

Review Article

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**Plant profile, phytochemistry and pharmacological properties of
Ceratophyllum demersum Linn.: A review**

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ABSTRACT:

Ceratophyllum demersum Linn.(CD) from the family Ceratophyllaceae is the significant & appealing marine macrophyte that has a slight affirmation in customary arrangement of medication as an pain relieving, antipyretics, anti-inflammatory, astringent, antiulcer, antidiabetic, anticancer and so forth. There isn't as quite a bit of data existing about phytoconstituents & therapeutic possessions of plant. Till date aggregated evidences about its therapeutic properties, phytoconstituents & further associated data are missing. In this review, we found that the plant CD. contains distinctive phytoconstituents like flavonoids and glycosides, sterols, terpenoids, sugars, tannins, proteins, volatile oil, alkaloids. Medicinal and other related data of CD. and fill the information hole in this specific field & supports further assessment on the plant & other oceanic macrophytes by way of these totally will benefit in making potential biopharmaceutical thing.

Keywords: Ceratophyllaceae, Hornwort, *Ceratophyllum demersum*L., marine macrophyte,

INTRODUCTION



Figure: 1. *Ceratophyllum demersum* plant

Family- Ceratophyllaceae

Distribution: Plant occurs all through world in aquatic circumstance e.g. tanks, Ponds, riverbeds, seacoasts.

Table 1: Alternative names of *Ceratophyllum demersum* Linn.

Region	Alternative name
Hindi	Sivar, Kai
English	Coontail, Hornwort
Sanskrit	Jaiaja
Kannada	Cande
Malayalam	Karimpayal
Telugu	Nasu
Marathi	Saival
Japan	Marsumo
Taiwan	Hornweed
United Kingdom	Rigid Hornwort

Propagation: Seeds, plant sections.

Habitat: Inland and beach front lakes, lakes and moderate moving streams and rivers. Tolerant of hard water (high calcium content) and low light levels.^(1,2)

Table 2: Scientific Classification of *Ceratophyllum demersum* Linn.

Kingdom	Plantae
Phylum	Spermatophyta
Sub phylum	Angiospermae
Class	Dicotyledonae
Order	Nymphaeales
Family	Ceratophyllaceae
Genus	<i>Ceratophyllum</i>
Species	<i>Demersum</i>

Description:

Ceratophyllum demersum L. (CD) is an aquatic herb, around eight inches to three feet in length, thickly leaved, green in shading. Leaves close around one inch long which are spread in water & shaping net-like, between together, over the water surface, step by step a thick inclusion on the water surface. It is comprehensively obtained in the lower side of lakes.⁽³⁾

CD is a submerged trustworthy macrophyte that will as a rule conveyed with the establishment of its stem covered up in grimy or silty substrates. It doesn't generate roots.

Nomenclature:

Leaf: The 1.6- 4 cm long leaves are branched into 2 (sometimes 4) straightened or linear segments with minor teeth along one edge. The leaves are regularly fairly hardened or crunchy. They are arranged in whorls of 5 to 13 leaves with the whorls getting thick towards the stem tip.

Stem: Prolong, 30cm- 60 cm long, unreservedly fanning and either delicate solidly extended or string like and versatile; hubs 1cm- 3 cm separated however becoming crowded near the tips.

Root: Roots are missing, replaced by finely isolated basal stem branches named 'rhizoid shoots' Floats openly underneath the surface, or is in some cases anchored to the base by altered leaves, particularly in streaming water.

Flower: Greenish, Tiny, little to one mm long, unisexual, separated & sessile in leaf bases, every subtended in 9- 12 calyx-like bracts, male & female blossom by occur independently on the similar plant.; female blossom brief ovary surmounted by a solitary straightforward style and single; The male blossoms happen two by two on inverse sides of the stem, with 12 to 15

sessile elongated anthers each ending in 2 sharp focuses. Blooming happens from June to September.

Fruit: The little (4-7mm), Black ellipsoid achenes, hard, one-seeded, egg shaped fruit has 3 long spines, one spine at the fruit tip and 2 at the base.

