Review Article

A brief review on Pharmacological and Phytochemical studies of *Capparis decidua*

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Abstract

Capparis decidua belongs from a plant family Capparidaceae and commonly known as “kair”. It is an important plant of xerophytic zone and grows abundantly in wild arid regions of Asia, Africa and Saudi Arabia. Many chemical constituents such as alkaloids, terpenoids, glycosides and fatty acids have been reported from its root and stems extracts. *C. decidua* possessed many pharmacological attributes such as antidiabetic, anthelmintic, antibacterial, antifungal, analgesic, anti-nociceptive, antirheumatic, hypolipidemic, antiatherosclerotic, anti-tumor, anti-giardial, antioxidant, anti-inflammatory, hepatoprotective, and anticonvulsant activities. The present article deals with the updated phytochemistry, traditional uses and pharmacological uses reported within a selected duration between 2009-2018.

Keywords: *Capparis decidua*, kair, xerophytic, anti-giardial, hepatoprotective

Introduction

The thousands of medicinal plants used in various traditional systems existing in India, which possess enormous potential of offering direct therapeutic effect individually or in combination. Medicinal plants have also become a growing part of modern medicine (Chishty et al., 2017). Plants are considered as a wealth house of prospective drugs along with participate very important role in the repression of nutritional and pathogen related afflictions of tribal people since antique times. *Capparis deciduas* belong to Capparidaceae family commonly known as “kair” (Dipti et al., 2016). *Capparis Decidua* is a densely, bushy, branched, spinous, shrub or tree distributed in arid and semi arid regions of the country. The tree usually grows in dry exposed habitat often on foothills and grows in wild states in arid and semi arid regions of the country and it is mainly distributed in western Rajasthan, Punjab, Gujarat, central area and Deccan and grows in all types of waste lands (Kumar et al., 2013). Total 44% species of vascular plants

are present and kair considered as one of the most important floras among them which comes under biodiversity hotspots. Distribution of kair is over 3540 km in piedmont plains of Jodhpur and Bikaner district in Rajasthan and

Figure 1. Whole plant of *Capparis deciduas*

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annual production of fruit is around 7,000 tons. People who lived in dessert areas used *Capparis Decidua* for many purposes. Caper buds are both wild-collection and cultivated; cultivated plants are usually spineless. Cultivation is done under well drained, sandy soil in sun. Propagation of plant is done after seed sowing in autumn or spring or even it can be grown by ripe woodcutting in summer at 19-24°C (66-75°F) (Dipti et al., 2016). The review will be a focus for and assist medicinal chemists, pharmacologists and phytochemists to distinguish on the subject of bioactive potential and nutra-pharmaceutical applications of this versatile plant.

Habitat

Capparis decidua is an indigenous medicinal plant of India having large biodiversity in different north-western states of India. *Capparis decidua* is a densely branching shrub or small tree found growing naturally in arid and semi-arid areas of India. It is found in the deserts, especially of Rajasthan, Punjab, southwards to Karnataka and Tamil Nadu and Gujarat. It grows in very shallow soils, soils affected by saline irrigation water, or in stabilized sand dunes. The plants of *Capparis decidua* also have high nutritional value (Chishty et al., 2017).

Geographical source

Capparis decidua is found in the subtropical and tropical zones and other arid regions in southern Asia. It is of a common occurrence in dry places in Sind, Baluchistan, Western Rajasthan, Deccan Peninsula, Egypt, Socotra, Arabia, Tropical Africa, India, Tinnevely and Pakistan. It is found in the deserts, especially of Rajasthan, Punjab, Sind, Southwards to Karnataka and Tamil Nadu and Gujarat. *Capparis decidua* is distributed over 3450km² plants in Nagaur, Bikaner, and Jodhpur districts of Rajasthan (Chishty et al., 2017; Godara et al., 2015). It's a little much divided tree or shrub of waterless regions in Africa, Middle East and southern Asia, including the Thar-desert tears a mass of slender, leafless branches, the small caducous leaves being found only on young shoots. It seldom exceeds a height of 5 Mtrs.(15 feet). "Khair" (A biggest town of Aligarh District) city has many Kair's trees in India. This city is famous for "Kair trees". The new flush of leaves appears in November–January. Red conspicuous flowers appear in March to April and August–September and ripe by May and October. The pink fleshy berries are eagerly eaten by birds. It coppices well and produces root suckers freely. It is extremely drought-resistant and tolerates some frost.

