

A Comprehensive Review On *Cadaba fruticosa* (L.) Druce

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Abstract

Cadaba fruticosa commonly called as 'Kalitaka' or 'Indian Cadaba' belongs to family Cappariaceae is a frequent plant found in deciduous forests of Maharashtra and in the tropical region of Indian sub-continent. The different medicinal uses of the plant are appreciated by Siddha. It is noted that the leaves and roots of the plant are used to cure some urinary complaints. Also it is recommended on, infestation, swelling, Eczema, constipation, gonorrhoea and to cure such an other ailments. The World Health Organization (WHO) has also declared the importance of such medicinal plants for public health care in developing nations. It is evident that, plant shows, anti-diabetic, anti-pyretic, anti-oxidant, antimicrobial, anti-inflammatory, cyto-toxic and so many important activities which will be applicable for the invention of novel drugs from the plant.

Morphology of the Plant :

Unarmed scandent shrubs. Leaves 0.9- 4.0 x 0.4- 1.5 cm, elliptic-oblong, apex obtuse, mucronate, base rounded, margins entire. Flowers dirty white in one sided racemes with few flowers, terminal; petals spatulate. Gynophore 2.0-2.5 cm long. Fruits 2.5-3.0 x 0.5cm, cylindric, dehiscent, Seeds many.

Capparaceae is a middle sized family with 45 genera and nearly 600 species which are distributed throughout the world, mostly in tropical and subtropical region. The capparidaceous plants are usually herbs, erect or scandent, shrubs and rarely trees. The

genera *Cadaba* is represented by 30 species. *Cadaba fruticosa* is an unarmed shrubs or trees with older, smooth, purplish, younger, pubescent, yellowish brown stems. The leaves are entire, simple, silvery gray and with simple scales. They are mucronate dull green, reticulately veined; base rounded having 12-35 by 8-12 mm oblong or elliptic-oblong and rarely ovate in size. The petioles are 2.5-4 mm long. The flowers are dirty white or whitishgreen to yellow, develop at the tips of the branches (terminal) on apical racemes, 15 mm across and in few flowered, terminal at one sided. The upper flowers contain corymbose racemes (Fig. 1).

The flowers are with four petals which

are very pale yellow, spatulate, equaling the sepals with long claws. They are 8-9 mm long, oblique mouth, pale, rose colored, toothed at apex. The Sepals are 8-13 mm long, having two outer boats shaped, valuate, ovate, acute petaloid, all pubescent outside. The Stamens are 4 or 5 in number inserted about half way up the gynophores and having 9-18 mm long pedicels with pubescent-bracts minute subulate. The flower have long filamentous ovary-oblong on gynophores, 17-23mm long style. Shrubs or small trees of *Cadaba fruticosa* are usually with no spines but branches sometimes end sharply and grow in dry short grass savanna. Fruit are 2.5 cm by 3 mm in size with cylindrical, irregularly torulose, glabrous or pubescent containing many seeds. The Seeds of plant are covered in a bright orange membrane strait, surrounded by orange red-aril. Wood is white, turning light yellow on ageing. It is moderately hard and heavy (wt, 820 kg/m³), closed and straight to slightly twisted grained, and even fine textured. It is suitable for turnery articles. The Bark of plant contains a fibre.



Fig. 1. *Cadaba fruticosa*.

Habitat and Distribution :

Cadaba fruticosa is mostly distributed throughout the world mostly tropical and subtropical regions. It is a common shrub of the arid plains of Sind and Baluchistan provinces of Pakistan. They are common not only in large depressions but also found on sandy silts of valleys, around temporary ponds and on stabilized dunes, where there is subsoil rich in fine particles containing termite mounds. *Cadaba fruticosa* are found in Angola, Cameroon, Democratic Republic of Congo, Egypt, Ethiopia, India, Kenya, Niger, Saudi Arabia, Senegal and Somalia. Also tropical and Sub tropical regions of Africa, Asia, Australia. In India it is found wildy grown in Punjab, central and western India, Gujarat, konkan, Deccanarea, southwards Vishakhapatnam and Karnataka.

Researchers throughout the world have studied various aspects of the plant extensively and intensively. Plant has been studied with its, anatomical, morphological, palynological, antimicrobial, antioxidant, anticancer, phytochemical, pharmacognostic, antinociceptive, antibacterial, physicochemical, antiinflammatory, antidiabetic and many other activities by researchers. Results of all those have been presented in the following paragraphs.

