phenolic

acids resembling p-hydroxybenzoic, vanillic and syringic acids, tartaric, citric acids, calcium oxalate, flavones (acacetin and apigenin), glycoflavones (vitexin, iso-vitexin and orientin) and flavonols (quercetin). Herb has an acidic taste because of its higher oxalate concentration. As well comprises 6-C-glucosyl luteolin (iso-orientin), 6-C-glucosylapigenin (iso-vitexin) and iso-vitexin-7-methyl ether (sertisin). A significant amount of moisture is present in the leaves. It contains a lot of crude lipids and protein. Additionally, it is comprised of mineral components like sodium, potassium, nitrogen, and magnesium. Leaves have water content of 86%, fats of 0.8%, an acidity level of 8.2%, 150 mg of calcium, 78 mg of phosphorus, 8 mg of iron, 0.6 mg of niacin, 78 mg of Vitamin-C and oxalate 7 and 12 %³¹ **Table 3.**

TABLE 3: COMPOUND COMPOSITION AND PHYTOCHEMICAL EXAMINATION OF ETHANOL, METHANOL, CHLOROFORM, AND AQUEOUS EXTRACT OF *OXALIS CORNICULATA*; (+) = PRESENT; (-) = ABSENT³²

S. no.	Phytochemicals	Ethanol	Methanol	Chloroform	Aqueous
1	Alkaloid	-	+	-	+
2	Carbohydrates	+	-	-	+
3	Saponin	-	-	-	-
4	Glycosides	+	+	-	-
5	Phenolic compounds	+	+	+	-
6	Flavonoid	+	+	+	-
7	Tannin	+	+	-	+
8	Proteins and Amino acids	+	+	-	+
9	Volatile oil	+	+	-	-
10	Gums and Mucilage	-	-	-	-
11	Phytosterol	+	+	-	-
12	Steroids	+	+	+	-

***Oxalis corniculata* as Traditional Ethnic Medicine:** From the ancient times, *O. corniculata*, known as wood sorrel has remained employed in traditional medicine. The wood sorrel has been used in treating liver and digestive issues mentioned in early Ayurvedic medical writings.

Ideal for treating scurvy as the herb is rich in Vitamin-C. The flu can be treated using plant. External leaf paste is employed as a remedy to alleviate poisoning brought on by *Datura* and snakebites.

Leaf extract is used in treating burns, bug bites and various skin outbreaks, aids in the treatment of boils, warts, corns, and inflammation. By combining leaf juice and onion extract, warts can be eradicated. A leaf infusion helps relieve corneal opacity and eye pain. Infants with hookworms are cured with this herb for its anthelmintic

properties. Jaundice is treated with leaf juice, which is also quite efficient at healing diabetes. Leaf infusion is used to treat fevers of mild and high grades.

Leaf paste is physically rubbed to the forehead to cure headaches. Crushed leaves are placed to the area to lessen irritation.

Oil and leaf extract used to alleviate insomnia by massage. The aqueous extract of herb has a cardio-protective effect and is virtuous for general health. Vata and kapha doshas are also treated. In rural areas of Nepal entire plant is used as medicine, sensitive teeth can be treated with this shrub³³.

Medicinal Properties: Consistent use of *Oxalis corniculata* might possibly be beneficial in obtaining relief from a variety of illnesses. A few of them are enlisted in **Table 4**³⁴.

TABLE 4: SOME MEDICINAL PROPERTIES OF *OXALIS CORNICULATA*³⁴

S. no.	Causes	Medicinal properties
1	Food intolerances	A good appetizer, stimulates the gastric fire, reduces abdominal pain and cures malabsorption syndrome and diarrhea.
2	Antifungal	Precise shrub to treat fungus-related illness such as Aspergillosis and Tinea.
3	Antiviral	Cures viral infection of all categories, including HIV and HPV.
4	Immuno-modulator	Due to high Vitamin-C content, used in patients with poor immunity.
5	Nausea	Helps reduce nausea and burping.
6	Anti-allergic	Removes toxins and free radicals from the body, stimulation of T-cells.
7	Skin diseases	Cure boils, corns and viral warts.
8	Eye diseases	Acts as earlier stages for cataract.
9	Cardiac tonic	Potassium and Vitamin-C are helpful to the body's general fitness.

Home Remedies: *Oxalis corniculata* has remained the focus of abundant scientific studies for a variety of ailments. Some of the studies are enlisted in **Table 5**^{34, 35}.

