



A comprehensive review on phytochemistry and biological activities of Della (*Capparis decidua*)

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Abstract

Capparis decidua is a drought-resistant plant. Besides many ecological and socioeconomic benefits, different parts of this plant have several applications in medicines. The plant is usually used to cure arthritis, toothache, asthma, inflammation, swelling, cough, malaria, intermittent fevers and rheumatism. Fruit pulp and root bark extract made in alcohol is claimed to have anti-helminthic activity. The seeds and fruits are used to cure dysentery, cholera and urinary purulent discharges. Della plant and its various parts have been traditionally used for the treatment of a variety of diseases. A chemical constituent "isocodonocarpine" was isolated from the roots of Della plant and observed to have anti-asthmatic and anti-inflammatory activity. In the present paper, the chemical composition of this plant and their biological or pharmacological activities are discussed in detail.

Key words: Malaria, Tocopherols, Medicines, Essential oil, Isocodonocarpine

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1. Introduction

Capparis decidua is a drought-resistant plant that can grow in dry regions of South Asia and Africa middle-east as dense tufts. Besides many ecological and socioeconomic benefits, different parts of this plant have several applications in medicines [1]. The plant is usually used to cure arthritis, toothache, asthma, inflammation, swelling, cough, malaria, intermittent fevers and rheumatism. Fruit pulp and root bark extract made in alcohol is claimed to have anti-helminthic activity. The seeds and fruits are used to cure dysentery, cholera and urinary purulent discharges [2]. Spicy taste fruits are served as an astringent for bowels, a remedy for bad breath and are claimed for the treatment of cardiac troubles. However, green immature fruits are thought to have laxative and anti-helminthic and are employed to treat constipation, asthma, hysteria, coughs and many other psychological problems [3]. The plant has also been studied for its depressive and sedative effects on the central nervous system (CNS) and also for antimicrobial properties. [1]. Water and methanol extracts of *C. decidua* also show hepatic protective activity. The capparidisine, a spermidine alkaloid present in *Capparis decidua* showed cardiovascular activity [1]. Essential oil is generally extracted from various parts of the plant materials [4-7] which has different biological applications [8-9]. There is a number of chemical constituents present in the oil which are generally analyzed

by GC-MS [9-11]. In the present paper chemical composition of this plant and their biological or pharmacological activities are discussed in detail.

2. Demography/location

C. decidua is a rangeland plant species that grow in isolated regions in Pakistan, India and African countries. This is a drought-resistant plant that can grow in dry regions of South Asia and Africa middle-east as dense tufts [12]. Identification of precise country of *C. decidua* origin is impossible, and actually, the range of fruit's native habitat is wide. There are many *C. decidua* variants native to the Mediterranean Basin in the West, and parts of North Africa and Central Asia [13].

3. Botany, Morphology/Ecology

C. decidua is a bushy shrub in dense tufts, 4-5 m high, or once in a while a small tree with many green vine-like leafless branches, hanging in bundles. The bark turns whitish-grey color with age, but most branches and twigs are a glossy dark green. Small, light brown spines occur in pairs on the twigs at each node. Leaves very minute (2 mm long), with a very short life span on young shoots, so that the plant looks leafless most of the time. Flowers are pink, red-veined, in small groups along with the leafless shoots, in the axils of the spines. Fruit a small many-seeded ovoid or sub-globulous, slightly mucronate pink berry of the size and shape of a cherry, becoming blackish when dry. The generic name is derived from the Arabic 'kappar', the name for

Cappariss spinosa [14].

4. Chemistry

4.1. Chemical composition

C. decidua leaf contains volatile oils which possess multiple chemical constituents such as butyl isothiocyanate (6.3%), isopropyl isothiocyanates (11%), thymol (24.4%), 2-hexenal (13.2%), N-alkanes, phenylpropanoid chlorophyll, proline (amino acid) and starch. In addition, both ripen fruit and the root contain volatile constituents such as methyl isothiocyanate, isopropyl isothiocyanate, sec-butyl isothiocyanates glucoiberin, sinigrin, glucocleomin, glucocapangulin, glucobrassicin and neoglucobrassicin [15].