Juliet *et.al.*⁶, observed effect of growth regulators on direct shoot formation from leaf explant of *Cadaba fruticosa*. Also they studied antioxidant activity of in situ and in vitro plants of same *C.fruticosa*. They observed multiple shoot formation from the surface sterilized leaf segments. They used MS medium containing 13.32 μ m benzyl amino

purine (BAP), 1.16 μm Kinetin (KIN) and 1.35 μm α -naphthalene acetic acid (NAA). In their experiment they observed direct shoot primordial formation in explants without callus formation. They used BAP, TDZ, KIN and NAA in combination to achieve multiple shoot formation from leaf explant. It is observed that, MS medium with various combinations of BAP, KIN and NAA showed different shoot variations. In vitro developed shoots are then excised and inoculated in the MS media supplemented with different concentrations of NAA, IAA and IBA for root induction. It was observed that, a root formation was predominant with NAA as compared with IAA and IBA. After successful acclimatization it was found 85 % plant survival rate.

The antioxidant activity of *C. fruticosa* was assessed by DPPH and FRAP. They observed that both the extracts had significant scavenging activity with increasing concentration of extract from 1- 5 mg/ml.

In vitro antibacterial activity of *C. fruticosa* has been studied by Ramasamy *et.al.*¹⁸, they used various solvents like acetone, benzene, butanol, chloroform and ethanol to get leaf extract. They tested antimicrobial activity by using disc diffusion method against some pathogenic organisms like *Streptococcus pyogenes*, *Staphylococcus aureus*, *Salmonella typhi*, *Proteus vulgaris*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Escherichia coli*. They compared their results with standard antibiotics like streptomycin etc. Results of their experiment shows that maximum zone of inhibition was observed from ethanolic leaves extract. All the solvents of *Cadaba fruticosa* exhibited the maximum zone of inhibition for

Streptococcus pyogenes. The acetone extract of *Cadaba fruticosa* showed the maximum zone of inhibition for all tested microorganisms.

Shashikanth *et.al.*²⁵, in their experimental work done by using inductively Coupled Plasma Mass Spectroscopy (ICP-MS) concluded that, *Cadaba fruticosa* contains total 16 elements including heavy metals and mineral trace elements. Heavy metals such as Selenium, Lead, Arsenic, Cadmium, Nickel and Chromium were found in permissible limits as per WHO guidelines. Whereas, mineral or trace elements are found in considerable amount which are very important and helpful in the management of many diseases and to check adulterants in crude drug.

Prabhakar *et al.*¹⁷, and an attempt to study the anatomical studies of the *Cadaba fruticosa*. According to them the leaves of the plant are amphistomatic with the anisocytic stomata. Trichomes are also recorded to be present on the both surfaces. Leaf mesophylls are clearly differentiated into palisade and spongy tissues. Ground tissue of midvein consists of three types of tissues, collenchymas, parenchyma and sclerenchyma.

A phytochemical and antioxidant property of *C. fruticosa* was studied by Krishnmoorthi and Elumalai⁹. They selected whole plant for the study. Phytochemicals were extracted by using various solvents such as Hexane, ethyl acetate, ethanol and aqueous. Results of their study reveals that, the plant contains carbohydrates, tannins, flavonoids, quinines, cardiac glycosides, terpenoids, phenols, coumarins and steroids. The tests for

saponins, glycosides, phlobatannins and anthraquinones were negative in all four solvents. They also studied free radical scavenging by using DPPH. Ethanol extract of the plant showed better antioxidant activity.

Murugesan and Shanmugam¹³ carried out a research work on the in silico studies on the phytoconstituents of *C. fruticosa*. In their study they performed molecular docking analysis for the prerecorded 20 compounds present in the plant against CYP 17 enzyme using Schodinger Glide software. CYP 17 enzyme is responsible for adrenal and ovarian androgen synthesis. Increased activity of the enzyme shows, hyperandrogenism (excess androgen synthesis), which can be prevented by inhibiting enzymatic activity. The commercial synthetic drug, Clomiphene citrate is used to cure the problem related infertility which shows some side effects like heart diseases and congenital malformation. Thus authors here claimed that naturally extracted compounds from medicinal plants have been preferred as the therapeutic agent to treat infertility disorders. When the natural docked compounds were compared with the synthetic drug, Clomiphene citrate, it is observed that natural compounds showed best results without any side effects.

