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Phytochemistry and bioactivities of a harsh Terrain plant: *Capparis decidua* (Forsk.) Edgew.

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ABSTRACT

Capparis decidua (Forsk.) Edgew. (Capparaceae) is a xerophytic plant, found chiefly in dry and arid regions of North-West India (Thar Desert), Pakistan and some Asian and African countries. It is an important plant of traditional Indian System of Medicine (ISM) and is mainly used to treat cough, asthma, ulcers, boils, piles and as antidiabetic remedy, antihypertensive, hypolipidemic, hepatoprotective and antiinflammatory. With advancement in the techniques of isolation, purification and analysis it became possible to identify the different classes of phytochemicals in this plant such as alkaloids, flavonoids, fatty acids and glucosides showing a wide array of biological activities. Here, an attempt has been made to provide a detailed systematic review of phytochemistry and bioactivities of the xerophyte *Capparis decidua*.

KEYWORDS

Capparis deciduas;
Capparaceae;
Alkaloids;
Spermidine;
Hypolipidemic;

INTRODUCTION

The name Capparis (Καρπαρις) was coined by Theophrastus (4th century BC) and endorsed by Dioscoroides (1st century AD). It seems to have come into wide use after the spread of Arab culture in the middle ages. The genus Capparis was created by Linnaeus (1753, 1754) with the description of *Capparis spinosa L.* and other Capparis species[39]. Capparis comprises around 250 species including shrubs, trees and woody climbers distributed in tropical and sub-tropical zones of southern America, Europe, Africa, Madagaskar, Asia, Australia and the Pacific islands[64].

Distribution and habitat

Capparis decidua (Forsk.) Edgew. is chiefly found in dry and arid regions from Punjab southwards towards up to Dakshina Kannada. The plant usually grows in dry, exposed habitat, often on foothills, in wastelands, in association with Anogeissus pendula Edgew., Calotropis procera (Ait.) R. Br., Maytemus emarginatus (Willd.) Ding Hou, etc. It is reported to be suitable for very shallow soils and soils affected with saline irrigation water, and for stabilizing sand dunes[10]. This species is common in dry tropical Africa, especially in the Sahel, where it sometimes constitutes lines of small trees in the Wadi bed. In the Republic of Niger it reaches the Konadougou. In West Africa, the area of distribution is identical to that of Cadaba arinose; its southern limit corresponds to the northern loop of the Senegal River. Its area includes Tibesti (West Chad), much of the Sudan (except the extreme south) the Arabian peninsula, Jordan, India, Pakistan, Iran, the Mascarene islands and Natal[45].

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DESCRIPTION

Capparis decidua (Forsk.) Edgew. (Capparaceae) commonly known as ker, karer, karira or caper etc., is a densely branched, spinous perennial shrub or tree of Thar desert. It is chiefly found in tropical and subtropical zones and other dry arid regions of southern Asia, occurring as a small shrub with many dark green vine-like apparently leafless tender branches with waxy bloom, hanging in the form of bundles.

The bark is grey rough, corky and turns whitish-grey colour with age. The bark is covered with light brown straight or recurved, 3-7 mm long, paired thorns on twigs at each node. Very minute (2 mm) leaves with a very short life span occurs only on young shoots, so plant looks leafless most of the time but new flush of leaves generally emerge in November-January. The leaves are linear, 1-2 cm long, short apex, stiff, pale mucro-like in appearance. Groups of red, pink rarely yellow coloured flowers in lateral corymbs are present on leafless shoots or axils of spines. Red coloured conspicuous flowers bloom in March-April and August-September and ripe by May and October respectively. Berries (fruits) are many seeded globose or ovoid, 1-2 cm in diameter. Raw fruit is green in colour while ripe fruit is mucronate pink-red berry which becomes blakish-brown on drying. The seeds are globose in shape, 2-5mm in diameter. It produces root suckers freely and coppices well[10].