4.2. Phytochemistry

Chemical examinations of family Capparidaceae revealed too many active constituents such as alcohols, carbohydrates, alkaloids, amino acids, glycosides, flavonoids, steroids, sterol, saponins, terpenes, anthocyanins, amyirin, and betulin. *C. deciduas* contain phytosterols, carotenoids, tocopherols, glucosinolates and flavonoids in different plant parts [15]. Flavonoids, mainly rutin is a major depressive episode, which showed a remarkably in various pharmacological activities including antiallergic, anti-inflammatory, and antioxidant effects. Rutin is an important plant origin compound which is believed to improve capillary functions and permeability "vitamin P" and as a general free-radical antioxidant. [15] Leaves and flowers present in their constitution: rutin, tocopherols, O glycosides, 3-O-glycoside-7-0- rhamnoside, 3-O- gentiobioside, lutin, neoxanthin, violaxanthin, quercetin, stachydrine, vitamin C, and carotenoids.[16]. Other organic compounds are volatile oils, fatty acids, protein, fiber, oils, minerals, sugar and protein and pro-vitamin A, isocodonocarpine, 3-methyl-2butenyl-3-beta glucoside, steroids, phthalic acid, beta sitosteryl glycoside 6' octadecanaote, 3-O-(16"-alpha L-rhamnoside-6 beta o glycosyl)-beta-D glycoside.

Leaves flower and stem of *C. decidua* possess quercetin, capparilosides B, 6(S)-hydroxy-3-oxo-ionol-glucoside, carchoionoside-C, 3-O-(6"- L. rhamnosyl-6"-β-D-glucosyl)-β-D-glucoside [16]. Flower buds contains the following components: tocopherol, vitamin C glycosides, alkaloids, polyprenol (cappaprenol-12, cappaprenol), kaempferol glucosides, capparicide (4-hydroxy-5-methylfuran-3-carboxylic acid isothiocyanates [16].

Fruits have biflavonoids, isoginkgetin, ginkgetin, sakuranetin, P-hydroxyl benzoic acid, 5-(hydroxymethyl) furfural, bis(5-formylfurfuryl) ether, daucosterol, α-D-fructofuranosides methyl, uracil, stachydrine, cadabicine P hydrobenzoic acid, (6S)-Hydroxy-3-oxo-α-ionol glucosides, (6S)-hydroxyl-3-oxo-α-ionol glucosides corchoionoside C (6S,9S)-roseside) prenyl glucoside,, cappariloside A and B, 1H-Indole-3 acetonitrile glucosides [16].

Mature fruit contains 5-(hydroxymethyl) furfural,

bis(5-formylfurfuryl) ether, daucosterol, α-D-fructofuranosides methyl, methylstachydrine, hydrocinnamic acids, corchoionoside C, 4-hydroxy-5-methylfuran 3-carboxylic acid, flavonoids, isoginkgetin, ginkgetin, isocodonocarpine, 1H-indole-3-acetonitrile,, capparilosides A [16].

Seeds contain fatty acids tocopherols sterols, proteins, glucosinolales oleic and vaccenic acid, sitosterol, campesterol Stestent, campestent stigmaterol, palmitic acid, linoleic acid, p-methoxybenzoic acid, glucoside, glucocapparin, N-pentacosane, N-tricantanol [16]. Root bark have diterpene alcohol and ester, spermidinealkaloids, isocodonocarpine, capparisinine, capparisterpenolide, 14 N- acetyl isocodonocarpine, cadabicine, stachydrine, rutin, codonocarpine, β-sitosterol, L-stachydrine, capparoidisin, capparisin, capparissinin, root alkaloid capparine, cappariline, capparinine. Stem have sterols, lupin tercantanol, cappaprenol-12, cappaprenol-13, cappaprenol - 14, flavonoids, indoles, phenolic acids, lectins, kaempferol, and quercetin [16].