Botanical Description

Capparis decidua is a densely branched shrub or a small tree with scanty, 4-5 m high, small caducous leaves found only on young shoots (Rathee et al., 2010).

(a) Root

Capparis decidua has tap root system. At first, primary root grows which then develops secondary branches. One year later many secondary roots formed but initial roots remains dominant.

(b) Stem

Capparis decidua is very much branched. Every branch is smooth, slender, spinous and terete. Developed branches of the plant are leafless only young shoots have leaves. Mostly branches and twigs are shiny and green, while along with time bark attains white grayish in colour.

(c) Leaves

Caducous are available on new shoots. Leaves are acute, pointed and little, about four to twelve millimeter long and one to three millimeter broad. These are with very short petiole or sessile. Fresh leaves emerge in the month of November to January.

(d) Inflorescence

Corymbs with several flowers growing from short lateral shoots or from old branches, in the spines axils.

(e) Flowers

Flowers are commonly either red or pink but sometimes they are yellow also, in lateral corymbs pattern. Fresh shoots have lesser flowers on them, but plentiful flowering is found on the matured shoots. Flower appears from February to July while during summer season have maximum flowering.

(f) Fruits

Fruits are small, fleshy berry, glabrous, globular, and similar to a small cherry in size and shape with diameter of 1-2 cm. New berries are greenish in colour, turn pinkish after ripening. The fruit is hard woody in nature having 1-2 mm thick brownish rind; pedicel's are short and brittle; bitter in taste; strong and foetid odour. Fruiting period is from March to April, while subsequently fruits were rise in May to July.

(g) Seeds

Seed are globose having diameter of 2-5 mm, dried seeds are kidney shaped having length, width and thickness of 4-5 mm, 3-4 mm and 1.5-2 mm which is surrounded by white grayish fleshy aril.

Phytochemistry

Various phytoconstituents have been identified and isolated from different parts of *Capparis decidua* which includes alkaloids, glycosides, terpenoids, sterols, flavanoids,

Table 1. Amounts of phenolic compounds, flavonoids and flavonols in leaves of *C. deciduas* (Nazar et al., 2018)

Extracts	Phenolic compounds ($\mu\text{g mg}^{-1}$)	Flavonoids ($\mu\text{g mg}^{-1}$)	Flavonols ($\mu\text{g mg}^{-1}$)
Aqueous	154	98.33	148.33
n-Hexane	367	812.33	868.33
Acetone	49.83	106.33	341

Table 2. Phytochemical isolated from various parts of *C. deciduas* (Nazar et al., 2018)

Plant part used	Phytochemicals	References
Root bark	Sitosterols, Alkaloids, Heterocyclic compounds	Rathee et al., 2010a; Rai, 1987; Ahmad et al., 1989; Ahmad et al., 1985; Ahmad et al., 1992; Dahot, 1993; Gaiind et al., 1969; Gupta and Ali, 1997
Leaves	Flavonoids and Phenolic components Alkaloids	Daniel and Sabnis, 1977; Mann et al., 2013; Baghiani et al., 2012; Abra and Ali, 2011
Roots	Alkaloids	Rathee et al., 2010a; Dahot, 1993; Rathee, 2010b; Singh et al., 2011
Aerial parts	Terpenoids, Sesquiterpene lactones	Gupta and Ali, 1997; Mohammed et al., 2014
Seed	Glucocapparin and methyl isothiocyanate, N-pentacosane, b-sitosterol and b-carotene, Fatty acids	Rathee et al., 2010a; Rathee et al., 2010b; Ahmed et al., 1987a; Ahmad et al., 1987b; Abra et al., 2011
Flowers	Hydrocarbons, Sterols and sugars, Stachydrine	Rathee et al., 2010a; Mishra et al., 2007; Rai, 1987; Ahmed et al., 1987a; Ahmad et al., 1987b
Fruit	Stachydrine, Carotene	Ahmed et al., 1987a; Ahmad et al., 1987b; Mishra et al., 2007