Vernacular names

English	Caper plant, Caper berry
Gujarati	Ker, Kerada
Hindi	Kachra, Kurrel, Karer, Kabra
Kannada	Nispatige, Nispatigae, Niovate-gidda, Chippur, Karira, Kariuppi-gidda
Marathi	Nepati
Punjab	Kair, Karil, Delha (fruit)
Rajasthan	Kair, Kareal, Kerro, Taint
Sanskrit	Karira
Tamil	Sengam, Karyal
Telugu	Enugadanta, Kariramu[34]

The plant shows strong resistance to harsh environmental conditions. Despite of the adverse conditions, it does not seem to show any water stresses hence resistant to drought and tolerates frost well. It also attracts helpful insectivores. *Capparis decidua* can be used in landscape gardening, afforestation and reforestation in the semi-arid and desert areas; it provides assistance against soil erosion and floods. The immature flower buds are pickled in vinegar or preserved in salts. Additionally, fruits with soft seeds are used for preparing vegetables, curry and fine pickles; the plant is also used as folk medicine[29];

Medicinal value

The green berries are used in food preparations like pickles due to the belief that it has antidiabetic action. In traditional Indian system of medicine the *Capparis decidua* holds an important place and different parts elaborate numerous uses. The bark has an acrid, sharp, hot taste; analgesic, diaphoretic, axeleretic, laxative, anti-helmintic; good in cough and asthma, ulcers and boils, vomiting, piles, and all inflammations. The fruit has sharp hot taste; astringent to the bowels; destroys foul breath, biliousness, and urinary purulent discharges; good in cardiac troubles (Ayurveda). The plant has bad smell and taste; carminative, tonic, emmenagogue, aphrodiasic, alexipharmic; improves the appetite; good for rheumatism, lumbago, hiccough, cough and asthma (Yunani). In the Punjab, the top shoots and young leaves are made into powder and used as blister (Stewart); they are also used in boils, eruptions and swellings, and as an antidote to poison; also in affections of the joints (Baden Powell). They are very efficacious in relieving toothache when chewed (Murray). The fresh twigs (tips only) are crushed and soaked in water. The water is strained off. Sometimes this is done twice or thrice. The residue is dried and allowed to solidify. A tiny piece of it is eaten with butter and gives relief from pain after a bruise or fall. Also makes a very strong plaster (Hoston), [10,41].

Reported phytochemicals

The plant is found to reveal number of phytoconstituents from its different parts:

Capparis decidua revealed the presence of a number of alkaloids, terpenoids, glycosides and some fatty acids[52]. Alkaloids were also reported during a survey for alkaloids in Rajasthan desert plants[28]. Spermidine alkaloids like isocodonocarpine[4,5,6,18], capparisinine, capparadisine have been isolated from the root bark[7]. The root bark have also showed the

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presence of alkaloids like 14-N-acetyl isocodonocarpine, 15-N-acetyl capparisine, cadabicine[4], capparisine[24] and codonocarpine[7]. Colourless, crystalline and hygroscopic alkaloids capparine (m.p. 236^{0}C, $C_{15}H_{35}N_3O_6.2H_2O$), cappariline (m.p. 188^{0}C, $C_{15}H_{35}N_3O_6.5H_2O$) and capparinine (m.p. 236^{0}C) were isolated successfully when roots of C. decidua were extracted with ethanol and chromatographed on neutral alumina column with chloroform - methanol (90:10, 80:20, 50:50, 20:80) respectively[7]. Petroleum ether extract of the root bark furnished n-pentacosane, n-triacontanol, β-sitosterol while from the alcoholic extract, a water soluble alkaloid, l-stachydrine (0.10 %) and chloroform-soluble alkaloid (0.15 %) were obtained[27].

The chromatographic separation of the aerial parts (stem) of C. decidua afforded one shikimate derivative, two acycylic terpenoids, four fatty acids, two sterols and two lupine terpenoids. Beside the earlier reported alkaloid, 2-carboxy-1, 1-dimethylpyrrolodine (stachydrine) stem also contained aliphatic alcohol n-triacontanol[36]. In the preliminary screening of leaves for the presence of flavonoids, isorhamnetin was detected but quercetin, rhamnetin, kaempferol, myricetin, glycoflavones and leucoanthocyanins were found to be absent. Further study on distribution of phenolic content showed the presence of p-hydroxybenzoic acid, protocatechuic acid, salicylic acid, syringic acid, vanillic acid, gentesic acid, 2-hydroxy-6-methoxybenzoic acid and sipanic acid[19]. The tannin content of the leaves collected from hot arid region of Rajasthan exhibited a seasonal variation of being absent in spring and winter and present at 2.95 mg/100 mg^2 concentration in summer months[61].

An isothiocyanate glucoside, identified as glucocapparin was isolated from the seeds[40]. There are 3 major hydrolysis products of glucocapparin, a glucosinolate occurring in *Capparis decidua* i.e. isotiocyanate, oxazolidinethione and thiocyanate. Out of these isothiocyanate and its derivatives like β-phenylisothiocyanate have shown to possess antitumor and antimicrobial activity[38].

