# A review on *Cressa cretica* Linn.: A halophytic plant

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## ABSTRACT

Herbal medicine is used by up to 80% of the population in developing countries. *Cressa cretica* L. is a popular holophytic plant and is used in folklore medicine for ailments including diabetes, ulcers, asthma, anthelmintic, stomachic, tonic and aphrodisiac purposes, enriches the blood, and is useful in constipation, leprosy, and urinary discharges. The plant is traditionally used in Bahrain as expectorant and antibilious agent. Scientific evidence suggests its versatile biological functions such as its antibacterial, antifungal, antitussive, anticancer with some other plants, anti-inflammatory, and improving testicular function in rats. In this article, a comprehensive account of the morphology, phytochemical constituents, ethnobotany, and biological activities are included in view of the recent findings of importance on the plant, *C. cretica.*

**Key words:** *Cressa cretica*, holophytic, review

## INTRODUCTION

World Health Organization survey indicated that about 70–80% of the world's population rely on nonconventional medicine, mainly of herbal sources, in their primary healthcare. This is especially the case in developing countries where the cost of consulting a western style doctor and the price of medication are beyond the means of most people.[1,2] There has been an explosion of scientific information concerning plants, crude plant extracts, and various substances from plants as medicinal agents during last 20–30 years. Although herbal medicine has existed since the dawn of time, our knowledge of how plants actually affect human physiology remains largely unexplored. Numbers of plants are claiming various medicinal uses and many researches are going on in this view. India is one among the 25 hotspots of the richest and highly endangered eco-regions of the world.[3]

Among the medicinal plants, halophytic plants are very significant. Halophytic vegetation dominates these tidal marsh ecosystems. Plants develop specific anatomical, morphological, and physiological characteristics enabling them to perform their vital functions in the presence of large concentrations of harmful salts.[4] The ability of some of these halophytes to resist high salt conditions is because of two main mechanisms—these plants exclude the salt well in leaves (salt exclusion) and compartmentalize it in vacuoles (salt compartmentalization). Salt exclusion from leaves occurs by selectivity of uptake of Na+ and Cl− by root cells, preferential loading of K+ rather than Na+ by the stellar cells, and removal of salt from the xylem. Another mechanism of export from leaves or the capacity for salt avoidance is through structures like salt glands. Salt compartmentalization occurs by sequestration of Na+ and Cl− in the vacuole of the cell. Salt compartmentalization is an efficient mechanism used by halophytes to store excess Na+ in the vacuole.[5] This mechanism is aided by the Na+/H+ antiport activity, which was demonstrated in a relatively salt-tolerant glycophyte like *Beta vulgaris*.[6] It was later shown that glycophytes also possess similar strategy, revealed by the identification of Na+/H+ antiporters.[7] However, the importance of this mechanism in salt tolerance is exemplified by the finding that overexpression of the *AtNHX1* gene, which encodes a Na+/H+ antiporter, improved plant salt tolerance.[8] Most importantly, halophytes have developed "controls" in $Na^+$ influx strategy in roots that are proposed to be an important mechanism for lower $Na^+$ accumulation compared to glycophytes.[9] Halophytes also have a capacity for osmotic adjustment.

Most of the medicinal halophyte plants are herbs and forbs and were perennial, and their biological types were therophyte and chameophyte. There is a need for systematic study of all plants used in native medicine or folk medicine as no pharmaceutical and chemical research has yet been done on these species, among which *Cressa cretica* is one.[10]

*C. cretica* L., belonging to the family Convolvulaceae, is a perennial plant with a lifecycle that continues in the summer period when the salt marsh area drains. *C. cretica* is a thermocosmopolitan halophilous species. *C. cretica* usually grows in sandy or muddy

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saline habitats along the sea coast along with the species *Suaeda maritima*, *Salicornia europaea*, *Salsola soda*, *Limonium vulgare* subsp. *Serotinum*, and *Crypsis aculeate*.[11]Variation in *Cressa* has been handled in two ways: extreme lumping into the single species *C. cretica*, or extreme splitting of every morphological variant into 19 species.[12-16] Those in the New World represent *C. nudicaulis* and *C. truxillensis*.[17-19] The two in the Old World, however, are still being placed in a single species, *C. cretica*.[16-22] Old World plants are considered one species even though those in Europe, Africa, and Asia are morphologically and geographically distinct from those in Australia. In this article, a comprehensive account of morphology, phytochemistry, ehthnomedicinal uses, and pharmacological activities are included in view of many recent findings of the importance on this plant.