phenols and fatty acids. The roots of *C. decidua* are found to contain sitosterol and a spermidine alkaloid, isocodonocarpine. Spermidine and spermine polyamines are found to have an important role in the proliferation, growth, and development of mammalian cells. Moreover, these compounds also possessed antioxidant, anti-arteriosclerotic, and anti-allergenic properties. Three crystalline, colourless and hygroscopic alkaloids, Capparine, Cappariline, Capparinine, are also isolated from the roots. It contains npentacosane, n-triacontane, n-triacontanol, 2-carboxy-1, 1-dimethylpyrrolodine, 6-(1-hydroxy-non-3-enyl) tetrahydropyran-2-one, β -sitosterol, β -carotene, ascorbic acid, proteins, carbohydrates, calcium, potassium, phosphorus, zinc, iron, manganese, glucosinolates. The roots contain the indole bases capparin, capparilin and capparinin (Chishty et al., 2017; Singh et al., 2011; Rathee et al., 2010; Abdalanman, 2016). Amounts of phenolic compounds, flavonoids, and flavonols in various extracts of *C. decidua* leaves are shown in table 1 whereas table 2 is presenting other phytochemicals isolated from

various parts of *C. deciduas*.

Traditional Uses

Capparis decidua is extensively employed by conventional healers and tribal people for treatment of several diseases. Ancient literature also documented Therapeutic activity of *Capparis decidua*. They frequently prescribe it in CVS diseases, scurvy and colic pains. The plant is beneficial in respiratory disorders, flatulence, skin diseases in general weakness and also in diuretic and anthelmintic.

Infusion of *Capparis decidua* is used topically for boils, joint disease, eruptions and internally in cough, asthma and as an antidote for poisoning. Fresh *Capparis decidua* plant juice is prescribed to destroy worms in ear. It is also an excellent alternative of senega. Powdered bark of the *Capparis decidua* is used as poultice for the healing of wounds (Nazar et al., 2018).

Roots are used as expectorant, anti-asthmatic, thermogenic,

Table 3. Physical properties of *C. deciduas* (Alrasheid et al., 2018)

Parameters	Value (%)
Moisture	5.18±0.01
Total ash	6.34±0.06
Crude fibre	6.19±0.5
Total proteins	14.32±0.2
Total carbohydrate	61.95±0.03
Total oil	6.02±0.02

carminative, sudorific, digestive, anodyne, stimulant, aphrodisiac, antibacterial, anthelmintic and beneficial in arthritis, constipation, dyspepsia, odontalgia. Root bark is recognized to be diaphoretic, astringent, alexeteric, acid in traditional system.

Infusion or powder of bark is prescribed for cough, palsy, gout, dropsy, intestinal worms, rheumatism, asthma and intermittent fever. Powder is topically applied topically on ulcer. A paste of coal produced by flaming the wood is useful for the treatment of muscular injuries. Chewing Fresh leaves and young shoots are very beneficial in tooth ache.

Their paste is used as plaster on swellings and blisters. In western region of country, powder mixture of tender branches and wheat flour fed to animals to reduce pain. The flower buds and green berries of *Capparis decidua* are eatable & generally pickled or utilized in making curry and vegetable due to their traditional faith that it posses hypoglycemic activity. The fruit vegetable prepared in ghee is also supposed to be beneficial for eyes (Chishty et al., 2017; Jaiswal et al., 2016; Singh et al., 2011; Rathee et al., 2010; Singh et al., 2011).

Pharmacological Studies

Anti-oxidant activity

Anti-diabetic treatment with powdered fruit of *Capparis decidua* decreased Alloxan induced lipid peroxidation significantly in erythrocytes, kidney and heart. Erythrocyte superoxide dismutase (SOD) activity decreased while the kidney and heart SOD increased in diabetic animals. These alteration in SOD were counteracted by insulin as well as with powdered fruit of *C. decidua*. Increased catalase activity in erythrocytes, liver, kidney and heart with *C. decidua* treatment indicate that the treatment may neutralize H_2O_2 toxicity by its increased decomposition by CAT (Singh et al., 2011).