Flowers on extraction with petroleum ether, chloroform and ethanol successively yielded two hydrocarbons: n-nonacosane and n-hentriacontane, two new saturated aliphatic ketones (C_{28} and C_{32}), n-nonacosanol, β-sitosterol, β-D-glucoside of β-sitosterol, a new isomer of β-sitosterol, a new glycoside, pelargonidin-3-galactoside, glucocappasalin, glucocapparin and also two free sugars, D-glucose and D-galactose [49]. From the unsaponifiable fractions of petroleum ether extract of flowers and fruit husk n-pentacosane, n-triacontane, n-triacontanol and β-sitosterol were isolated. In addition to this fruit husk also contained β-carotene. The unsaponifiable matter from seeds yielded n-pentacosane, n-triacontanol and β-sitosterol but n-triacontane was found to be absent. From the saponifiable matter of flowers and fruit husk phthalic acid was isolated. From the ethanolic extracts of flowers, fruit husk and seeds an alkaloid l-stachydrine was isolated. Among these fruit husk possessed the maximum amount of l-stachydrine along with traces of choline[24].

Six oxygenated heterocyclic constituents capparis sesterpenolide and deciduaterpenolides A, B, C, D and E have been isolated from the alcoholic extract of root bark and their structures were established as 7, 11, 15, 19- tetramethyleicos-13-ene-17-ol-6,21-olide; 13-(15,19,19-trimethylcyclohexyl- 14, 17-diene-16-one-yl)-10-methyl-6-hydroxymethyl - enetridec - 10 - ene - 7, 8, 12 - triol - 5(20) - olide; 13-(15,19,19-trimethylcyclohex-14,17-diene-16-one-yl) -10-methyl - 6 - hydroxymethylenetridec - 6 - ene - 1, 8, 12 - triol -5(20) - olide; 14-(16,20,20- trimethylcyclohex- 15, 18- diene-17- one- yl)-tetradec -3-ene-13-ol-1(5),8(24)-diolide; 14-(16,20,20- trimethylcyclohex-15, 18- diene-17- one- yl)-11-methyl pentadec-1,22-dihydroxymethylene -7-ene-13-one-6,21-olide and 19-(21,25,25- trimethylcyclohex-20)30-diene-22- one- yl-16-methylnonadec -8-ene-14-one-8-hydroxy methylene-18-ol-7,26-olide-28-oic acid, respectively. Later two sterols, one diterpene alcohol, two aliphatic constituents and one diterpenic ester were reported from C. decidua root barks. β-Sitosterol was also isolated from the roots by extracting with ethanol and chromatographing the alcoholic extract on neutral alumina with the eluents benzene, ether, chloroform and methanol successively. The structures of the sterols were established as 24-β-methylcholest-7-ene-22-one-3β-ol and 24- β -methylcholest-9(11)-ene-22-one-3α-ol. The structure of diterpene alcohol was identified as 3-methyl-7- hydroxymethylene-10-(12, 16, 16-

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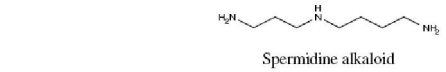
trimethylcyclohex-11-enyl) - dec-9-ene-5-one-8-ol. Butyl-3-oxoeicosanoate and 25-oxooctosan- 1, 20-diol were the aliphatic constituents. The diterpenic ester was identified as 9-(11, 15, 15- trimethylcyclohex-11-ene-13-one-yl)-one-6- hydroxymethylene-7-one-yl, 4'-Me heptanoate[36]. Aqueous and ethanolic extracts of the plant in a preliminary examination afforded arabinose, galactose, polyphenols, carotenes, free amino acid alanine, chloroplast pigments and an unidentified carbonyl compound[21]. The 50 % ethanolic extract of plant (excluding root) was found to be devoid of tannins[11].