Sanjeevani is among the most mysterious and most sought-after herbs in Indian mythology, whose existence and identity are steeped in deep controversy. While the miracle associated with this herb is due to its alleged potentiality for "resurrecting" life, the controversy about its existence and identity is because of the difficulties in arriving at a specific candidate plant (species) that could pass as Sanjeevani. *C. cretica* is a plant that is referred to by the name that reflects the features of *Sanjeevani*. So this plant is commonly known in Sanskrit as Sanjeevani as it prolongs the life and prevents the onset of old age.[23]

### Hierarchy of *C. cretica* L.

Kingdom – Plantae
Phylum – Angiosperms
Class – Magnoliatae
Subclass – Asteridae
Order – Polemoniales
Family – Convolvulaceae
Genus – *Cressa*
Species – *Cretica*

### Vernacular names[23- 26]

Hindi – Rudravanti
Oriya – Dahna
Tamil – Uppu Marikkozhundu
Telugu – Uppusanaga
Sanskrit – Rudanti
Bengali – Rudravanti

## GROWTH AND DISTRIBUTION

*C. cretica* L. is a small dwarf shrub upto 38 cm height. The specimens of *C. cretica* start to shoot in the beginning of June. The smallest adult specimens are about 5–6 cm high, while the highest ones are about 20 cm. Most of the specimens are about 10 cm high. Flowering and fruiting time is from the end of June to the end of August. During September, the plant gradually withers. In the end of September and beginning of October, coincides with the opening days of more abundant and higher quantum of precipitation, when the moisture content in the soil increases and finally the whole area becomes inundated again. The seeds of *C. cretica* remain dormant in the inundated soil until June of the next year. This plant is distributed throughout India, Timor, and Australia (Western Australia, Northern Territory, Southern Australia, Queensland, New South Wales, Victoria).[23-25]

## MORPHOLOGY

*C. cretica* is a cushion chamaephyte excretive halophyte. An erect dwarf shrub can be upto 38 cm in height. Roots are horizontal, geminate, with lateral branches leading upward to produce above-ground parts. It is a perennial subshrub or herb, usually much-branched. Stems are at first erect and then become decumbent, apparently short-lived, gray appressed pilose to sericeous. Leaves on main branches are often larger than those on branchlets, the blade 1–12 mm long, lanceolate, ovate or elliptic- to scale-like, sessile, or shortly petiolate. Flowers are solitary, axillary, 5–8 mm long, sessile or on short peduncles, bracteate, in spicate to head-like clusters at tips of branchlets, bracteoles unequal in length. Sepals ovate to obovate, imbricate. Corolla salver form, the limb 5-lobed, the lobes mostly ovate, imbricate, spreading to reflexed. Stamens exserted; filaments filiform; styles exserted [Figure 1]. Ovary 2-locular, 4-ovulate; styles 2, distinct to the base; stigmas capitate. Fruit is capsular, ovoid, unilocular, 2–4-valved, usually one-seeded. Seeds are 3–4 mm long, glabrous and smooth, and shining to reticulate, dark brown.[23-25]

### Therapeutic uses as depicted by ethnobotanical studies

It is reported to be antibilious, antitubercular, and expectorant.[27,28] The plant is used as anthelmintic, stomachic, tonic and aphrodisiac purposes, enriches the blood, and is useful in constipation, leprosy, asthma, and urinary discharges, in the treatment of diabetes and general debility.[29] The plant is traditionally used in Bahrain as expectorant and antibilious agent.[28] Dry leaves of *C. cretica* crushed with sugar are used as emetic in Sudan.[30]