Seed-The fruit goes about as seed.⁽⁵⁾

Chemical Constituents:

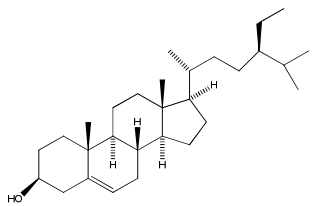
The plant *CD* extracts comprise of various types of phytochemicals for example, flavonoids, alkaloids, glycosides, tannins & cardiac glycoside.^(6,7) *CD* incorporates magnesium, calcium dry matter, nitrogen free extract, crude protein, crude fibre, crude Fat & ash.^(8, 9, 10) The essential oil obtained from the *CD* was isolated by the steam distillation method & the structure of isolates identified by GC- MS.

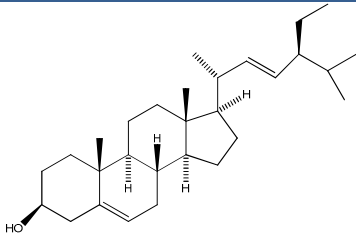
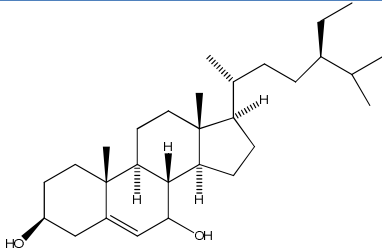
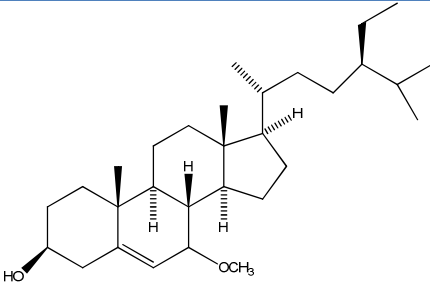
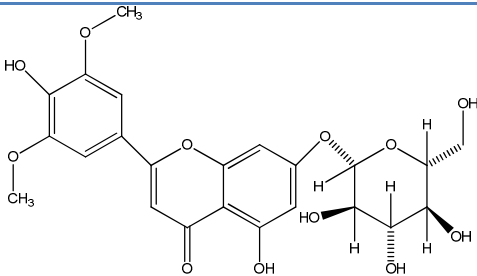
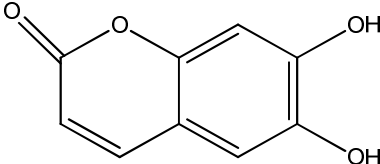
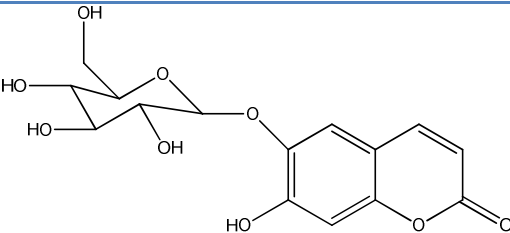
Table 3: The chief constituents identified from essential oil of the plant *CD* include:^(11,12)

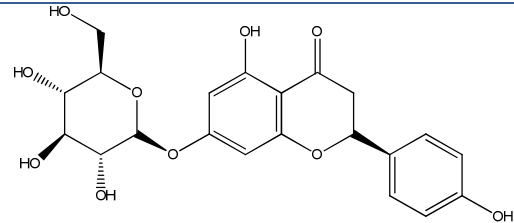
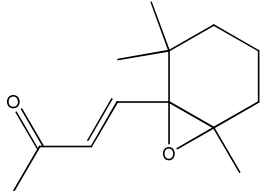
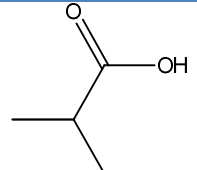
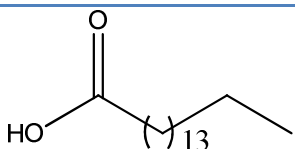
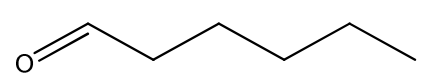
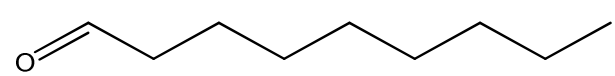
β -sitosterol	2-methylpropanoic acid	1,2-benzenedicarboxylic acid di(2-methylpropyl) ester	Tricin-7-O- β -D-glucoside
hexanal	7 α -methoxy- β -sitosterol	2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	β -ionone-5,6-epoxide
esculetin	7 α -hydroxy- β -sitosterol	palmitic acid	naringenin-7- O- β -D-glucoside

