Introduction

From old age, plants are used as crude material for drugs. In India, rich knowledge of medicinal importance of plants is available to the common people. About 3,500 plant species are useful as a source of crude drug in India. Medicinally important plants are about 2,500 in number. Some plant species are considered as a weed, but they are also medicinally important too. In various traditional and modern methods of therapy, plants products are used. In current era, the trend of using herbal medicine is in scope. New drugs are discovered by the invention of modern biotechnological and bioinformatics techniques. In current era, herbal medicines are used more often as human believe in natural therapies is increasing day by day. Novel clinically active drugs are discovered from natural products isolated from higher plants and microorganisms. Cleome viscosa Linn. (wild or dog mustard), family (Capparaceae) is a sticky herb found as a common weed in plains of Pakistan, India, China, Ceylon, Africa etc and throughout the tropical regions of world annually. In traditional system of medicine leaves, seeds and roots of the plant are widely used as an anthelmintic, antiscorbutic, antisptic, cardiac stimulant, carminative, febrifuge and sudorific, antidiarrhoeal, and are also used to treat skin diseases. It is called as ‘Hurhur’ in India. Traditionally Cleome viscosa Linn. plant is an antimalarial drug and useful in blood diseases, uterine complaints also. The pungent seeds and seed pods are used as a mustard substitute in curries.

Biological Description and Taxonomy

Cleome viscosa Linn. is an annual, erect, 30-90 cm high plant. Stem of plant is grooved, densely clothed with glandular and simple hairs. Leaves of the plant are 3-5 foliolute. Lower leaves petioles are 2.5-5 cm long gradually becoming shorter upwards. The bracts are subsessile. Leaflets are elliptical–oblong or obovate, acute or obtuse. Petioles are slender, terete and hairy. Flowers are yellow in colour, axillary, growing out into a lax raceme. Pedicels are slender, terete and hairy. Flowers are yellow in colour, axillary, growing out into a lax raceme. Petals are oblong–obovate, about 12 mm long, veined. Stamens are more than 20 in number. Capsules 5-6.3 by 0.4 cm., erect, hairy, obliquely striate, compressed, tapering towards both ends, terminated by a style 3 mm. long. Seeds are brown–black in colour when ripe, finely transversely striate, subglobose (Figure 1).

Classification

<table>
<thead>
<tr>
<th>Kingdom</th>
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<tr>
<td>Subkingdom</td>
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<td>Magnoliopsida</td>
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<td>Subclass</td>
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Key words: Anticonvulsant, Biodiesel, Cleomiscosin, Cleome viscosa Linn., Phytochemical, Psychopharmacological.

Summary

- A number of phytochemicals isolated from various parts (root, stem, leaf and seed) of Cleome viscosa Linn have been reported. Out of them, terpenes, flavonoids, phenol carboxylic acid are major category. The coumarin, cedrene, α-amorphene, ethyl palmitate, coumarinolignoids (Cleomiscosin A and B), and Eriodictyol-5-rhamnoside as chief pharmacologically active principle.
- Cleome viscosa Linn has been explored in a wide range of pharmacological activities such as antimicrobial, antiinflammatory, antiinfectious, hepatoprotective, antifibrotic, antitumor, anticonvulsant and miscellaneous activities. Its anticonvulsant potential has been reported as prominent activity.


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Order: Cappares
Family: Capparaceae
Genus: Cleome Linn.
Species: Cleome viscosa Linn.

Distribution
*Cleome viscosa* Linn. occurs throughout the tropical regions of the world. It occurs in India, USA, Nigeria, China, Ceylon, Pakistan, and Africa.¹