A comparative evaluation of antimicrobial and anti-inflammatory activities of three plants, *Ocimum sanctum*, *Phyllanthus niruri* and *Cadaba fruticosa* to detect their bioactive compounds using GC-MS was carried out by Saha *et al.*²⁰. They observed that, *C. fruticosa* contains significant free radical scavenging. Antioxidant, antimicrobial and anti-inflammatory activities. GC- MS analysis also revealed that

it contains several bioactive compounds which have many health benefits. The bioactive compounds like hydroxyurea, 1-amino-2 propanol, 2 hexanamine, 4 methyl, derivatives of dodecenol and derivatives of imidazoles and isoglutamine are detected in *C. fruticosa*. According to authors, the above bioactive compounds can be used as antineoplastic drug, on sickle cell disease and even on HIV/AIDS viruses. Derivatives of Dodecenol can be used as food additives, cosmetics and in pharmaceutical industries.

Mythreyi *et.al.*¹⁵, conducted a study on antipyretic activity of *C. fruticosa* leaves. They examined the effect of aqueous and ethanol extracts on the Wistar albino rats. They observed that, the aqueous and ethanol extract showed significant reduction in body temperature. Authors recorded presence of alkaloids, tannins, lactones and steroids in alcoholic extract and presence of alkaloids, flavonoids, phytosterols and tannins in aqueous extract. Alcoholic extract of *C. fruticosa* is more effective on induced fever than aqueous extract and shows a most significant antipyretic effect in yeast-induced pyrexia.

Kalimuthu *et.al.*⁷ made an attempt to study comparative anti-diabetic and anti-inflammatory activities of wild and micropropagated *Cadaba fruticosa*. Their findings reveal that both wild and micropropagated plant shows anti-diabetic and anti-inflammatory property and they suggested that, micropropagated plants can be used instead of wild plants.

A tissue culture study on *C. fruticosa* was performed by Lodha *et al.*¹¹ in which, a

high frequency in vitro multiplication and micromorphological studies have been carried out. According to this study a high rate of shoot multiplication was achieved due to selection of appropriate medium (MS medium with added 3 % sucrose, with and without additives, ascorbic acid, citric acid, adenine sulfate and arginine, PH of medium 5.8) and an optimum combination of plant growth regulators. Micropropagated roots were rooted by using ex vitro technique for many advantages. Authors the entire protocol designed by them will be helpful for commercial propagation of plants and conservation of medicinal plants.

Sreeramulu *et al.*²⁶, carried out an ethno-botanical medicinal study on the Nalgonda and Warangal districts of Telangana of Andhra Pradesh and collected an information of about 249 plants belonging to different families. According to their study, the bark of the plant *Cadaba fruticosa* is used by local people for the treatment of boils, blisters and cuts. Similar information is provided by Santosh Kumar *et al.*²³ in their elaborative article which was published on indigenous knowledge of medicinal plants used by ethnic communities of south India.

Shashikanth *et al.*²⁴, published an article on *C. fruticosa* which reveals the traditional medicinal uses of the plant. In their article, authors enumerated different uses of the plant in the human as well as human health. Authors have proposed the need of the conservation of the plant as it is becoming scarce due to overexploitation and other natural and manmade calamities. According to this article plant is used for the treatment of sores, urine obstructions, helminthiasis, syphilis, hemiplegia,

dysentery and diarrhea, snake bite, Boils, blisters and cut.

Mythreyi *et al.*¹⁴, have done an extensive research on cytotoxic activity of two species of *Cadaba* including *C. fruticosa* and *C. trifoliata* using MTT- dye assay. Their studies revealed that, alcoholic extract is more cytotoxic activity as compare to aqueous extract. Alcohol extracts of both species exhibited cytotoxicity against Vero (primary monkey kidney cell line), RD(Rhabdom-yosarcoma) and Hep-2 (human epithelioma cell lines of the larynx) cell lines. Phytochemical screening of aqueous extract of plant revealed presence of glycosides, phenolic compounds, tannins and steroids while alcohol extract showed presence of alkaloids, glycosides, steroids, tannins and triterpenoids as main principle.