Apigenin-7-O-glucoside isolated and identified as a flavonoid glycoside & sitosterol in another investigation. Volatile composites were isolated and identified mainly as sesquiterpene, n-paraffins, benzyl acetate.⁽¹³⁾ In another investigation of the extract of *CD* reported β –carotene, Gentisic acid, ferulic acid, vitamin C and Coumaric acid.⁽¹⁴⁾

Table4: Important Chemical Constituents of *Ceratophyllum demersum* Linn.

Sr. No.	Name of Compound	Structure
1.	Beta-Sitosterol	

2.	Stigmasterol	
3.	7 α Hydroxy Beta sitosterol	
4.	7 Methoxy Beta sitosterol	
5.	Triacin-O- Beta glycoside	
6.	Esculatin	
7.	Aesculin	

8.	Naringenin 7-O- Beta- D- Glucoside	
9.	Beta ionone 5,6 Epoxide	
10.	2- Methyl Propanoic acid	
11.	Palmitic acid	
12.	Hexanal	
13.	Nonanal	

Traditional Uses:

The ethnomedicinal usages of the plant *CD* recommended in the treatment of different maladies. The juice of *CD* with sesame oil is recommended for the treatment of discoloured skin. 10 to 15 ml of aqueous extract of plant given two times in a day for 7 to 10 days for the treatment of biliousness and ulceration.^(15,16)

Leaf is utilized as antipyretic, to control bile release & cardio tonic. Pest of leaves is smeared

on the superficial level in occurrence of scorpion nibble.^(17, 18, 19) It is utilized as antipyretic, healing agent, antitoxic, astringent, pain-relieving, anti-inflammatory, hepatoprotective, anti-diarrheal & in the respiratory infections.⁽²⁰⁾

The plant is bitter, oleaginous, refrigerant, fragrant, constipating & is helpful in circumstances of pitta, burning sensation, hematemesis, dysentery, epistaxis, diarrhoea, haemorrhoids or piles, ulcers, hyperdipsia, haemoptysis, & intermittent fevers.^(21,22,23) In Indian medication, the plant *CD* is utilized in jaundice, in the treatment of malaria and for scorpion bites⁽²⁴⁾; in China its ancient with haemoptysis, watery dig up of the established in contradiction of diarrhoea & wound restoring impact.⁽²⁵⁾ It is endorsed for CVS infections, rheumatism, giddiness, morbid thirst, haemothermia, leucorrhoea, spermaturia, venereal diseases.^(23, 26)

In Sushruta The whole plant *CD* is utilized traditionally as antidiabetic.⁽²⁷⁾

In Ayurveda; Charaka used the whole plant, in prescriptions, for hypothermia, dizziness, morbid thirst; externally in rheumatism, erysipelas.

Shaivala, in Ayurvedic writings, has a place with Bhadrashriyaadi Group, which is recommended in natural haemorrhages. Sushruta utilized in the treatment of spermaturia.

In conventional medication, it is utilized to stop the bleeding when it is applied to a wound; additionally recommended in leucorrhoea to stop thick, whitish vaginal release & sexually transmitted ailments. Its ash is applied superficially on discoloured skin with sesame oil. The paste is utilized externally in inflammations.⁽²⁸⁾

Charaka recommended the seeds of *CD* taken with Ushira: *Vetiveria zizanioides* & Dhaanyaka: *Coriandrum sativum* in vomiting and digestion problems. On account of unnecessary consuming sensation and in fever, the soup of seeds of *CD* was recommended (Bhaavaprakasha). Maadhava Dravyaguna recognised antibilious, blood-purifying potential to seed of *CD* yet furthermore considered it punsatvaghna for example it is responsible for impotency.⁽²⁸⁾

Pharmacological review of plant *Ceratophyllum demersum* Linn.

