

A DETAILED PHARMACOLOGICAL APPROACH ON CAPPARIS ZEYLANICA

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ABSTRACT

Capparis zeylanica Linn. belongs to capparidaceae family. Different types of activities are found in this *Capparis zeylanica*, such as antimicrobial, analgesic, immunostimulant, antipyretic, antioxidant and anti-inflammatory activities. Flavonoids, alkaloids, saponin glycosides, terpenoids, tannins, saponins, syringic, p-coumaric acid and ferulic are present in this plant. Wide distribution of this plant is in Sri Lanka, Malaysia, Bangladesh and in India. In this present review article, a brief pharmacological study of plant was carried out. This review article contains brief information about some traditional uses of *Capparis zeylanica*, plant profile, distribution of *Capparis zeylanica* macroscopical and microscopical investigations. A brief information about phytochemicals of *Capparis zeylanica* is also included in this article. Various pharmacological activities of *Capparis zeylanica* such as CNS depressant, antiaggressive, analgesic and antipyretic, antiulcer, immunostimulant effects, antidiarrhoeal, antimicrobial, antifungal and antioxidant activities are discussed in this paper. Overall this study showed that there are various important roles of *Capparis zeylanica*.

KEYWORDS: *Capparis zeylanica*, Pharmacological, Phytochemicals, Pharmacognostical, Antioxidant.

INTRODUCTION

As we know very well that everything in this world change time by time, since thousands of year the era was of Ayurveda or Herbal origin drug. But last few decades it was replaced by allopathic system of medicine, which was firstly accepted worldwide, but later due to its lots of adverse effect again men step down on Ayurveda because of its better therapeutic result and safety profile and now the people are more believing in natural origin drug. Herbal drugs have played a vital role in curing so many ailments throughout the history of medicine as well as the existence of mankind. If we take a worldwide comparison of patronization of modern and alternative medicine, it is depicted that 75% of the population world over is per forced, compelled to use the alternative system of medicine especially the herbal medicine indigenous to that part of the world.^[1-2]

The genus *Capparis* L. encompasses shrubs or climbing shrubs (about 250 species) which are often armed with stipular spines and found distributed in tropical and subtropical regions. The genus includes perennial flowering shrubs that are known by the common name caper shrubs or caper bushes.

The leaves are simple, entire and rarely reduced. Flowers are bisexual, bracteates, axillary or supra-axillary, solitary or in rows, in racemes or umbels. Sepals and petals are 4 in number and are free. Stamens are many, ovary on a gynophore, 1-celled.

Fruit is a berry, globose or ellipsoid. Many species are medicinally important and are widely used in various traditional medicine systems including Ayurveda. *C. zeylanica* L. is a climbing or straggling shrub with tomentose branches armed with recurved stipular spines. It is called Anthundikai in Kannada and Govinda phala in Sanskrit. It is frequent along the hedges. Leaves are ovate-elliptic. Flowers are 3.5-5cm across, white, fading to pink or purple, in supra-axillary rows of 2-6 flowers, often developing before leaves. Flowering occurs between December to April. Fruits are said to be edible. Several phytochemicals have been identified from different parts of the plant. The plant is used in traditional medicine and is reported to possess several biological activities.

Capparis zeylanica is a rare species, indigenous, herbaceous and perennial plant native to E. Asia – southern.

China, India, Sri Lanka, Myanmar, Thailand, Cambodia, Laos, Vietnam, Malaysia. It is the best-known member of the family Capparidaceae. The plant's fruit has a long history of use as a medicine for its anthelmintic, antimicrobial, antioxidant, antipyretic, analgesic, anti-inflammatory and immuno-stimulant activity. The fruits are also considered as an antidote for snake bites. Till date, a detailed analysis about the fruit extract of this plant species has not been done.^[4-5]

Capparis zeylanica Linn. have been used as folk medicine and as ingredient in various Ayurvedic preparations. Traditionally it is used as Antidote to snake bite, to cure swelling of testicle, small pox, boils, cholera, colic, hemiplegia, neuralgia, sores, pneumonic & pleurisy.^[6,8] The whole plant was much more used in traditional as well as in modern era. Whole plant showed the presence of saponin, p-hydroxybenzoic, syringic, vanillic, ferulic and p-coumaric acid. Leaves & seeds showed presence of β -carotene, thioglycoside, glycocapparin, n-tricortane, α -amyrin & fixed oil where as root bark showed presence of an alkaloid, a phytosterol, a water soluble acid and a mucilaginous substance. Pharmacological study revealed Anti-rheumatic, anti-inflammatory & in-vitro antibacterial activities.^[10-11]