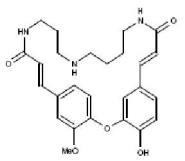
Beside secondary metabolites fruits also elaborated varied kinds of macro and micro nutrient. So, many studies have also been conducted to find out the nutrient content of the fruits and other parts of the C. decidua. Like in one study green fruits were reported to contain proteins, 8.6; sugars, 1.7; minerals (K, Ca, Mg), 1.2; phosphorus, 0.05 per cent by weight and vitamin C, 7.8 mg/100 g pulp. The physicochemical characteristics of seed fats were also reported in this particular work[50]. In an another study the unripe fruits contained crude protein, 14.88 %; digestible carbohydrates, 59.41 %; ascorbic acid, 120.70; β-carotene, 5.40; calcium, 90; phosphorus, 179; iron, 3.50; zinc, 1.60; copper, 1.10 and manganese, 1.90 mg/100 g. The contents of protein fraction were albumin, 7.85; globulin, 2.40; prolamine, 1.58; glutelin, 1.79 g/100 g on dry matter basis and phytic acid, 304 mg/100 g. The fruits showed absence from anti-nutritional factors, viz., tannins, trypsin inhibitor and haemagglutinins (lectins), [17]. Further, the fruits were reported to contain; protein (17 ± 2), fats (5 ± 1), crude fibre (1 ± 0), ash (6 ± 2) and total carbohydrates (71 ± 6), expressed as g/100 g, on dry matter basis. The mineral composition reported as mg/100 g, on dry matter basis was calcium (210 ± 0), phosphorus (360 ± 20), zinc (4 ± 1), iron (6 ± 0), and manganese (2 ± 0),[22]. The β-carotene contents of fresh, blanched, dried and roasted fruit were reported as 2.45, 2.42, 10.81 and 1.58 mg/100 g, respectively on dry weight basis[16]. The total dietary fibre of unripe fruit was reported to be 38.5 g/100 g. Hemicellulose was the predominant constituent (34.15) followed by cellulose (30.5), lignin (24.5) and pectin (10.9) expressed as g/100 g, on dry matter basis of the total dietary fibre. The protein content was reported to be 16.3 %[1]. The fatty acid composition of the seed fat was found to be as: myristic (0.6), palmitic (21.1), stearic (7.7), arachidic (2.0), oleic (57.2), linoleic (11.4), linolenic (0.0) expressed as per cent. The seed fat was unusually rich in oleic acid[54,55]. The copper, zinc and manganese concentration in leaves was reported as 19.6, 103.5 and 29.7 μg/g, respectively, on dry weight basis[59]. The phosphate and lime content of leaves were 0.80 and 0.92 % respectively[20].

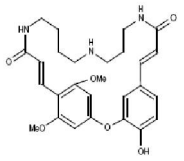
Structures of reported phytochemicals

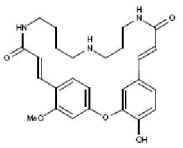
Reported bioactivities

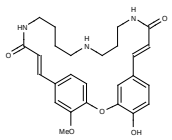
Several studies have been performed to evaluate biological potential of the plant. The bioactivities exhib-

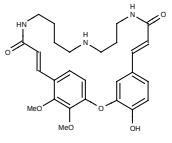

Spermidine alkaloid

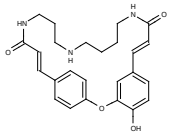

Isocodonocarpine

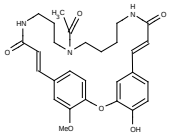

Capparisinine

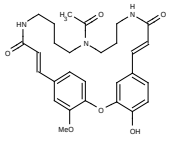

Cadabicine

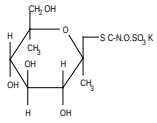

Codocarpine

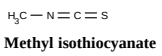

Capparidisine


Cadabicine


14-N-acetyl codonocarpine

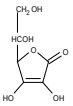

15-N-acetyl capparisine

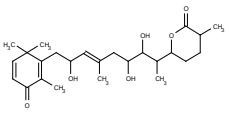

Glucocapparin

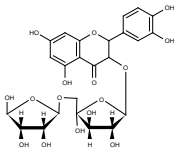

Methyl isothiocyanate

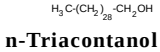

Stachydrine

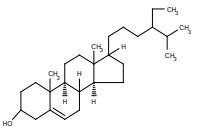

Phthalic acid

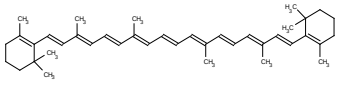

Ascorbic acid


Decidua terpenolideA


Rutin


n-Triacontanol


β-Sitosterol


β-Carotene

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ited by C. decidua are summarized below:

Depressant activity

Capparidisine a new alkaloid from C. decidua was reported to have dose dependant depressant effect on heart rate and coronary flow[51].

Anti-inflammatory and analgesic activities

Out of 5 plants used in Saudi Arabia for their anti-inflammatory properties, the ethanolic extract of *Capparis decidua* and the aqueous extract of Capparis spinosa were found to possess significant anti-inflammatory activity against carrageenan induced oedema in rats. These two plants were also tested for their antipyretic and analgesic activity. C. decidua was found to possess significant antipyretic effect. Both of them were devoid of analgesic activity[3].