TABLE 5: SOME HOME REMEDIES OF *OXALIS CORNICULATA*^{34, 35}

S. no.	Causes	Home remedies
1	Piles	<i>Trivrit</i> , <i>Danti</i> , <i>Oxalis corniculata</i> and <i>Curcuma</i> leaf mixtures fried in ghee or oil taken with curd internally.
2	Insanity	Equal amount of herb juice taken in sour gruel and jaggery blend completely can be used internally in a meal.
3	Liver disorders	Leaf extracts made from 20-30 leaves can be consumed once daily for six weeks to treat liver damage caused by much use of paracetamol.
4	Bacterial infections	<i>Oxalis corniculata</i> and <i>Curcuma</i> are combined to make a decoction and consumed having effective antibacterial effects.
5	Fever	Entire shrub is crushed, an antipyretic decoction of 200ml with 30 leaves is prepared taken to cure fever.
6	Hyperglycemia	Combination of <i>Curcuma</i> , <i>O. corniculata</i> and <i>Amalaki</i> used to prepare a decoction controls blood sugar levels.
7	Remove warts	Indian sorrel juice combined with coconut oil, regular application helps in smoothing the skin warts, which can disappear easily.
8	Jaundice cure	A tablespoon of Indian sorrel when mixed with a cup of buttermilk and consumed.
9	Red-spot eruptions	A teaspoon of Indian sorrel juice, combined with black pepper and ghee to get rid of red spot breakouts.
10	Insomnia	Mix fresh juice of Indian sorrel with castor oil, gently massage your scalp cures the insomnia
11	Headache and migraine	Combine Indian sorrel with water to make a paste when applied on forehead reduces headache.
12	Removes wrinkles	Mix sandal powder with Indian sorrel leaf juice when massaged on face reduces wrinkles.
13	Gum problems, Oral infections	Gargle with a combination of Indian sorrel leaf and normal water. Helps to whiten the teeth and reduce gum pain, cavities, tooth decay, plaque and so on.

***Oxalis corniculata* as Modern Medicine:**

Pharmacological Activities: Since its polyphenolic, glycosidic and flavonoid composition, *O. corniculata* is protective against an extensive range of infections plus exhibits several biological actions, including antifungal, anticancer,

antioxidant, antibacterial, antidiabetic and cardio protective effects. In addition, bioactive composites derived from herb have noteworthy wound curing potential³⁶. Some of the pharmacological activities of *Oxalis corniculata* are enlisted in **Table 6**.

TABLE 6: SOME PHARMACOLOGICAL ACTIVITIES OF *OXALIS CORNICULATA* LINN

S. no.	Pharmacological Activities	Results	Research
1	Wound healing	The use of <i>O. corniculata</i> in wound healing has been established. The plant extract promotes wound contraction rate, wound breaking and increased proline content.	(37, 38)