Phytochemistry
To isolate and characterize compounds, phytochemical work has been performed on various parts of the plant (root, stem, leaf, and seed). Preliminary phytochemical screening of the extracts was performed and it was reported that terpenes, flavonoids, phenol carboxylic acid, polyphenols were present.² It has been reported that monoterpenes hydrocarbons, sesquiterpenoids, oxygenated derivatives were isolated from leaves, seeds, and root extracts. Compounds identified by Gas chromatography (GC), Gas chromatography/mass spectrometry (GC-MS),¹ H NMR in leaves extract of *Cleome viscosa* Linn. were Heptane-4-one, α-pinene, camphene, dehydrosabenene, 6-Methylhept-5-ene-2-one, β-pinene, myrcene, p-cymene, limonene, E-ocimene, α-tepeniol, allo-ocimene, citronelic acid, coumarin, cedrene, α-amorphene, ethyl palmitate. Oct-1-ene, α-pinene, β-pinene, myrcene, p-cymene, E-ocimene, dehydrolinalool, undecan, allo-ocimene, limonene oxide, α-tepeniol, Decan-2-ol, citronelic acid, Deca-2,4-dien-1-al were identified in roots extract. In seeds extract, Oct-1-ene, Heptane-4-one, Heptane-2-one, Non-1-ene, α-pinene, dehydrosabenene, 6-Methylhept-5-ene-2-one, E-ocimene, myrcene, p-cymene, limonene, dehydrolinalool, undecan, limonene oxide, α-tepeniol, benzoic acid, Deca-2,4-dien-1-al, Decan-2-ol, Gerniol, Undec-10-e-1-al, coumarin were detected.³ Viscocic, viscosin (monomethoxy trihydroxyflavone) were identified in seeds.⁷ Eriodictyol-5-rhamnoside (Novel glycoside) has been isolated from whole plant.⁶ Cleomiscosin A and B were detected in seeds extracts.⁸ Glu-cocapparin and glucocleomin (glucosinolates)⁹ and cleomaldeic acid ((3E,7E,11E) 20-oxocembra-3, 7, 11, 15-tetraen-19-oic acid) a macrocyclic diterpene have been separated from whole plant.¹⁰ Some of the phytoconstituents are presented in Table 1.

**Pharmacological Activity**
In view of its traditional claim in literatures, researchers have focused on its pharmacological screening. Out of all the activities reported, some important activities are explained in this manuscript as:

**Antimicrobial Activity**
The antimicrobial study was performed on various extracts of *Cleome viscosa* Linn. seeds. Eight microbial species were used. Petroleum ether...
extract, chloroform extract, ethyl acetate extract, ethanol extract and aqueous extract of Cleome viscosa Linn. seeds were screened against these eight microbial species. Clinical samples of pus from ear ache patients were also used. The test materials have shown significant antimicrobial activity. The zones of inhibition were found to be between 10 mm to 17 mm. The Minimum inhibitory concentration (MIC) values of extracts were also determined against microorganism which ranges from 0.1 to 0.45.14

**Antalgic Activity**

A study was performed to evaluate the analgesic effect of Cleome viscosa Linn. in experimental animal models. The number of writhes were decreased at doses (75 mg/kg body weight, 100 mg/kg body weight, 125 mg/kg body weight) of Cleome viscosa Linn. seeds fixed oil when compared to aspirin treatment and the control. Fixed oil in doses of (75 mg/kg body weight, 100 mg/kg body weight, 125 mg/kg body weight) reduces the writhes number by 91.69%, 92.33% and 96.0%, respectively. At a dose of (150 mg/kg body weight) the mice group treated with aspirin had 11 writhes. But the control group had 62 writhes, thus the positive effect of aspirin was that it reduces the writhes by 82.42%. The acetic acid induced writhing method is an effective method to evaluate peripherally active analgesics.3

**Antiemetic Activity**

A study was performed to evaluate the antiemetic effect of Cleome viscosa Linn. fixed oil on young chicks. Fixed oil in doses of (75 mg/kg body weight, 100 mg/kg body weight and 125 mg/kg body weight) reduces the retches number by 84.43%, 85.56% and 91.77%, respectively. At a dose of (150 mg/kg body weight) the chicks group treated with chlorpromazine had 47 retches. But the control group had 68 retches, thus chlorpromazine reduced the retches by 30.56%. Cleome viscosa Linn. seed oil inhibited emesis to a greater extent than chlorpromazine. On the basis of these results, it may be said that the fixed oil of Cleome viscosa Linn. has antiemetic potential and is comparable with chlorpromazine, which can relieve nausea.3

**Antidiarrhoeal Activity**

For evaluation of the effect of a Cleome viscosa Linn. methanolic extract (Family; Capparidaceae) for its anti-diarrhoeal potential against some of the models of diarrhoea in rats, "A study was performed." In castor-oil-induced diarrhoea and PGE, induced enteropooling in rats inhibitory activity was observed due to extract. A significant reduction in gastro-intestinal motility in the charcoal meal test in rats was also shown by the extract. From the results achieved it was cleared that Cleome viscosa Linn. is an effective anti-diarrhoeal agent.13