Thomas Abu 2017 and Ibrahim Syed, et. al., 2018 revealed as a pharmacological survey of the medicinally significant plant *CD* that has been depicted by numerous authors, I have outlined major pharmacological exercises that have been reported.^(24, 29)

1. Antidiarrhoeal & wound curative activity:

The methanol & aq. extracts of whole plant *CD* were assessed for in contradiction of diarrhoea & wound restoring possibilities utilizing different test models. The 250 mg/kg &

500 mg/kg dose is utilized for assessment of antidiarrhoeal potency. Both extracts shown significant antidiarrhoeal & major wound curative activities. It might be contemplated that; methanol and aq. extracts has hostile to diarrhoea and wound restoring exercises, which support the utilization of the total plant in constant medicine deal with the free guts and wound.⁽³⁰⁻³³⁾

2. Antioxidant & anti-acetyl cholinesterase potential:

DPPH radical scavenging & ferric reducing antioxidant power assay method was utilized for screening of antioxidant potential at different concentrations. Folin-Ciocalteu's reagent method is used for determination of total phenol contents present in the extracts. 528.29±4.07 of total phenol content found in extract of *CD* & percentage of DPPH radical scavenging activity was found to be 39.3±1.11; 22.6±0.62 & 12.2±1.06 at 2.0; 1.0 & 0.5 mg/ml conc. Respectively and as a Standard Gallic acid shown percentage of inhibition at the same conc. i.e. 93.2±0.00, 92.6±0.10 and 91.6±0.06.

In FRAP, the absorbance were obtained 0.329±0.02 & 0.609±0.02 at conc. 0.5 & 1.0 mg/ml; Standard Gallic acid: 3.569±0.02 & 3.677±0.02 at same conc.⁽³⁴⁾

In vitro free radical scavenging potential of aqueous & methanol extracts from *in vitro* proliferated *CD* utilizing DPPH were researched. DPPH scavenging potential water & methanol extracts was found to be 68.91% & 51.22% at conc. 10 mg/ml and IC₅₀ values 3.689 mg/ml & 10.301 mg/kg respectively. Standard Gallic acid was showed 0.029 mg/ml with statistically significant ($p < 0.05$).⁽³⁵⁾

Another investigation showed that the inclusion of the aquatic macrophyte *CD* to dichlorobenzene (DCB) method had the option to cause an enactment of the antioxidant framework, showing an isomer unequivocal model, which suggests that the protection arrangement of the plant is expecting a huge activity in scavenging ROS, assisting with guaranteeing the organism against horrible oxidative effects delivered by the prooxidant movement of the attempted xenobiotics.⁽³⁶⁾

3. Antimicrobial Potential:

The antimicrobial capability of *CD* with other macrophyte were extracted with solvents; acetone, butanol & methanol and decided the potency against pathogenic organisms like Gm^{+ve} , Gm^{-ve} bacteria & fungi through agar well dissemination method.

The 50% acetone extract of *CD* triggering 18mm zone of inhibition against fungi indicates that antifungal potency. The plant extract did not shown any action against Gm^{+ve} , Gm^{-ve}

bacteria.⁽³⁷⁾

In another examination, extracts of *CD* with other plants attempted for in vitro antimicrobial action against 17 different microorganisms(MO) including Gm^{+ve} , Gm^{-ve} bacteria.& fungi; 09 of these recognized organisms were gained from various sources. The other 08 organisms were quarantined from alternative source & perceived by utilizing API 20E strip framework. Hundred pathogenic bacteria separates signifying 08 genera were perceived to species level. The extract displayed antimicrobial activity in logical inconsistency of the entirely tried organisms.⁽³⁸⁾

4. Antiinflammatory & Antineoplastic potential:

Along with other plant extract; hexane extracted essential oil components of *CD* assessed for the antineoplastic & activity against inflammation through prediction activity spectra for substances (PASS). The foreseen estimation of antineoplastic & activity against inflammation showed twelve composites with above 0.8 probability value & distinguished as; 2,6-Dimethylcyclohexan-1-ol, beta-ionone, biformen, 2-Phenylacetaldehyde, alpha-murolene, kaurene, Octa-3,5-dien-2-one; alpha- eudesmol, Hepta-2,4-dienal, geranylacetone, manol and beta-eudesmol.⁽³⁹⁾