2	Antidiabetic	The aqueous extract of <i>O. corniculata</i> has been assessed for its inhibitory action against procaine pancreatic amylase showing maximal inhibition.	(39)
3	Anticancer	The ethanol extract of <i>O. corniculata</i> was tested for its anti-cancer action in Swiss albino rats resulting in reduction of tumor growth.	(40)
4	Antioxidant	The methanolic and ethanolic extract of <i>O. corniculata</i> leaves revealed strong antioxidant activity for inhibition of DPPH radical scavenging assay by 50%. The phosphomolybdate technique was used to evaluate antioxidant capacity.	(41,42)
5	Antifungal	The most susceptible organism to the aqueous extract of <i>O. corniculata</i> was <i>A. niger</i> , inhibiting fungal mycelial growth.	(43)
6	Antibacterial	<i>O. corniculata</i> leaf methanolic and ethanolic extract showed resistance activity against <i>Xanthomonas</i> and fourteen human pathogens.	(44)
7	Antidiarrheal	The antidiarrheal effect of aqueous and methanol extracts of <i>O. corniculata</i> on castor oil induced diarrhoea in rats was assessed, thus resulting in delayed beginning of diarrhoea and reduced defecation frequency.	(45)
8	Antiulcer	The antiulcer activity of aqueous and ethanol extracts of <i>O. corniculata</i> was estimated resulting reduction in gastric volume, acidity, increase in catalase as well as SOD levels and decrease in lipid peroxide.	(46)
9	Anti-inflammatory	Albumin denaturation assay, membrane stabilization assay and proteinase inhibitory action used to assess <i>in-vitro</i> anti-inflammatory action of <i>O. corniculata</i> methanol extract. Aspirin used as control agent.	(47)
10	Antiamoebic	Antiamoebic activity in axenic culture of <i>E. histolytica</i> recognized in <i>O. corniculata</i> by NMR, Infra-red and mass spectrometry. GGL shown to have most potent antiamoebic activity.	(48)
11	Hepatoprotective	Oral administration of aqueous and ethanol extract of <i>O. corniculata</i> leaves showed hepatoprotective effect against thioacetamide-induced hepatotoxicity.	(49)
12	Hypolipidemic	The hypolipidemic actions of <i>Phlogacanthus thyriflorus</i> , <i>O. corniculata</i> and <i>Fragaria vesca</i> leaves were evaluated to induce hyperlipidemia. Blood levels reduced after taking the extracts.	(50)
13	Cardio-protective	The study examined capability of <i>O. corniculata</i> aqueous extract to protect rats from ISO-induced myocardial infarction which raised activity of cardiac damage marker enzymes.	(51)
14	Nephrotoxicity	The chemical conformation and preventative function of <i>O. corniculata</i> methanol extract contrary to CCl ₄ induced nephrotoxicity in rats were examined.	(52)
15	Nematocidal	Ethanol extract of <i>O. corniculata</i> has nemato-toxic attributes against phyto-parasitic nematodes and <i>Meloidogyne incognita</i> . Nematode was immobile after 7 days incubation, examined under light microscope, approving herb's nematocidal actions	(53)

Wound-Healing Activity: The petroleum ether and alcohol extract of whole herb *O. corniculata* was tested in rats by means of excision, incision and dead space wound models. Both extracts exhibited wound healing action by increasing wound contraction level, wound contraction and reducing epithelization duration. When correlated with control, both extracts increased the granuloma tissue contraction power and hydroxyl proline content^{37,38}.

Antidiabetic Activity: The aqueous extract of *O. corniculata* shrub was evaluated for inhibitory action compared to procaine pancreatic amylase at concentration of 100g/ml indicating maximal

inhibition of 89.27%. Organic extracts showed no significant inhibition, suggesting that amylase inhibitory potential isolated only in aqueous extract³⁹.

Anticancer Activity: *O. corniculata* herb's ethanol extract was tested for anticancer action in EAC-induced in Swiss albino mice. The results showed that ethanolic extract was effective to lessen tumor development⁴⁰.

Antioxidant Activity: Mice treated with several doses of ethanol extract of *O. corniculata* indicated strong antioxidant action. When compared to standard ascorbic acid, the MEOC revealed strong

antioxidant activity. The IC₅₀ values for MEOC and standard ascorbic acid were 30 mg/ml and 37 mg/ml, respectively for the concentration of plant extract required to inhibit DPPH radical scavenging effect by 50%. Phosphomolybdate technique was used to evaluate antioxidant capacity of whole herb in three distinct solvent solutions. By using variety of conventional *in-vitro* techniques, radical scavenging activity of plant extract was studied. The quantitative estimation of main antioxidant constituents was done by means of standard method^{41, 42}.

Antifungal Activity: Antifungal action in contrast to different pathogens was evaluated in aqueous extract of four different plants. Each of the four plants showed a different response to each pathogenic fungus. Following three days of incubation, *O. corniculata* showed utmost antifungal action against *A. niger*, significantly inhibiting growth of fungal mycelia by 71% - 86%⁴³.

Antibacterial Activity: Methanol and ethanol extracts of *O. corniculata* demonstrated substantial antimicrobial action against *Xanthomonas* and fourteen humanoid pathogenic microbes. Methanol extract, when compared to K-cycline and Bact-805, showed considerably noteworthy activity against plant pathogenic bacteria. When compared to normal streptomycin, methanol extract shown moderately significant antibacterial action against human pathogenic bacteria⁴⁴.

Antidiarrheal Activity: The antidiarrheal effect of aqueous and methanol extracts of *O. corniculata* on castor oil-persuaded diarrhoea in rats, as well as on small muscle intestinal transit, was assessed when taken orally. The extracts considerably hindered the beginning of diarrhoea and reduced defecation frequency, also decreased the wetness of faeces in castor oil-induced diarrhoea and reduced the flow of charcoal meal through small intestine. The aqueous extract was more effective than methanol extract at all dosages⁴⁵.