Some Traditional Uses of *Capparis zeylanica*

Traditionally *Capparis zeylanica* L. was first time reported used as vegetable.^[12] Root bark is ground with water, boiled and taken orally to treat indigestion. Traditionally it is used as Antidote to snake bite, to cure swelling of testicle, small pox, boils, cholera, colic, hemiplegia, neuralgia, isores, pneumonic & pleurisy.^[13-16] In Northern India, the leaves are widely used as counter-irritant, febrifuge and as a cataplasm in swellings, boils and piles. Leaf and stem parts are as spasmolyte. Root bark preparation is used as a sedative.^[17] Leaves extract of *Capparis zeylanica* L with black pepper powder is taken twice daily for the treatment of dysentery.^[18] Leaves juice of *Capparis zeylanica* L taken orally with cup of fresh goat milk for curing cough and cold.^[19] For the treatment of diabetes ripe fruits are consumed twice for few night and during digestion, stem bark extract is administered thrice daily.^[20]

Capparis zeylanica L. plant is also served as an appetizer prepared as a dipping paste with pepper, tamarind and garlic.^[21] Grind the stem bark by adding 10 seeds of black pepper, 2 bulbs of garlic and mix it into 500ml water. Given twice daily for two days to cure colic. Handful fresh roots, 50g onions, 50g jaggery grind all together and make a bolus. Feed *Capparis zeylanica* L. twice daily for 3 days to cure convulsive seizures.^[22]



Fig.1: Leaves and flowers of *Capparis zeylanica* Linn.

Plant Profile

Capparis zeylanica Linn. is commonly known as Indian caper; a climbing scandent shrub and found throughout India. *Capparis zeylanica* Linn. is belonging to the family Capparidaceae plants are 2-3m in height, armed with 3-6mm long recurved thorns, branched, leaves are elliptic or broadly lanceolate, base rounded, apex mucronate; flower profuse, pinkish white, later turning pink, berries are globular or ellipsoid, 3-4 cm in diameter, and seeds are globose, embedded in white pulp. It grows in moist habitat. Large climbing shrubs with hooked spines, stems woody, rough, young parts green, rusty tomentose with pungent smell, leaves ovate or elliptic, 3.5-6.5x2.5-4 cm, rusty-tomentose when young, glabrous at maturity, base cuneate, entire, tip mucronate, flowers yellowish-white or white in supra-axillary, solitary, 2-3 pedunculate, berries globose, scarlet red.^[23]

Taxonomical Classification^[24]

Kingdom	:	Plantae
Subkingdom	:	Viridiplantae
Phylum	:	Tracheophyta
Subphylum	:	Euphyllophytina
Infraphylum	:	Radiatopses
Superdivision	:	Spermatophyta, Seed plants
Division	:	Anthophyta
Class	:	Magnoliopsida
Subclass	:	Dilleniidae
Super order	:	Violanae
Order	:	Capparales
Suborder	:	Capparineae
Family	:	Capparaceae.
Genus	:	Capparis
Specific epithet	:	zeylanica - L.
Botanical name	:	<i>Capparis zeylanica</i> L.

Part's used- The entire plant leaves, flowers, fruit, bark, stem etc.

Vernacular Names

Oriya	:	Asadhua
Sanskrit	:	Karambha, Vyaghra Nakhi
Bengali	:	Kalokera
Hindi	:	Ardanda, Jhiris, rula, Kevisi kodi
Malayalam	:	Elippayar, Gitoran, Karthotti

Gujarati	:	Govindakal,	Kakhbilado,
Karrallura	:		
Kannada	:	Aantundikayee	
Marathi	:	Govindi,	Vaghanti,
Kaduvaghanti	:		
Tamil	:	Adondai, Suduthoratti, Karotti	
Telugu	:	Adondai	
French	:	Catalpa	
English	:	Ceylon Caper	
Konkani	:	Vaghamti	

Occurance

The plant is a many branched thorny, sub-scandent climbing shrub. It grows in moist habitat.