### As a source of edible oil

It is also reported that the fruits of *C. cretica* are a potential source of edible oil. The oil of *C. cretica* was free from any undesirable

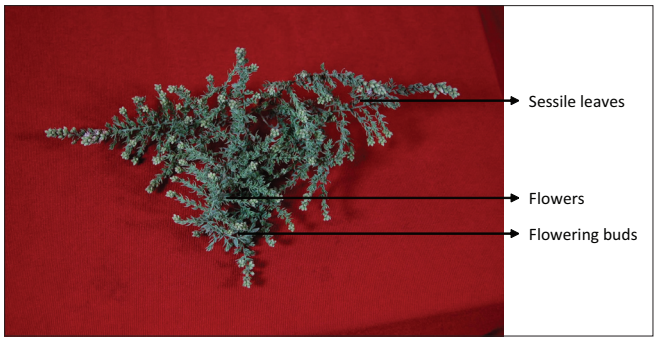


**Figure 1:** Showing flowers, flowering tops, and leaves with branching stem

components and could safely be recommenced for human consumption. Also the oil is of similar in composition with respect to individual fatty acids of commercial oils.[31]

## BIOLOGICAL ACTIVITIES

### Antibacterial activity

Parekh and Chanda[32] have studied *in vitro* screening of antibacterial activity of aqueous and alcoholic extracts of various Indian plant species against selected pathogens from enterobacteriaceae. They have taken 34 medicinal plants, belonging to 28 different families; they were screened for potential antibacterial activity against six bacterial strains belonging to Enterobacteriaceae, viz. *Enterobacter aerogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *P. vulgaris*, *and Salmonella typhimurium.* Antibacterial activity of aqueous and alcoholic extracts was tested by the agar disc diffusion and agar well diffusion methods. The ethanol/methanol extracts were more active than aqueous extracts for all the plants studied. The most susceptible bacterium was *K. pneumoniae*, while the most resistant bacteria were *S. typhimurium* and *E. coli.*

Parekh and Chanda[33] have also studied 34 Indian medicinal plants belonging to 28 different families; they were screened for potential antibacterial activity against three *Staphylococcus* species, namely *Staphylococcus aureus, Staph. epidermidis, and Staph. subflava.* Antibacterial activity of aqueous and alcoholic extracts was performed by agar disc diffusion method and agar well diffusion method. The alcoholic extracts were more active than aqueous extracts for all the plants studied. The most susceptible bacterium was *S. aureus*. The *in vitro* susceptibility testing of the studied *Staphylococcus* strains was done against standard antibiotics (chloramphenicol, ciprofloxacin, gentamicin, piperacillin, imipenem).

### Antifungal activity

Mandeel and Taha[34] studied *in vitro* antifungal activities of various extracts of indigenous Bahraini medicinal plants. Antifungal activity of aqueous, ethanol, chloroform, petroleum ether, and residue extracts from 10 indigenous Bahraini plants used in folk medicine for the treatment of various diseases is reported. Extract efficacy was evaluated using the agar well diffusion assay against four filamentous fungi and two yeasts monitored by standard antifungal disks. The results showed that all but, in particular, ethanol and chloroform plant extracts reveal variable degrees of bioactivity against at least two of the tested microbes. The highest ethanol extract activity was exhibited by *C. cretica* (L.) against *Penicillium citrinum* Thom (32.2 mm) followed by *Candida albicans* (C. P. Robin) Berkhout (25.7 mm). The diffusable metabolites of *Heliotropium curassavicum* L. also demonstrated marked inhibitory effects against the same microorganisms. Chloroform extracts of Emex spinosa Campd. displayed an elevated potency against Alternaria alternata (Fries) Keissler (27.9 mm) and *Saccharomyces cerevisiae* Meyen ex. E. C. Hansen (27.5 mm). Zone of inhibition against other fungi varied from 19.9 to 25.9 mm. However, the highest growth inhibition was encountered with *Fagonia indica* Burm F. against *P. citrinum* (29.3 mm). With the exception of chloroform extracts from cultivated soils, various extracts of plants randomly collected from saline-affected soils exhibited higher fungal radius inhibition than plants from cultivated soils. The significance of these results in relation to ethnobotanical data.[34]