An *In vitro* antibacterial and antioxidant potential of the leaf extracts of *Cadaba fruticosa* have been studied by Lavinya *et al.*¹⁰. They checked antimicrobial activities of the leaves aqueous and methanolic extracts against different bacterial strains by disc diffusion method and compared with that of the standard antibiotic cefotaxime. An antioxidant potential of *C. fruticosa* by the determination of the reducing power and 1,1-Diphenyl-2 Picryl-hydrazyl (DPPH) radical scavenging activity. From their study, it is revealed that, methanolic extract of the leaves of *C. fruticosa* possess significant antimicrobial and antioxidant activities. According to authors antioxidant potential is due to the phenolic content, free radical scavenging and reducing power.

Meerabai¹², carried out an interesting research on various pollinators to *C. fruticosa*.

Flowers were solely visited by Pieridae butterflies, *Colotis eucharis*, *C. danae* and *Anapheis aurota*. Author made observations on the foraging behavior of pollinators to determine their flower visitation rates. Author measured proboscis length of butterfly along with nectar tube length of flower. The number of pollen grains adhered on the different parts of body were analyzed under microscope. Sugar concentration was studied by refractometer and type of sugar present in the nectar was analyzed by paper chromatography. It is revealed from her study that, the flowers avoided from fly visit are unable to set fruits. Individual flower contains very small volumes of concentrated nectar. Histidine was the main sugar present in the nectar. It is evident from the study, that butterfly species *Colotis danae* and *Anapheis aurota* have their proboscis lengths 17mm and 20mm respectively and both visits 09 plants whereas the species *C. eucharis* has its proboscis length 17mm and visits 11 flowers.

Mythreyi and Sasikala¹⁴ carried out a research work on the antinociceptive activity of two species of *Cadaba*, *C. fruticosa* and *C. trifoliata*. They used leaf extract using central and peripheral pain model viz. tail flick, tail immersion, hot plate method and acetic acid writhing test. They concluded that alcohol extract of *C. trifoliata* and alcohol extract of *C. fruticosa* exhibited antinociceptive activity on thermal and chemical stimuli induced animals.

Sundara *et al.*,²⁷ checked anti-cancerous activity of leaves of *C. fruticosa* by using human lung cancerous cell line A 549 by in vitro methods. They used ethyl acetate

extract, Ethanol extract and aqueous extracts of leaves and found that ethyl acetate extract is predominantly cytotoxic and cancerous cells starts characteristic apoptosis, like cell shrinkage, chromatin condensation and nuclei fragmentation. Authors confirmed these results with the help of fluorescence microscopy using acridine orange and ethidium bromide. Acridine orange is a vital dye capable of staining both dead and live cells whereas ethidium bromide will stain cells that have lost membrane integrity.

Yasmeen *et al.*²⁹ reviewed phytochemical properties of *C. fruticosa* according to their study, plant contains heavy metals like Selenium, lead, arsenic, cadmium, chromium and nickel. It also contains trace mineral elements including Iron, Copper, Manganese, Zinc, Cobalt, Calcium, Sodium, Potassium, Magnesium, and Aluminum. It contains Pyrrolidine, anhydrous sugar, diterpene, epoxide, carboxylic, epoxide, sesquiterpene alcohol, ester, acetate, alkyl, alkene, ketone, steroid and other compounds.

An anti-hyperglycemic activity of *C. fruticosa* leaves was studied by Hari *et al.*⁵. They studied glucose lowering potential of the plant by using the in vitro methods such as alpha amylase inhibitory activity, inhibition of glucose diffusion, glucose adsorption and uptake by yeast cells. In their experiment, authors made an attempt to slow down the absorption process of glucose by the ethanolic leaf extract of the plant which controls hyperglycemia. Also, by using in silico methods, carbohydrate digesting enzyme inhibitors present in the leaves can be identified.

Arokiyaraj *et al.*³, analysed *C. fruticosa*

phytochemically with its antidiabetic activity. Their studies reveals that, the aqueous extract of plant contains, terpenoids, flavones, proteins, furans, gum and sugars whereas alcohol extract showed positive tests for terpenoids, flavones, steroids, proteins, alkaloids, gum, saponins and sugars. According to the results above phytochemical constituents may be useful for the anti-diabetic property of the plant.

Kalimuthu *et al.*⁷, studied antimicrobial and anticancer activities of ethanol and methanol extract of wild and micropropagated *C. fruticosaplant*. Their results revealed that highest zone of inhibition was obtained in *Escherichia coli* of wild and tissue cultured ethanol extract whereas in methanol extract the highest zone of inhibition against *Streptococcus pyogenes* and *Staphylococcus aureus*. The higher percentage of anticancer activity was observed in wild and tissue cultured plant ethanol extract.