Antiulcer Activity: The antiulcer activity of aqueous and ethanol extracts of *O. corniculata* leaves was tested with ethanol induced gastric mucosal ulcers and pylorus ligated ulcers. Both extracts resulted reduction in gastric volume and

acidity, increase in catalase and SOD levels and decrease in lipid peroxide⁴⁶.

Anti-inflammatory Activity: *In-vitro* study was used to assess the antioxidant and anti-inflammatory actions of methanol extract of *O. corniculata*. Albumin denaturation assay, membrane stabilization assay and proteinase inhibitory action at several concentrations were used to assess *in-vitro* anti-inflammatory action. Aspirin was used as control agent in study of anti-inflammatory activity⁴⁷.

Antiamoebic Activity: Numerous composites demonstrated antiamoebic action in axenic culture of *E. histolytica* identified in *O. corniculata*. The following were recognized by NMR, Infra-red and Mass spectrometry: (I) Oc-1, a mixture of saturated fatty acids C24 - C28; (II) Oc-2, a mixture of long-chain alcohols C18 - C28; (III) Oc-3, a single compound, GGL which revealed to have most potent antiamoebic activity out of all compounds produced⁴⁸.

Hepatoprotective Activity: Following oral administration of aqueous and ethanol leaf extracts of *O. corniculata*, hepatoprotective effect was assessed in contrast to thioacetamide induced hepatotoxicity. Histology of liver sections revealed dosage-dependent reduction of necrosis in animals treated with extract⁴⁹.

Hypolipidemic Activity: The study revealed antioxidant and hypolipidemic actions of *O. corniculata*, *Fragaria vesca* and *Phlogacanthus thyrsoiflorus* leaves. Rats were fed with high fat diet comprising of coconut oil as well as vanaspati ghee to persuade hyperlipidemia. Blood level of total cholesterol, triglycerides, LDL and MDA decreased significantly after taking extracts. On the other hand, there was large increase in HDL, CAT and SOD⁵⁰.

Cardio-Protective Effect: The research work examined ability of OCE to protect rats from ISO induced myocardial infarction. They were given isoproterenol to cause myocardial infarction. Rats received OCE orally over the course of 30 days as a pretreatment via an intragastric tube. ISO increased serum lipid levels and significantly raised up LDH and CPK activities. Concentration of CPK, LDH,

serum, cholesterol, LDL and triglycerides were considerably reduced after OCE pretreatment⁵¹.

Nephrotoxicity: CCl₄ causes oxidative stress in numerous tissues by changing the defence system of antioxidant enzymes. The biochemical configuration and defensive function of OCME compared to CCl₄ induced nephrotoxic rats were examined. In OCME, flavonoids, alkaloids, terpenoids, saponins, cardiac glycosides and steroids were present, but tannins absent. Total flavonoid concentration recorded at 6.92±0.52mg (rutin equivalents/g extract), whereas total phenolic contents assessed at 7.76±0.36 mg (gallic acid equivalents/g extract). Treatment with OCME led to noteworthy enhancement in altered parameters. Due to antioxidant properties of phenolics, it can be said OCME has defensive influence against CCl₄-induced oxidative stress in rats⁵².

Nematocidal Activity: It was revealed through investigation that ethanol extract of *O. corniculata* has nemato-toxic attributes against phyto-parasitic nematodes and *Meloidogyne incognita*. In this study nematode was immobile after 7 days' incubation. This was examined under light microscope, approving herb's nematocidal actions⁵³.

CONCLUSION: Through the analysis done in this study, it can be concluded that *O. corniculata* includes a diverse collection of bioactive constituents including tannins, flavonoids, glycosides, oleic, linoleic and stearic acid, all of which have been employed medicinally and have a number of positive nutritional benefits since prehistoric eras. It has gained ample usage in traditional medication to treat a variety of conditions, including piles, skin infections, wound curing and diarrhoea.

Modern medicine today recognizes the *O. corniculata* extracts' numerous desirable traits, including their antioxidant, antibacterial, anti-inflammatory, wound-healing and hepato-protective effects. The study emphasizes the morphological, phytochemical, therapeutic, nutritional and pharmacological attributes of the plant. Despite the plant's benefits, research on the toxicity of plant-based medications is still crucial. As an outcome, it could be summarized that *O.*

corniculata in modern medicine has bounteous scope for further study when taken into account its entire potential^{54,55}.

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