### Testicular function in albino rats

Gupta and his coworkers[35] studied on methanolic extract on testicular function of albino rats. They have administered a methanolic extract of *C. cretica* Linn. (Convolvulaceae) (whole plant) by oral route at a dose level of 100 mg/kg/day for a period of 60 days, which led to a significant decrease in the weight of testis, epididymis, seminal vesicle, and ventral prostate. *C. cretica* reduced the fertility of male rats by 100%. There was a marked reduction in the number of primary spermatocytes, secondary spermatocyte, and spermatids. Sertoli cell counts as well as the cross-sectional surface area were significantly decreased. Leydig cell nuclear area and the number of mature leydig cells were also significantly decreased. The protein, sialic acid, glycogen, and cholesterol content of the testis, the fructose in the seminal vesicle, and protein and sialic acid in the epididymis were significantly decreased. Serum testosterone levels were also reduced after *C. cretica* treatment. The RBC and WBC counts, hemoglobin, hematocrit, blood sugar, serum cholesterol, phospholipids, triglyceride, and HDL cholesterol were within the normal range. The methanol extract of *C. cretica* produced intrusion in testosterone production and affected spermatogenesis in male albino rats. *C. cretica* to male rats is responsible for the decline in testosterone production and also alters spermatogenic activity without adverse toxicity.

### *In-vivo* antitussive activity of *C. cretica* using cough model in rodents

*C. cretica* has also been extensively used to get relief from asthma and cough by the indigenous people of India. The study of the antitussive effect of the plant was evaluated in two different experimental models. The antitussive effect of aerosols of two different concentrations (2.5%w/v, 5%w/v) of methanolic extract of *C. cretica,* codeine (0.03g/ml), and normal saline was tested by counting the numbers of coughs produced due to aerosols of citric acid 10 min after exposing the male guinea pigs to aerosols of different solutions. In another set of experiment, extract was investigated for its therapeutic efficacy on a cough model induced by sulfur dioxide gas in mice. The results showed significant reduction of cough number obtained in the presence of both concentrations of CME and codeine. The antitussive effect on guinea pigs of higher concentration of CME was significantly ($P<0.01$) greater than those of lower concentration and the prototype antitussive agent codeine phosphate ($P<0.01$). It exhibited significant antitussive activity as that of codeine phosphate, when compared with control in a dose-dependent manner in sulfurdioxide gas induced cough model. The extract at 100, 200, and 400 mg/kg, p.o. showed inhibition of cough by 22.1, 34.35, and 55.44% within 90 min of performing the experiment.[36]

The formulation of a medicinal preparation, which comprises a mixture of herbs viz. *C. cretica*, *Tridax procumbens*, *Euphorbia microphylla*, and other optional herbs, has been found to be effective for the treatment of cancer, thus providing an effective alternative/supplement to the conventional treatments of surgery, chemotherapy, and/or radiotherapy.[37]

## PHYTOCHEMISTRY

The air-dried, powdered whole plant of *C. cretica* L. (1kg) was defatted with *n*-hexane and then extracted subsequently with $CHCl_3$, $CH_2Cl_2$/MeOH (1: 1), and water. The $CH_2Cl_2$/MeOH extract was evaporated under reduced pressure and dissolved in aqueous MeOH 20%. The aqueous methanolic solution was partitioned first against $CHCl_3$, EtOAc, and then against *n*-BuOH. The EtOAc fraction was subjected to column chromatography (CC) on Sephadex LH-20 using propanol with increasing amounts (10%) of MeOH; four fractions (Cr1–Cr4) were collected after monitoring with TLC. The spots were detected with UV before and after spraying with NA reagent. The fraction was submitted to CC (silica gel 60), the separation was initiated with $CHCl_3$, and polarity was gradually increased with steps of 5% MeOH. The flavonoid-containing fraction was eluted with $CHCl_3$/MeOH (2:8) and then subjected to PTLC to give compounds quercetin, quercetin-3-*O*-glucoside, kampferol-3-*O*-glucoside**.** The fraction eluted with $CHCl_3$/MeOH (3:7) was also subjected to PTLC using the same solvent followed by CC on Sephadex LH-20 and eluted with MeOH to give compounds kampferol-3-rhamnoglucoside, and rutin [Figure 2].[38]