Sedative and anticonvulsant activities

Some workers screened the alcoholic extract of aerial parts of C. decidua, including flowers and fruits for central nervous system (CNS) activity using conventional behavioral animal models. In the barbiturate-induced sleeping test a significant increase in sleeping time was observed. While in the pentylenetetrazole-induced seizures test the C. decidua extract dose-dependently decreased the number of animals with convulsions. The findings of the present animal study suggested that C. decidua exhibits CNS depressant and anticonvulsant activities[31].

Antidiabetic activity

Antidiabetic treatment with powdered fruit of *Capparis decidua* lowered lipid peroxidation (LPO) and also altered the superoxide dismutase (SOD) and catalase enzymes (CAT) to reduce oxidative stress in alloxan induced diabetes[63].

Alcoholic extracts (50%) of fruits, flowers and bark of *Capparis decidua* Linn. (Capparidaceae) were tested for their hypoglycemic effect. Results indicated that the alcoholic extracts of every tested part, manifested a significant hypoglycemic activity. The alcoholic extract of fruit displayed the best hypoglycemic activity, followed by that of bark and flower[14]. In a similar study, the ethanolic extracts (50%) of different parts of *Capparis decidua* i.e. bark, fruit and flower were used to evaluate their glucose lowering potential. The serum glucose levels reduced by 81.4%, 60.48% and 55.43% in fruit, flower and bark extract treatments respectively. Thus indicating that *Capparis decidua* fruit possessed significant antihyperglycemic activity[32].

Treatment of diabetic mice with alkaloid rich (AR) fractions of C. decidua significantly inhibited the acute elevation of blood glucose level during oral glucose tolerance test (OGTT) and also reduced total cholesterol (TC) and triglyceride (TG) content. Activity of glucose-6-phosphatase (G6Pase) was reduced, also liver and muscle glycogen content showed significant improvement. AR fraction revealed promising results in terms of anti-diabetic activities thus establishing its candidacy for further purification and characterization of the individual alkaloids, in order to understand the mechanism of action involved[57].

Antidiabetic activity of aqueous and ethanolic extracts of *Capparis decidua* stem in alloxan-induced diabetic rats was also reported by some workers. The fasting blood glucose level decreased by 58.5%, 83.6 % (aqueous extract) and 60.2%, 98.51% (ethanolic extract) after 21st day in diabetic rats treated with a different doses of 250 mg and 500 mg/kg body weight respectively[53].

Antitubercular activity

C.decidua fruits were found to possess anti-tubercular activity[13].

Antiplaque activity

Capparis decidua fruit and flower extracts were effective in preventing plaque formation[47].

Antihelmintic and purgative activities

The aqueous extract of roots of C. decidua was found to have purgative activity[26] while the alcoholic extract of the fruit pulp and root bark showed anthelmintic activity[42].

Antimicrobial activities

Root bark: The alcoholic extract of root bark possesses significant antibacterial and antifungal activities. The ethanolic extract from the root bark of C. decidua was tested for its anthelmintic and anti microbial activities and was found to be active against Pseudomonas aeruginosa, Staphylococcus aureus and

Escherichia coli, but was inactive against Candida albicans[23,42].

Seeds: On studying the antibacterial activity of the seeds it was found that glucoside, glucocapparin had no activity but its isothiocyanate aglycone had good antibacterial activity[40]. It was found to inhibit cell cultures of Vibrio cholerae, V. ogava, V. inaba and V. eltor[25].

Stem: In an investigation the antimicrobial activity of *Capparis decidua* against seven bacterial strains was studied. The chloroform, acetone, methanol and ether extracts of *Capparis decidua* showed very high susceptibility to the Lactobacilus that is MIC value was obtained in a range of 0.028 - 0.0625 µg/ml, while aqueous extracts have showed lowest MIC value in a case of Klebsiella pneumoniae and Micrococcus luteus. Similarly MBC values of various extracts were also determined in similar strains. Chloroform extract has showed lowest MBC value for Lactobacilus acidophilus i.e. 0.125 µg/ml[60]. Free and bound flavonoids of different parts of Tridax procumbens L. (Asteraceae) and *Capparis decidua* (Forsk.) Edgew. (Capparaceae) were studied for their antimicrobial activities using disc diffusion assay, against two Gram negative bacteria (Escherichia coli and Proteus mirabilis), one Gram positive bacteria (Staphylococcus aureus), and a fungi (Candida albicans). Both plants exhibited broad spectrum antimicrobial activity. Free and bound flavonoids of T. procumbens flowers and C. decidua stem were found to be more potent than other parts. C. albicans was found to be most susceptible organism followed by S. aureus, P. mirabilis, and E. coli [56].