A concept of Psychophily and co-evolutionary concept of *Cadaba fruticosa* has been studied by Aluri and Rao¹. According to their studies, the pollination in the plant has been effected exclusively by pierid butterflies namely, *Colotis eucharis*, *C. danae* and *Anaphaeis aurota*. The arrangement of petals and androgynophore provides landing place for butterflies confirms psychophily. The results of the study conclude that, *Cadaba* plant and *Colotis* butterfly have co-evolved and any disturbance in the habitat is bound to affect both.

Sakeena *et.al.*²¹, done a comparative study on physic-chemical and HPTLC of leaves and fruits. Authors used standard

methods to carry out the physic-chemical studies. The physic-chemical parameters indicated that the fruit is having more solubility and moisture content than the leaf whereas HPTLC finger print of leaf and fruit determine the quality and purity of the leaf and fruit.

Medicinal Uses:

It has been reported to possess hypoglycaemic activity³ and the leaf juice is used internally to treat diarrhoea, dysentery and general weakness²². It is also used as an anti-allergic, antidote, antiscorbutic and anti-helminthic herbal drug^{3,22}. The leaf extracts also possesses antimicrobial activity⁴ and is used in traditional medicine to treat syphilis and gonorrhoea¹⁹. Also plant shows Hepatoprotective activity, antioxidant, antiprotozoal, antifungal, antibacterial, cutotoxic, anticancer, antidiabetic and wound healing properties²⁸.

Traditional Uses :

The young leaves and twins of *Cadaba fruticosa* are edible and also used in spicing and flavoring food. Twins with leaves are pounded with cereals and eaten as cake or pudding in Nigeria. They are also boiled and made into gruel. The whole plant is used as fodder by all livestock except horses and donkeys, particularly during the dry season. Camels are the main consumers, since other species find it difficult to reach the foliage. Buffalo, black rhino and hartebeests also seek the foliage. The fodder has 30% protein content with digestibility *in-vitro* value of 78%. *Cadaba fruticosa* also possess high ash content. The plant also provides fuel wood. Crushed leaves mixed with millet flour are

used as a medicine against coughs. The Fruits are edible.

Ethno-medicinal Uses of Cadaba fruticosa:

The whole plant is purgative, anthelmintic, antisyphilitic, emmenagogue, aperients, stimulant, antiscorbutic, antiphlogistic. It is also used in treatment of cough, fever, dysentery and as antidote against poisoning. Leaves are externally used to relieve rheumatic pain and as a poultice to boil to promote suppuration along with a leaves of *Odina woodier*.² The boiled leaves are eaten as an anthelmintic; decoction with other ingredients is employed in the treatment of amenorrhea, dysmenorrheal and uterine obstruction, decoction of leaves with myrobalans and ginger or with a senna and Epsom salt given as purgative and antiphlogistic in syphilis, scrofula and rheumatism. The root of plant posse's similar medicinal properties like leaves, the root preparation is used in anthrax. The flower buds are stimulant, antiscorbutic, purgative, emmagogue, antiphlogistic and anthelmintic especially for round worm¹⁸. The ash of plants is rubbed into skin to relieve general body pains²⁸. In some parts, powder of leaves of *Cadaba fruticosa* (L.) Druce mixed in coconut oil is applied on chronic bleeding wounds for quick healing.

In the present article an effort has been taken to make an assemblage of different research works took place worldwide on the medicinal plant, *Cadaba fruticosa*. It is evident from the study that, researchers thorough out the world have successfully carried out research on the plant and showed

that, plant bears antimicrobial, antioxidant, anticancer, phytochemical, pharmacognostic, antinociceptive, antibacterial, physicochemical, antiinflammatory, antidiabetic, antipyretic, cytotoxic, anti-hyperglycemic properties. Anatomical ethnobotanical, ethnomedicinal, co-evolutionary, tissue cultural and palynological studies of the plant also carried out by some other researchers. From the above results, it is clear that, *Cadaba fruticosa* is an excellent medicinal plant and can be used for many purposes. This research article would be very important for the formulations of novel drugs on various ailments. Due to some natural and manmade activities this important plant is gradually reaching to extinction. It is needed to be conserved by using some advanced methods, so that this valuable treasure will be protected for the next generations.

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