Distribution of *Capparis zeylanica*

This is native to Bangladesh, Cambodia, China Southeast, Hainan, India, Myanmar, Nepal, Philippines, Pakistan, Sri Lanka, Sulawesi, Thailand, Vietnam.

In India this is widely distributed in East of line of Mumbai, Delhi and Dehradun, South of Himalayas and Andamans.^[25-26]

Review on Pharmacological Activities of *Capparis zeylanica*

The ethanol and methanol extracts of root of *C. zeylanica* extracts shows strong *n vitro* antioxidant activities by 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging activity and by reducing power assay methods. Antioxidant properties of methanolic extracts of raw floral buds have been shown in various *n vitro* models and the potential use in oxidative stress-based pathological conditions has been suggested.^[27] *C. zeylanica* root powder extract showed antioxidant activities.^[28]

The leaves of *C. zeylanica* were found to exhibit immune stimulant activity. Oral administration of ethanolic and water extracts at doses of 150 and 300 mg/kg in mice, dose dependently potentiated the delayed type hypersensitivity reaction induced by sheep red blood cells. The extracts also prevented myelosuppression in mice treated with cyclophosphamide drug.^[29] The crude extract of plant was reported to have CNS depressant activity. The steam volatile fraction of flowers and seeds were highly antimicrobial. The 50% alcoholic extract of aerial parts reported as spasmolytic.^[30]

The ethanol and water extracts of *C. zeylanica* leaves showed dose dependent increases in pain threshold in tail-immersion test. Moreover, both the extracts exhibited a dose-dependent inhibition of writhing and also showed a significant inhibition of both phases of the formalin pain test. The water extract significantly reversed yeast-induced fever^[31] in rodents. The aqueous extract from total aerial parts of the plant has been used for its antifungal, antiinflammatory, antidiabetic, and antihyperlipidemic activities and is among the

constituents of polyherbal formulations to treat liver ailments.^[32-36]

Chloroform, ethanol and water extracts of *C. zeylanica* root exhibited *n vitro* antibacterial activity against Gram positive and Gram negative bacteria, whereas petroleum ether extract exhibited antibacterial activity against selected bacterial strains.^[37] The cytotoxic activities of crude extract and fatty acid are also explored.^[38]

Pharmacological study revealed Antirheumatic, antiinflammatory & *n vitro* antibacterial activities.^[39-40]

C. zeylanica constituents flavonoids have been known to possess antioxidant, antineoplastic, antiulcer, antiinflammatory and antimicrobial activities. Ethanolic extract of *C. zeylanica* root showed promising antiaggressive activity qualitatively comparable to that of diazepam.^[41] The Methanolic extract of *C. zeylanica* plant has significant antipyretic activity.^[42]

Review on Phytochemicals of *Capparis zeylanica*

C. zeylanica was found to have variety of chemical constituents. Whole plant showed the presence of saponin, p-hydroxybenzoic acid, syringic acid, vanillic acid, ferulic acid and p-coumaric acid. Leaves & seeds showed presence of β -carotene, thioglycoside, glycocapparin, n-triacontane, α -amyrin & fixed oil where as root bark showed presence of an alkaloid, a phytosterol, a water soluble acid and a mucilaginous substance.^[39-40]

The roots are reported to contain alkaloid, phytosterol, acids and mucilage. A new fatty acid E-octadec-7-en-5-ynoic acid has been isolated from the chloroform extract of roots. Fatty acids like ricinolenic acid, malvalic acid, stercularic acid, linoleic acid etc. has also been identified.^[41] The elemental analysis was performed by EDX and found that it contains Al, Si, Cl, K, Ca, Fe, Cu and Zn.^[42] In the present paper, a detailed pharmacognostic study on *C. zeylanica* (leaves) based on its physicochemical and preliminary phytochemical studies were carried out to lay down the standards.