Hypolipidemic activity

In a study, the ethanolic extract of different parts of C. decidua i.e., fruit, flower, shoot and bark were found to have antihyperlipidemic 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 500 mg/kg body weight was given to rabbits [47,48,58]. Yet in an another study the ethanolic extract of C. decidua produced a significant dose-dependent decrease in the levels of total cholesterol (TC), triacylglycerol (TG), low-density lipoprotein-cholesterol (LDL-C), with a significant increase in the level high-density lipoprotein-cholesterol (HDL-C). Therefore, extracts of C. decidua proved to have a hypolipidemic potential[15].

Dietary fibre from the plants also showed a significant hypolipidemic action. Dietary fibre content of foods namely, khejri beans (Prosopsis cinereria), peepalbanti (Ficus religiosa), barbanti (Ficus bengalensis), gullar (Ficus glomerata) and teent (*Capparis decidua*) varies from 38.5% to 55.7%. Cellulose and lignin are predominating constituents in peepalbanti, barbanti and gullar; hemicellulose in teent and pectin in khejri beans. Fibre from all these plant foods was when fed at the 10% dietary level to rats, induced a greater resistance to hyperlipidemia than cellulose. Teent had the most pronounced hypocholesterolemic effect which appeared to operate through increased faecal excretion of cholesterol as well as bile acids[2].

In a clinical study performed on *Capparis decidua*, the diet of hyperlipidemic human adults (40-60 years) was supplemented with the unripe fruit powder for three months. Significant reductions were observed in plasma triglycerides, total lipids and phospholipids concentrations of the patients[33]. The extract of unripe fruits and shoots of C. decidua caused reduction in plasma triglycerides, total lipids and phospholipids; hence used as hypocholesterolemic. It appeared to operate through increased faecal excretion of cholesterol as well as bile acids[33].

Antiatherosclerotic activity

Oral administration of *Capparis decidua* flower extract reduced serum cholesterol and LDL cholesterol level by 58% and 67% respectively. The plant extract also reduced serum triglycerides and phospholipids level by 52% and 22% respectively. The HDL/total cholesterol ratio was reduced significantly in cholesterol fed rabbits which became normal in plant extract treated groups. These results again indicated the antiatherosclerotic and hypolipidemic nature of the plant product[48].

Antihypertensive activity

Ethanolic extract of C. decidua at a dose of 1-30 mg/kg exerted a dose dependent fall in blood pressure and heart rate in experimental animals. The extract displayed inhibition of nor-epinephrine or potassium

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induced contractions and it also inhibited the contractions produced with acetylcholine, histamine and histidine. All this clearly manifested that direct relaxation action of C. decidua extract on myocardium and blood vessels could be responsible for its antihypertensive action[30]. Further, in a study the water, ethanol and acetone extracts of root exhibited 21, 41 and 26 % angiotensin converting enzyme (ACE) inhibition, respectively[44].

Hepatoprotective activity

In this study, hepatoprotective effect of aqueous and methanolic extracts (200, 400 mg/kg) of C. decidua stems were evaluated against carbon tetrachloride induced liver damage in rats. Slight to mild changes in hepatocytes were observed in rats dosed by aqueous extract of C. decidua stems and higher dose of methanolic extract, whereas the lower dose of methanolic extract revealed more severe lesions than the higher dose[9].

Rubifacient activity and vesicant activities

The shoots and young leaves exhibited significant rubifacient and vesicant activity[12].

CONCLUSION

Capparis decidua (Forsk.) Edgew. is a perennial shrub used in Ayurveda, Unani and Siddha systems of medicine from ancient time. Literature survey reveals a wide spectrum of bioactivities of *Capparis decidua* either in the form of powder, extracts or in its isolated phytochemicals. But a number of other bioactivities are yet to be explored and thorough phytochemical investigation is still needed. However, some of its positive effects in various diseases may be attributed to presence of antioxidant ascorbic acid and high amount of unsaturated fatty acids like oleic, linoleic and linolenic acids. But, in future studies the isolated principles from the plant needs to be evaluated in scientific manner using specific experimental models and clinical trials are to be done to understand the molecular mechanism in search of a lead molecule.