Figure 2. Chemical structures of major chemical constituents

Anti-inflammatory and analgesic activity

The in vitro anti-inflammatory activity observed in their study support the utilization of the plants in traditional medicine as crude anti-inflammatory agent. Ethanolic extract of aerial parts exhibited anti-inflammatory and analgesic activity. Isocodonocarpine was found to be responsible for anti-inflammatory activity and anti-asthmatic activity (Mohammad et al., 2012).

Anti-bacterial activity

C. deciduas extracts are also rich in antioxidant compounds, phenolics, Flavonoids, rutin, tocopherols, carotenoids and vitamin C. The inhibited growth of *E. coli* and *S. aureus* can be correlated with flavonoid compounds in *C. deciduas* extracts (Chishty et al., 2017).

Anti-fungal activity

The antifungal activity of *C. decidua* has a good inhibitory effect on *C. albicans* than *A. niger*. The hexane extracts of *C. decidua* were also applied to *C. deciduas* and found the MIC was 2.9 µg/ml. *C. deciduas* showed an increase in the inhibitory concentration in a dose dependent manner (Jameel, 2018).

Hepatoprotective-activity

The aqueous and Methanolic extracts of *Capparis deciduas* stems locally known as altoundob were screened for their hepatoprotective activity against CCL₄ induced hepatotoxicity in rats. This plant is used in traditional system medicine in the treatment of jaundice (Ali et al., 2009).

Antinephrolithiasis activity

C. decidua show preventive and curative regimen test sample show significant changes with comparison of Hyperoxaluria group in urinary LDL, Urinary ALP, serum Urea and serum creatinine. In preventive regimen capparisterol 80 mg/kg show greater creatinine clearance then standard drug cystone 750 mg/kg and in curative regimen capparisterol 70mg/kg has greater effect then cystone (Godara et al., 2015).

Hypolipidemic activity

In a study the ethanolic extract of different parts of *C. deciduas* i.e., fruit, flower, shoot and bark were found to have antihyperlipidaemic activity in rabbits. The serum cholesterol level was reduced by 61%, 58%, 48% and 28% in *C. decidua* fruit, flower, shoot and bark after a dose of 500mg/kg body weight was given to rabbits (Rathee et al., 2010; Purohit et al., 2005).

Anti-diabetic activity

C. decidua may have potential use as an anti-diabetic agent and in lowering oxidative stress in diabetes. *C. deciduas* powder has

hypo-glycaemic activity, decrease lipid peroxidation and alters free radical scavenging enzymes such as superoxide dismutase and catalase in erythrocytes, liver, kidney and heart in aged alloxan induced diabetic rats (Yadav, 1995).

Conclusion

Capparis decidua has found significant ethnomedicinal applications including antirheumatic, analgesic, anthelmintic, laxative, renal disinfectant, diuretic, cough, diarrhea, dysentery, cholera, cardiovascular diseases, and digestive tract disorders. The presence of a wide range of biologically active phytochemicals lends the plant its diverse pharmacological activities, some of which are antidiabetic, antibacterial, antifungal, anti-aging, anti-tumor, antinociceptive, antiatherosclerotic, hepatoprotective, antioxidant, antiangiogenic, antihypertensive, hypolipidemic, and anti-inflammatory. Using the *C. Decidua* in the local communities of *C. Decidua* in rheumatism and gout prevails. This plant function can be used for the isolation of possible chemicals for the treatment of rheumatism by propagating and selling certain plants. Because of the numerous antioxidants present, *C. Decidua* can be used in cosmetics which are anti-aging. These plants are a good source of food due to their fruit's high carbohydrates and protein content, and high seed lipid profile.

But further scientific-based research is still needed to explore the nutritional value of this plant, so it can contribute to the increasing need for food for the world's growing population. This plant material's anticancer activity was correlated with the existence of highly possible terpenoidal glycosides. *C. decidua* contains various terpenoids which make the plant compatible with cancer treatment. Although some studied did reveal the plant's anticancer properties, its true potential remains to be revealed.

Conflict of interest

Not declared

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