5. Post-Harvest Technology

Multiplication of the shoots starts after bud break initiation from in vitro cultured plants. After 3-4 weeks in vitro regenerated shoots of the cultures attain the height of 2-3 cm which was cut into shoot segments containing at least two nodes 1.5 to 2 cm in length. The fresh fruit (ripe or unripe) of Della plant is not eaten as it has an acrid taste. However, it converted into various other products after processing which are used to eat such as its pickles. There are three grades (depending on the size) of processed Della are available in the market i.e., small, big and medium. However, small fruit is better than that of bigger. The dried fruit of Della can be stored in poly bags without altering the quality for about one year.

6. General uses

C. decidua plant has applications in folk medicine, food industry and, biodiesel industry. It acts as a tonic agent, carminative, aphrodisiac and appetite stimulant [17]. Pickled fruits were used for the treatment of constipation as well as other stomach ailments. The bark used to treat acute pain and inflammation, whereas the roots used to treat fever and buds used to alleviate boils. In Sudan, shrub parts were used against jaundice as well as joint infections [18]. The fruit of the plant is generally relished by camels. However, it can be used to eat when little else is available, so goat can also eat this plant. It is also used in firewood and charcoal in its native range. *C. decidua* plant has hardwood and can be used to make water troughs and water pipes [19]. Della is the drought-tolerant plant and efficiently consumed by livestock for its nutrition. Berry pickle of Della plant has been used by the people of both arid as well as semi-arid regions as a good source of vitamins, protein, and carbohydrates. Furthermore, it also has application in biodiesel (fatty acid methyl ester) industry. Seeds of Della

plant can be used to produce biodiesel via transesterification process as the seed oil of Della plant has fatty acid. Fatty acids react with alcohol in the presence of a suitable catalyst and yield biodiesel [20-21].

6.1. Pharmacological activities

6.1.1. Bronchodilatory and anti-inflammatory activities

Della plant and its various parts have been traditionally used for the treatment of a variety of ailments. A chemical constituent "isocodonocarpine" was isolated from the roots of Della plant and observe to have anti-asthmatic, anti-inflammatory, and analgesic activity. Bronchodilator effects may be associated with decreased cholinergic activity. Anti-inflammatory effects and analgesic effects may be associated with non-selective inhibition of cyclooxygenases [19].

6.1.2. Antihelmintic activity

The aqueous extract and the alcoholic extract of the root *C. decidua* have anthelmintic effect however the aqueous extract is more effective in the treatment of helminth parasites. The mechanisms involved in the antihelmintic effect of *C. decidua* are not completely elucidated. The literature reports that this effect may be closely related to the biological activity of β -sitosterol found in these extracts [19].

6.1.3. Antibacterial activity

Seeds of Della plant were observed to have excellent antibacterial activity against *Vibrio indaba*, *Vibrio eitor*, and *Vibrio cholera*. Flavonoid fractions got from the various parts of *C. decidua* (flowers, stem, and root) were studied by some researchers for their antimicrobial activity by the use of disc diffusion assay, against *Proteus mirabilis* and *Escherichia coli* (Gram-negative bacteria) and *Staphylococcus aureus* (Gram-positive bacteria). It was found that plant exhibited broad-spectrum activity [20].

6.1.4. Insecticidal activity

It was found that Della plant has good insecticidal activities. In a research, it has shown more competitive insecticidal activity than any other plant species like *Artemisia princeps* and *Cinnamomum camphora* and *Melia dubia* and chemical constituents occur in *Foeniculum vulgare* Mill., *Mentha arvensis* (Japanese mint), and *Azadirachta indica* against adults of *Sitophilus oryzae*. Its volatile components have shown much higher contact and fumigant activities than found in *Piper nigrum*, *Curcuma longa*, *Artemisia anuua* and in corn leaf essential oil against stored grain insects. However, due to the presence of volatile chemicals such as glucosinolate present in *C. decidua*, alkaloids, glucosinolates, sterols, flavonoids present in *Capparis aegyptia* as well as quercetin, coumarins, rucic acid, saponins, and pectic acid have shown very high insecticidal activity against stored grain insect larvae and adults. All these chemical constituents have different functional groups due to which these persist for a longer time in closed chambers and poison the stored grain

insects and resulted in very lethality in insects [16].