REFERENCES

[1] V.Agarwal, B.M.Chauhan; Plant Foods Hum.Nutr., **38**, 189-197 **(1988)**.
[2] V.Agarwal, B.M.Chauhan; Plant Foods Hum.Nutr., **38**, 189-197 **(1989)**.
[3] A.M.Ageel, N.S.Parmar, J.S.Mossa, M.S.Al-Yahya, M.S.Al-Said, M.Tariq; Agents and Actions, **17**, 3-4 **(1985)**.
[4] V.U.Ahmad, S.Arif, A.R.Amber, K.Fizza; Liebigs Ann.Chem., 161-162 **(1987)**.
[5] V.U.Ahmad, S.Arif, A.R.Amber, K.Usmanghani, G.A.Miana; Heterocycles, **23**, 3015-3020 **(1985)**.
[6] V.U.Ahmad, N.Ismail, S.Arif, A.R.Amber; Phytochem., **28**, 2493-2495 **(1989)**.
[7] V.U.Ahmad, N.Ismail, S.Arif, A.R.Amber; J.Nat.Prod., **55**, 1509-1512 **(1992)**.
[8] V.U.Ahmed, K.Fizza, A.R.Amber, S.Arif; J.Nat.Prod., **50**, 1186 **(1987)**.
[9] S.A.Ali, A.A.Gameel, A.H.Mohamed, T.H.Al-Amin; J.Pharmacol. and Tox., **4**, 167-172 **(2009)**.
[10] Anonymous; 'The Wealth of India, A Dictionary of Indian Raw Materials and Industrial Products', 2(C), CSIR, PID; New Delhi, **(2000)**.
[11] C.K.Atal, J.B.Srivastava, B.K.Wali, R.B.Chakravarty, B.N.Dhawan, R.P.Rastogi; Ind.J.Exp. Biol., **16**, 330-349 **(1978)**.
[12] P.N.Behl, R.M.Captain, B.M.S.Bedi, S.Gupta; 'In skin irritant and sensitizing plants found in India', Asian Printers, Bombay, **(1996)**.
[13] A.E.Bundeally, M.H.Shah, R.A.Bellare, C.V.Deliwala; J.Sci.Ind.Res., **21(C)**, 305-308 **(1962)**.
[14] N.Chahlia; Biharean Bio., **3(1)**, 13-17 **(2009)**.
[15] N.Chahlia; Int.J.Biomed.Sci., **5(1)**, 70-73 **(2009)**.
[16] Y.Chaturvedi, R.Nagar; Plant Foods Hum.Nutr., **56**, 127-132 **(2001)**.
[17] B.M.Chauhan, A.Duhan, C.M.Bhat; Food Sci.Tech., **23**, 106-108 **(1986)**.
[18] M.U.Dahot; J.Chem.Soc.Pak., **15**, 78-81 **(1993)**.
[19] M.Daniel, S.D.Sabnis; Curr.Sci., **46**, 472-474 **(1977)**.
[20] R.D.Roy, K.A.S.Narayana, P.S.Pathak; India For., **106**, 306-311 **(1980)**.
[21] D.N.Dhar, R.P.Tewari, R.D.Tripathi, A.P.Ahuja; Proc.Nat.Acad.Sci. **42(A)**, 24-27 **(1972)**.
[22] A.Duhan, B.M.Chauhan, D.Punia; Plant Foods Hum.Nutr., **42**, 193-200 **(1992)**.
[23] K.N.Gaind, T.R.Juneja; Planta Med., **17**, 95-97 **(1969)**.
[24] K.N.Gaind, T.R.Juneja; Res.Bull.Panjab Uni.Sci., **21**, 67-71 **(1970)**.
[25] K.N.Gaind, T.R.Juneja, P.N.Bhandarkar; Ind.J.Pharm., **34**, 86-88 **(1972)**.

Review

[26] K.N.Gaind, T.R.Juneja, P.C.Jain; Ind.J.Hosp.Pharm., **2**, 153-155 **(1969)**.

[27] K.N.Gaind, T.R.Juneja, P.C.Jain; Ind.J.Pharm., **31**, 24-25 **(1969)**.

[28] S.P.Garg, R.Bhushan, R,Mehta, V.M.Jain, B.K.Dutta, I.Jayarama; Trans.Isdt.Ucds., **5(2)**, 62-64 **(1980)**.

[29] R.C.Ghosh; 'Handbook of afforestation techniques', Dehradun, **(1977)**.

[30] S.Ghulam; The Phytochemical and Phytopharmacological studies on Saraca indica, *Capparis decidua* and Lotus gracinii. PhD dissertation, University of Karachi, Karachi, **(2002)**.

[31] M.Goyal, B.P.Nagori, D.Sasmal; J.Nat.Med., **63**, 375-379 **(2009)**.

[32] N.K.Goyal; J.Cell and Tissue Res., **9(1)**, 1703-1707 **(2009)**.

[33] R.Goyal, R.B.Grewal; Nutr.Health., **17**, 71-76 **(2003)**.