**Hepatoprotective Activity**

In experimental animal models, hepatoprotective activity of Cleome viscosa Linn. ethanolic extract against carbon tetrachloride induced hepatotoxicity was evaluated. In “in vivo” and histopathological studies, the test material was found effective. The extract effectively shortened the “thiopental” induced sleep in animal poisoned with carbon tetrachloride. Cleome viscosa Linn. ethanolic extract showed similar effect as “Silymarin” a standard hepatoprotective agent. From the result observed it was cleared that Cleome viscosa Linn. ethanolic extract is an effective hepatoprotective agent.14

**Antifibrotic Activity**

The study was performed to evaluate the antifibrotic activity of Cleome viscosa Linn. ethanolic extract. Carbon tetrachloride was used to induce liver fibrosis in rats. By observing the level of liver hydroxyproline, thioctic acid and serum enzymes the extent of liver fibrosis was assessed. Hydroxyproline, thioctic acid and serum enzymes levels were elevated and total platelet was decreased after carbon tetrachloride administration. Hydroxyproline level, thioctic acid level and serum enzyme level was reduced after treatment with two different doses of Cleome viscosa Linn. ethanolic extract. By Cleome viscosa Linn. ethanolic extract liver weight was reduced that was increased after carbon tetrachloride administration that causes the deposition of collagen. From the result obtained it was clear that Cleome viscosa Linn. ethanolic extract is an effective antifibrotic drug.15

**Antitumor Activity**

A study was carried out to evaluate the anticancer effect of Cleome viscosa Linn. in experimental animal models. After 24 hours of tumor inoculation the extract was administered at the doses of 200 mg/kg, and 400 mg/kg body weight per day for 14 days. The mice were sacrificed after giving the final dose and 18 hours fasting. The effect of Cleome viscosa Linn. methanolic extract on the growth of transplantable murine tumor and life period of Ehrlich ascites carcinoma-bearing hosts was studied in current study. A significant reduction in tumor volume, packed cell volume, and viable cell count was observed due to Cleome viscosa Linn. methanolic extract. It also causes enhancement in the life period of Ehrlich ascites carcinoma-tumor bearing mice. In extract-treated mice the hematological profile was converted to more or less normal levels. From the results obtained it was clear that Cleome viscosa Linn. methanolic extract causes significant antitumor effect in Ehrlich ascites carcinoma-bearing mice.16

**Anticonvulsant Activity**

A study was performed to evaluate the anticonvulsant activity of Cleome viscosa Linn. seeds extract by Maximal Electroshock induced seizures (MES) test and Pentylenetetrazole induced seizures (PTZ) test. Significant activity was shown by both ethanolic and aqueous seeds extract in MES and PTZ induced convulsions.17

**Psychopharmacological Activity**

For different psychopharmacological actions such as general behaviour, exploratory behaviour, muscle relaxant activity and phenobarbitone induced sleeping time and effects on normal body temperature in rats and mice, Cleome viscosa Linn. methanolic extract was evaluated. Reduction in spontaneous activity, decrease in exploratory behavioural pattern by the head dip and Y-maze test, reduction in the muscle relaxant by rotarod, 30 degrees inclined screen and traction tests and lowering of body temperature was observed after extract administration. Extract also causes significant enhancement in the phenobarbitone-induced sleeping time. At 200-400 mg/kg dose Cleome viscosa Linn. methanolic extract showed significant psychopharmacological effect.18,19

**Cleome viscosa Linn-Biodiesel Application**

By chemical reaction of the lipids (vegetable-oil, animal fat) with an alcohol, biodiesel “vegetable-oil or animal fat based fuel” consisting of alkyl (methyl, propyl, or ethyl) esters can be obtained. Biodiesel is a clean burning alternative fuel to diesel. It is produced from domestically grown renewable resources. In variety of biodiesel alkyl esters are present but not in alkanes and aromatic hydrocarbons of petroleum derived diesel. Cleome viscosa Linn. seeds oil was used to prepare biodiesel. The physicochemical properties were studied for blended portion of biodiesel. The physico-chemical properties assessed includes, specific gravity, density, viscosity, flash point, fire point, cloud point, pour point, smoke point, pH, viscosity, carbon residue, saponification value, acid value, and iodine value.20

**Toxicity Studies**

It has been reported that Cleome viscosa Linn. is safe during acute toxicity studies in female swiss albino mice.15
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CONCLUSION

Cleome viscosa Linn. has been examined meticulously for its phytochemical and pharmacological activities. From the aforementioned explanation, it is noticeable that Cleome viscosa Linn. has been used as an important curative agent for various ailments, as discussed in the review. The review cited the use of Cleome viscosa Linn. seeds oil in the biodiesel production also. Numerous compounds were isolated from plant which are accountable for its pharmacological activities.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES


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