6.1.5. Immune system activities

It was observed by some researchers that extract of Della plant buds made in ethanol contributed in the improvement of immune surveillance of human peripheral blood mononuclear cells toward the infection caused by the virus by the up-regulating expression of peculiar pro-inflammatory cytokines. It suppressed the herpes simplex virus type II replication and increases the pro-inflammatory cytokines expression including interferon- γ , tumor necrosis factor- α and interleukin-12. Furthermore, chemical constituents involved in the inhibition of the replication of in vitro tumor cell were also isolated by some researchers from the *Capparis sikkimensis* roots. However, a protein has also been isolated by some investigators from the Della plant seeds which show potent antiproliferative activity against the tumor cells as well as the inhibitory activity against HIV-1 reverse transcriptase. Some carotenoids have also been reported as inhibitors of chemically induced carcinogenesis in the hamster's buccal pouch. Tocopherols have an important preventive role against cancer cells and phenolic compounds have also shown antitumor effect [22].

6.1.6. Hypocholesterolemic and/or hypolipidemic activity

It was found that *C. decidua* shows good hypolipidemic activity by administrating the *C. decidua* fruit extract (50% ethanolic) at 500mg/kg body weight dose considerably reduced LDL cholesterol (71%), serum total cholesterol (61%), phospholipids (25%) and triglycerides (32%). These results reveal the hypolipidemic potential of *C. decidua* fruit and roots [21]. Furthermore, the hypocholesterolemic effect of *C. decidua* was observed on fifteen volunteer subjects that have high blood lipid profile. It was observed that total cholesterol and LDL cholesterol level decreases significantly, 13% and 16% respectively. However, the change in HDL cholesterol level was observed to be non-significant. So, it is concluded that *C. decidua* supplementation can play an important role in the control of hypercholesterolemia [21].

6.1.7. Hepatoprotective activities

The methanolic and aqueous extracts of *Capparis decidua* stems were found to have good hepatoprotective activity against CCl₄-induced hepatotoxicity in rats. However, it was reported that this plant was used for the jaundice treatment in traditional system medicine. The hepatotoxicity produced by administrating the CCl₄-, in paraffin oil (1:9 v/v) at 0.2 ml kg⁻¹ dose for ten days, was observed to be inhibited by the simultaneous oral administration of methanolic and aqueous extracts of *C. decidua* stems (200, 400 mg kg⁻¹ b.wt.) for ten days, with the evidence of decreased level of alanine amino transferees, bilirubin, serum aspartate amino transferees and alkaline phosphates. Furthermore, the simultaneous administrating extracts with CCl₄-, for 10 days inhibit the liver fatty changes induced by the hepatotoxic compound observed in

the intoxicated control rats. Hence, the results of this study showed that methanolic and aqueous extracts of *C. decidua* stems may provide considerable protection against CCl₄-induced hepatotoxicity in rats [21].

6.1.8. Cardiovascular activity

The hypotensive activity of the ethanolic extract of *C. decidua* was found to have an inhibition effect of norepinephrine or potassium chloride (KCl) induced contractions observed in rabbit aorta. Moreover, it also helps in inhibition of contraction at a submaximal level with 1 mg extract produced with histidine, acetylcholine, and histamine. All these were showed that direct relaxation action of *C. decidua* extract on blood vessels and myocardium may be responsible for its hypotensive action [21]. In another study, it was shown that the methanolic extract of the plant *Della* has biological activity against cardiovascular disease. Root extract was found to have two sesquiterpene lactones (germacr-3b-ol-12-eno-6,14-olide-15-oic acid and germacr-3b-ol-7,9-dien-6,14-olide-15 opic acid) that dose-dependently inhibit thromboxane-induced platelet aggregation. Thus, these lactones can be considered promising antithrombotic substances [25].

7. Final considerations

C. decidua is useful for obtaining different industrial products and can prevent and/or cure different human pathophysiology. The therapeutic effects attributed to *C. decidua* depend on the part of the plant used (leaves, flowers, fruits, among others). Thus, we conclude that *C. decidua* is a plant with great potential for obtaining new industrial products that can benefit socioeconomic development, and represents a promising natural source for obtaining new biologically active compounds to produce new herbal medicines for the treatment of different pathophysiology.

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