Pharmacognostical Details of Plant

Macroscopical investigation^[43-47]

A. Morphological group of stem

Type of stem	:	Woody
Outer surface	:	Rough, spines or remanents of the spines are also found
Fracture	:	Irregular & fibrous
Odour	:	Characteristic
Taste	:	Bitter
Colour	:	Green

B. Morphological group of leaf

Type of leaf	:	Simple
Colour	:	Green
Odour	:	Characteristics
Taste	:	Bitter

C. Morphological group of root

Type of root	:	Tap root
Outer surface	:	Fairly smooth transverse cracks
Fracture	:	Short
Odour	:	Indistinct
Taste	:	Slightly bitter
Colour	:	Yellowish grey

Microscopical investigation^[48-49]**Transverse section of stem**

A transverse section of stem shows a single layer of epidermis, followed by 6-10 layer of parenchymatous cortex. The central region was occupied by wide pith, composed of thin-walled, circular to sodiametric parenchymatous cells, some of which are pitted. The secondary growth starts in the usual manner. The cork cambium arises in the outermost or the second layer of the cortex giving rise to the cork towards the outer and phlloderm towards the inner side.

Transverse section of leaf

A transverse section of leaf shows distinct layer of upper and lower epidermis. Upper epidermis was covered with thick cuticle. Vascular bundles were distributed in the middle zone. Each vascular bundle is surrounded by bundle sheath.

Transverse section of root

A transverse section of root shows a single layered epidermis, some of which elongated to form unicellular hairs. The epidermis was followed by 2-3 layered parenchymatous cortexes. The endodermis was distinct with casparian dots on the anticlinal walls. The pericycle was single layered and encloses a triarch stele. The phellogen arises in the epidermis.

Powder Microscopy**Powder microscopy of stem**

From the above microscopy it shows that the stem part is containing xylem, unligified vessel, and epidermis.

Powder microscopy of leaf

Some important characters of the leaf of *Capparis zeylanica* contains Calcium oxalate- it occur as cluster in the cell of mesophyll and as prism in a sheath of cells around the fiber, glandular trichome Anomocytic stomata present on upper epidermis, simple parenchyma cells were found numerous and stone cells were also found.

Powder microscopy of stem

It contains wood element as xylem vessel with numerous bordered pitted thickening. It xylem fibres- Large number of thick walled, elongated fibres mostly in groups. The walls of a few fibres show pitted thickening. It also contains calcium oxalate crystal-Large number of big elongated prism either entire or in fragments, some may also appear cubical in form, prisms are found scattered all over. Cork cells are thin walled, some colourless and other brown. It also contains sieve tubes.

Powder microscopy of root

It contains Parenchyma which are thick walled cells containing oil globules and minute acicular raphides. And also contains wood element- Vessels with boarded piths, scalariform and spiral thickening.

Treatment Approach of *Capparis zeylanica* in various disorders**CNS Depressant Activity of CZ L. Root**

The dried ethanolic extract of root of *Capparis zeylanica* Linn was assessed for effect on CNS using number of neuropharmacological experimental models in mice. Mice accurately treated with ethanolic extract of CZ at 100, 200 and 400mg kg⁻¹ doses prolonged the sleeping time induced by pentobarbitone 40mg kg⁻¹.

This extract at 100 and 200mg kg⁻¹ doses showed a sedative effect in hole cross paradigm and decreased spontaneous activity in mice.

Chemical analysis showed that ethanolic extract of CZ alkaloids, steroids, phytosterol, fatty acids, phenols, flavonoids, flavonols, tannins and mucilage are the main compounds of active extract.

Antiaggressive Activity of CZ L. Root

An exaggerated or fearful response to an appropriate or inappropriate condition may be observed during anxiety. Increased anxiety provokes elevated aggression. Such exaggerated responses may induce subtle alterations of different integrated systems resulting in undesirable symptoms of emotional reactivity reflected as aggression. Aggression is an "overt behavior with the intention of inflicting physical damage on the opponent". Aggression generally ensues due to conflicting interests associated with restricted territory, electrical, sensory, chemical stimulation or with the removal of positive reinforcements. Although aggression is an adaptive response, if it is prolonged it can have serious repercussions on the health and social behavior of the individual. Numerous natural remedies have found acceptance as anxiolytic agents as they diffuse the unwarranted effects produced by synthetic agents.

The four most widely used rodent models were chosen to evaluate the effect of EECZ on aggressive behavior, foot shock-induced aggression, isolation-induced aggression, resident intruder aggression and water competition test.