Syringaresinol-h-d-glucoside, scopoletin, 3,5-dicaffeoylquinic acid, and 4,5-dicaffeoylquinic acid were also isolated from *C. cretica* [Figure 2].[39]

The air-dried ethanolic extract was dissolved in minimum amount of methanol and adsorbed on silica gel to form slurry. The slurry was air-dried and subjected to silica gel column chromatography. The column was eluted with hexane, hexane:petroleum ether (1:3), petroleum ether, petroleum ether:benzene (3:1, 1:1, 1:3), benzene and benzene:methanol (1:1) benzene:methanol (1:1) to isolate creticane, cressatetracosanoate, cressanonacontanoic acid, cressatetratriacontanoic acid, cressatriacontanone, cressanaphthacenone.[40]

Creticane was obtained as colorless crystals from hexane eluants. Its mass spectra had a molecular ion peak of at m/z 434 corresponding to a monocyclic long-chain alkane, $C_{31}H_{62}$. The compound resisted acetylation and oxidation supporting the *n*-alkane nature of the molecule.

Cressatetracosanoate was isolated as colorless compound from hexane-petroleum ether (1:3) eluants. Its mass spectrum had a molecular ion peak at m/z 480 corresponding to a hydroxyl ester $C_{31}H_{60}O_3$. It indicated two degrees of unsaturation, which were adjusted in one olefinic bond and one ester group. Acetylation of this compound yielded a monoacetyl product. These data led to establish the structure as 4'-methyl-hexa-5'-enoyl-*n*-tetracosa-17-ol-1-oate. This is an unreported aliphatic ester isolated from a natural or synthetic source.

Cressanonacontanoic acid was obtained as a white amorphous powder from petroleum ether: benzene (3:1) eluants. It