By utilizing the Carrageenan persuaded rat paw edema model; the anti-inflammatory action at dose 250mg/kg & 500 mg/kg body weight of methanolic concentrate of *CD* was tried with control 1% CMC at dose 10 mg/kg & Nimesulide at dose 50 mg/kg. The methanolic concentrate of *CD* at the same dose showed paw volume reduced significantly ($p < 0.01$).⁽³⁹⁾

5. Analgesic Action:

By utilizing acetic acid persuaded writhing model in albino mice; methanolic extract of *CD* (250mg/kg & 500 mg/kg of body wt.) were affirm the analgesic potential. The extract demonstrated critical fall in quantity of writhes therefore showing its pain relieving movement dependent on dose.⁽⁴⁰⁾

6. Antipyretic Action:

For assessing antipyretic action of *CD* in rats; Brewer's yeast persuaded pyrexia technique utilized. The dose of 250 mg/kg body wt. of methanolic extract demonstrated huge diminished pyrexia & the number of writhes and paw volume decreased at the conc. 500 mg/kg body wt. indicated reduction in pyrexia essentially, hence displaying its antipyretic movement.^(39,40)

7. Antiulcer Action

Methanol & aq. Concentrate of *CD* was assessed for antiulcer action at a conc. of 250 & 500 mg/kg body wt. It demonstrates that, both the concentrates at 500 mg/kg indicated noteworthy rise in pH, reduction in gastric acid volume & total acidity. In this manner, *C. demersum* shows antiulcer potential, hence whole plant utilized to treat ulcer condition.^(41,42)

8. Genotoxic & Allelopathic capacity:

By using 'Mussel micronucleus test' the genotoxic capacity of aq. concentrate of *CD* was assessed together with other marine herbs to discover conceivable association with the complete tannin and polyphenol content. From the haemolymph of painter's mussel (*Unio pictorum* L.); micronucleus frequency was determined

In similar, total tannin and hydrolysable tannin matters were assessed. Remarkable mutagenic impact shown by the plant extracts. Noteworthy connection was resolved between mutagenic limit & tannin content. It showed that tannin is responsible for genotoxicity limit which may recommend this plant to clarify a genuine environmental impact in the ecosystem.⁽⁴³⁾

The Allelopathic action of *CD* was additionally assessed and a bioassay-coordinated technique advancement uncovered ideal extraction solvents for allelochemicals from the plant. Additional fractionation through liq.-liq. extraction & solid phase extraction methodology demonstrated that the marine macrophyte seem to have hydrophilic & moderately lipophilic active fraction. The macrophyte furthermore displayed active compounds allelopathically into the surrounding medium as seemed by SPE of their incubation H₂O.⁽⁴⁴⁾

In another examination, the prospective associations amid the phytochemical compounds i.e. alcohol, hydrocarbons, phenols, heterocycles, acids recognized within the plant extract & along these lines the allelopathic possessions against Gm^{+ve} and Gm^{-ve} bacteria & microalgal cultures were researched.

The Dried plants incubated for twenty five minutes at 50°C undergoes untargeted solid phase micro extraction (SPME) GC-MS investigation revealed that phenols are the significant constituents of the volatile fingerprint with a relative peak area above 13%, in particular: 3,5-bis (1,1-dimethylethyl); 2,6 bis(1,1-dimethylethyl)-4(1-oxopropyl) phenol.⁽⁴⁵⁾

CONCLUSION:

Natural things have been a basic resource for the affirmation of life and are getting rising hugeness as different prescriptions. *CD* had a wide history of ordinary uses for wide extent of illnesses. Experimentally proved biological activities of this plant are used in battling the different maladies. Be that as it may, explicit affirmation of the set as a common medication is deficient. It has been deductively demonstrated that this plant have various biological activities. Regardless, the preeminent difficulties in the propelled day treatment are the undesirable possibilities and the productivity in management of disease. A further examination requires utilizing the isolated composites from other marine macrophytes to explore its potency against the treatment of various maladies with the negligible/ not at all side effects. All the more in this way, guaranteeing the safe use of these plants ought to be strived more. This deposit is used in sort out to variety a trademark through a lot of diseases lighten and economical regimen to be had for poor people in emerging possible biopharmaceutical product.

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