Aggression can ensue due to exposure to an intimidating situation. Aggression is prominently seen when a disturbance occurs in the fine balance of neurotransmitters such as 5-hydroxytryptamine, gamma-aminobutyric acid, dopamine and their receptor subtypes. The present study investigated the ability of 100, 200 and 400 mg/kg of ethanolic extract of *Capparis zeylanica* root (EECZ) circumvent aggression. Foot shock induced aggression, isolation-induced aggression, resident-intruder aggression and water competition test were utilized as models for screening of antiaggressive

activity. Extract was given orally at three different dose levels (100, 200 and 400 mg/kg) once daily for three consecutive days, while Diazepam (2.5mg/kg), was administered as positive control.

Results suggested that EECZ showed significant antiaggressive activity in aforementioned validated models of aggression. EECZ at all dose levels (100, 200 and 400 mg/kg) have shown promising anti-aggressive activity qualitatively comparable to that of diazepam (2.5 mg/kg).

Analgesic and Antipyretic Activity of CZ L. Leaves

In many studies the ethanol and water extracts of *Capparis zeylanica* leaves showed dose-dependent and significant increases in pain threshold in tail-immersion test. Moreover, both the extracts (100–200 mg/kg) exhibited a dose-dependent inhibition of writhing and also showed a significant inhibition of both phases of the formalin pain test. The water extract (200 mg/kg) significantly reversed yeast-induced fever.

Antipyretic activity of drug was measured by slightly modifying the method described by Adams *et al.*^[50] Rats were fasted overnight with water *ad libitum* before the experiments. Pyrexia was induced by subcutaneously injecting 20% w/v brewer's yeast suspension (10 ml/kg) into the animal's dorsum region. Nineteen h after the injection, the rectal temperature of each rat was measured using a thermometer. Only rats that showed an increase in temperature of at least 0.7 °C were employed for the experiments. The EtOH and water extracts (100–200 mg/kg) or 10% v/v propylene glycol solution (10 ml/kg) was administered orally and the temperature was measured at 0, 1, 2 and 3 h after drug administration.

In the mouse writhing assay, EtOH and water extracts caused a significant and dose-dependent inhibition of the control writhes. The inhibition produced by the highest dose (200 mg/kg) of the extracts was significantly lower than that by acetylsalicylic acid (100 mg/kg). These extracts showed a dose-dependent inhibition of pain with the water extract being more active than the EtOH one.

Antiulcer Activity of CZ L. Extract on Gastric Secretions

Gastric ulcer is an illness that affects a considerable number of people^[61] worldwide. The development and progression of gastric ulcer depends to some extent on the type of the food consumed by the patient. It has been shown that spicy food, food with full of fat or foods having caffeine stimulates acid secretion^[62] in stomach and increase the risk of ulcer formation. Since herbs are the mines of useful drugs and medicinal plants have always been the principle source of medicine in India since ancient past and presently they are becoming popular throughout the developed countries.

Root bark of this plant is used as sedative, cooling, cholagogue, stomachic, antihidrotic and in fever. Leaves

are used as a counter irritant and as a cataplasm in boils, swellings, piles and^[63] rheumatism. Flowers are used as laxative. The methanolic extract of the leaves^[64] was found to possess antidiarrheal activity. Chemically the plant contains a saponin and p-hydroxybenzoic, syringic, vanillic, ferulic and p-coumaric acids. The leaves and seeds contain glucocapparin, alpha-amyrin, n-triacontane, betacarotene and fixed oil.^[65]

Through the pharmacological activity and statistical analysis, it was confirmed that the 50% ethanolic extract of roots of *Capparis zeylanica* plants is the most effective in prevention of ulceration in experimental animal model. The beneficial multiple properties present in medicinal plant offer exciting opportunity to develop them into novel therapeutics for ulcer.

Immunostimulant Effects of CZ Leaves

Different studies showed immunomodulatory activity of ethanolic and water extracts of *Capparis zeylanica* Linn. leaves on neutrophil adhesion test, humoral response to sheep red blood cells, delayed-type hypersensitivity, phagocytic activity and cyclophosphamide-induced myelosuppression.

A dose-related increase in both primary and secondary antibody titre was observed. Oral administration of ethanolic and water extracts of *Capparis zeylanica* leaves, at doses of 150 and 300 mg/kg in mice, dose dependently potentiated the delayed-type hypersensitivity reaction induced by sheep red blood cells.