[34] A.K.Gupta, N.Tandon; 'Reviews on Indian Medicinal Plants', 5(Ca-Ce), ICMR; New Delhi, **(2004)**.

[35] A.K.Gupta, N.Tandon, M.Sharma; 'Quality Standards of Indian Medicinal Plants', 3, ICMR, New Delhi, **(2005)**.

[36] J.Gupta, M.Ali; Ind.J.Heterocycles Chem., **6**, 295-302 **(1997)**.

[37] R.K.Gupta, I.Prakash; 'Environmental analysis of the Thar desert', Dehradun, **(1975)**.

[38] E.Hong, G.H.Kim; Food Sci. and Tech.Res., **14(4)**, 377 **(2008)**.

[39] C.E.Jarvis, R.Barrie, D.M.Allan, J.L.Reveal; 'A list of Linnean generic names and their types', Koeltz Königstein; **(1993)**.

[40] T.R.Juneja, K.N.Gaind, A.S.Panesar; Res.Bull.Panjab Univ., **21**, 519-521 **(1970 a)**.

[41] K.R.Kritikar, B.D.Basu; 'Indian Medicinal Plants', 1, Sri Satguru Publications; Delhi, **(1998)**.

[42] R.G.Mali, J.C.Hundiwale, R.S.R.Sonawane, N.Patil, B.C.Hatapakki; Ind.J.Nat.Prod., **20**, 10-13 **(2004)**.

[43] Manzoor-i-khuda, N.A.Jeelani; Pak.J.Sci.Ind.Res., **11**, 250-252 **(1968)**.

[44] U.Nyman, P.Joshi, L.B.Madsen, T.B.Pedersen, M.Pinstrup, S.Rajasekharan, V.George, P.Pushpagandhan; J.Ethnopharmacol., **60**, 247-263 **(1998)**.

[45] A.N.Pandey, M.V.Rokad; J.Arid Environ., **22**, 287-292 **(1992)**.

[46] A.Purohit, K.B.Vyas; J.Cell and Tissue Res., **6(1)**, 533-536 **(2006)**.

[47] A.Purohit, K.B.Vyas; Ind.J.Exp.Biol., **43**, 836-866 **(2005)**.

[48] A.Purohit, K.B.Vyas; Pharm.Biol., **44**, 172-177 **(2006)**.

[49] S.Rai; Curr.Agric., **11**, 15-43 **(1987)**.

[50] S.Rai, R.Gopal; Trans.Isdt.Ucds., **10(2)**, 63-68 **(1985)**.

[51] S.Rashid, F.Lodhi, M.Ahmad, K.Usmanghani; Pak.J.Pharmacol., **6**, 6-16 **(1989)**.

[52] S.Rathee, O.P.Mogla, S.Sardana, M.Vats, P.Rathee; J.Pharm.Res., **3(2)**, 231-234 **(2010)**.

[53] S.Rathee, P.Rathee, D.Rathee, D.Rathee, V.Kumar; Int.J.Phytomed. **2**, 10-17 **(2010)**.

[54] Sen Gupta, M.M.Chakrabarty; J.Sci.Food Agric., **15**, 69-73 **(1964 a)**.

[55] Sen Gupta, M.M.Chakrabarty; Ind.J.Appl.Chem., **27**, 49-61 **(1964 b)**.

[56] B.Sharma, P.Kumar; Int.J.App.Res.Nat.Prod., **1(4)**, 5-12 **(2008)**.

[57] B.Sharma, R.Salunkea, C.Balomajumderb, S.Daniela, P.Roya; J.Ethnopharmacol., **127**, 457-462 **(2010)**.

[58] I.Sharma, D.Gusain, A.Sharma, V.P.Dixit; Ind.Drugs., **28**, 412-416 **(1991)**.

[59] A.K.Thukral, R.Chanda, V.N.Sharma, M.C.Joshi; Giobios., **9**, 173-174 **(1982)**.

[60] R.K.Upadhyay, S.Ahmad, R.Tripathi, L.Rohtagi, S.C.Jain; J.Med.Plants Res., **4(6)**, 439-445 **(2010)**.

[61] S.Vaithiyanathan, M.Singh; Ind.J.Anim.Sci., **59**, 1565-1567 **(1989)**.

[62] J.C.Willis; 'A dictionary of flowering plants and ferns', 8th Ed., Cambridge University Press, Cambridge, **(1988)**.

[63] P.Yadav, S.Sarkar, D.Bhatnagar; Ind.J.Exp.Biol., **35(4)**, 389-392 **(1997)**.