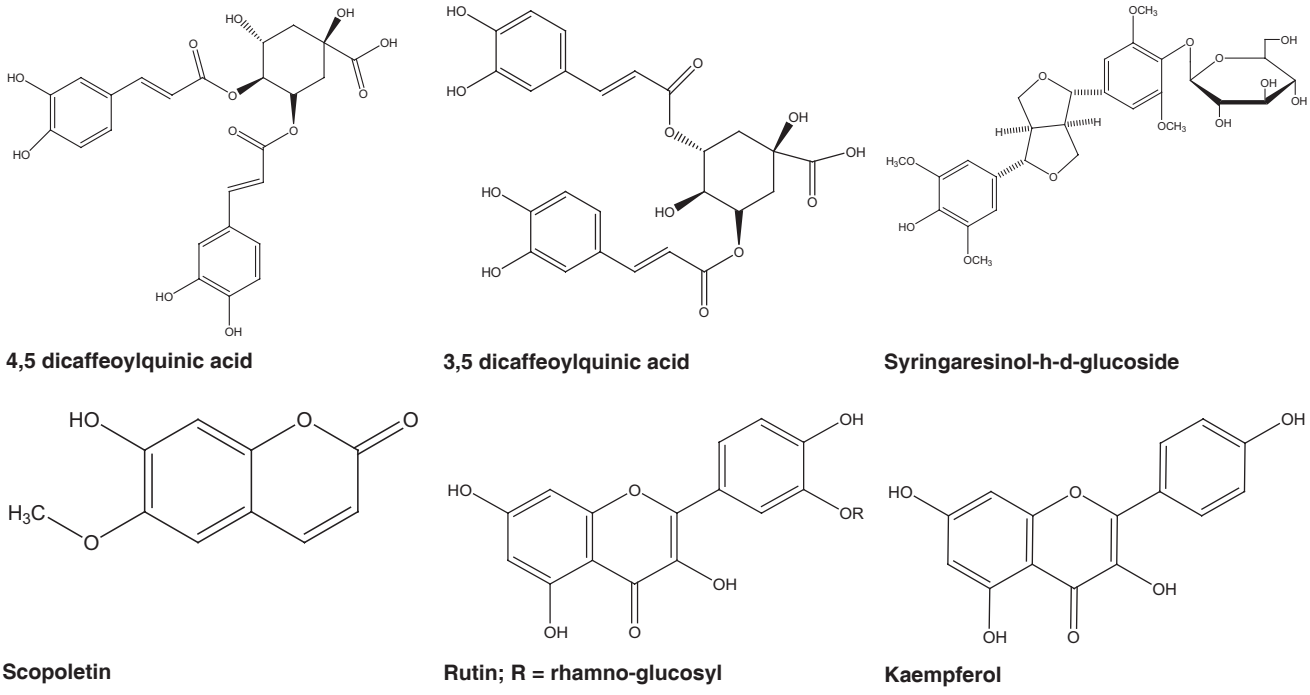


**Figure 2:** Structures of the isolated compounds from *Cressa cretica*

produced effervescences with sodium bicarbonate solution. Its mass spectrum displayed a molecular ion peak at m/z 452 corresponding to a molecular formula of aliphatic ketoacid $C_{29}H_{56}O_3$. It had two double-bond equivalents, which were adjusted in carboxyl and keto groups.

Cressatetratriacontanoic acid was obtained as a colorless compound from petroleum ether:benzene (1:1) eluants. It formed effervescences with sodium carbonate solution. Its mass spectrum displayed a molecular ion peak at m/z 522 consisting with a molecular formula of long-chain keto acid $C_{34}H_{66}O_3$. Treatment of this compound with diazomethane yielded a methoxy derivative supporting the existence of the carboxylic group in the molecule. On the basis of these spectral data analyses and chemical reactions has been elucidated as tetratriaconta-29-one-1-oic acid.

Cressatriacontanone was obtained as colorless crystalline mass from petroleum ether and benzene (1:3) eluants. It responded positively to 2,4-DNP test. Its mass spectrum displayed a molecular ion peak at m/z 480 relating to a hydroxyl ketoalkane, $C_{32}H_{64}O_2$. It had only one bond equivalent due to the presence of the carboxyl group.

Cressanaphthacenone was isolated as colorless crystals from benzene eluants. It responded positively to 2, 4- DNP test. It had a molecular ion peak at m/z 610 corresponding to long aliphatic chain attached to a tetracyclic moiety, $C_{43}H_{78}O$. It indicated five double bond equivalents; four of them were adjusted in a tetracyclic ring system and one in carbonyl group.

## CONCLUSION

The survey of literature revealed that *C. cretica* is the source of many chemical constituents, as quercetin, quercetin-3-*O*-glucoside, kampferol-3-*O*-glucoside, rutin, syringaresinol-h-d-glucoside,[1] scopoletin, 3,5-dicaffeoylquinic acid, creticane, cressatetracosanoate, cressatetratriacontanoic acid, cressatriacontanone , cressanaphthacenone, etc. Studies have revealed its use as antibacterial, antifungal, antitussive, anticancer with some other plants, anti-inflammatory, and improving testicular function in rats. However not much information is there in the proof of use of this plant for ulcer, asthma, pulmonary tuberoculosis, urinary discharges, enrichment of blood, stomachic, aphrodisiac, and the treatment of leprosy and constipation, as a tonic and appetizer.[41] Therefore further studies may be carried out to prove the potential of this plant as well as the isolated products. Besides this, the systemic studies of pharmacognosy, and the phytopharmacological aspects of the plant is under way by our research team.

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