Immunomodulatory activity was also assessed by serological and haematological tests.

Capparis zeylanica extracts prevented myelosuppression in mice treated with cyclophosphamide drug.

Antidiarrheal Activities of CZ Leaf Extracts

Diarrheal diseases are responsible for the death of millions of people each year.^[66] There are large numbers of epidemiological and experimental evidence pertaining to worldwide acute diarrheal disease, which is one of the principal causes of death in the infants.^[67] Worldwide distribution of diarrhea accounts for more than 5-8 million deaths each year in infants and children below 5 years old especially in developing countries.^[68] Most people are affected by diarrhea at some time in their lives. It is often accompanied by stomach pains, feeling sick and vomiting. It is usually due to consumption of drinking water contaminated with bacteria, undercooked meat and eggs or inadequate kitchen hygiene-in other words-an infection. According to WHO estimates for 1998, about 7.1 million deaths were caused by diarrhea.^[69] Despite immense technological advancement in medicine many people in developing countries still rely on traditional healing practices and medicinal plant for their daily health care need.^[70]

Castor oil causes diarrhea due to its active metabolite, ricinolic acid,^[71-72] which stimulates peristaltic activity in the small intestine, leading to changes in the electrolyte permeability of the intestinal mucosa. Its action also stimulates the release of endogenous prostaglandin.^[73]

In this study, the methanol extract of *C. zeylanica* (36.5% w/w) exhibited a significant antidiarrheal activity. Its effect was dose-dependent. Phytochemical screening revealed the presence of tannins, sterol and/or triterpenes and reducing sugars, which may be responsible for the mechanism of action of *C. zeylanica* antidiarrheal activity. The antidiarrheal activity of this extract may also be due to the presence of denatured proteins, which form protein tannates. Protein tannates make the intestinal mucosa more resistant and hence, reduce secretion.^[74]

The study reveals that the methanol extract exhibited significant diarrheal activity. Thus, *C. zeylanica* can increase the absorption of water and electrolytes from the gastrointestinal tract since the extract decreased the small intestinal transit that proves to its efficacy in an extensive range of diarrheal conditions. In conclusion, the results of this investigation revealed that *C. zeylanica* contains pharmacologically active substance(s) with antidiarrheal properties. These properties confirm the use of *C. zeylanica* as an antidiarrheal drug as proposed by traditional healers.

Antimicrobial & Antifungal Activities of CZ

Antibacterial activity of *C. zeylanica* was evaluated by using Agar well diffusion method against a panel of 7 bacteria (Gram positive bacteria- *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus subtilis* and *Bacillus cereus* Gram negative bacteria- *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella typhimurium*). The broth cultures of test bacteria were prepared by inoculating pure cultures of test bacteria into sterile Nutrient broth tubes followed by incubating the tubes at 37°C for 24 hours. The broth cultures were swabbed uniformly on sterile Nutrient agar plates, wells of 8mm were punched in the inoculated plates and the wells were filled with leaf extracts (20mg/ml of Dimethyl sulfoxide), reference antibiotic (Chloramphenicol, 1mg/ml of sterile distilled water) and DMSO. The plates were incubated at 37°C for 24 hours and the zones of inhibition were measured.

Antifungal activity of *C. zeylanica* was measured by Poisoned food technique against 6 fungi namely *Aspergillus niger*, *A. flavus*, *A. fumigatus*, *Alternaria* sp., *Curvularia* sp. and *Fusarium* sp. isolated previously from moldy grains of sorghum. The control (without extract) and poisoned Potato dextrose agar (PDA; 1mg extract/ml of medium) plates were inoculated aseptically with well sporulated cultures of test fungi. The plates were incubated at room temperature for 4 days and the colony diameter of test fungi was measured in mutual perpendicular directions. Antifungal potential of leaf extracts.

C. zeylanica showed antibacterial and antifungal activity. Among the *Capparis* species selected, marked inhibitory activity was shown by *C. zeylanica*. From the results of this study it can be concluded that the selected plants can be exploited as sources of antimicrobial agents which can be used against microbial infections. Formulations prepared using these plants can be used against bacterial infections and seed mycoflora and other phytopathogenic fungi. Further studies on purification of secondary metabolites from leaves and their antimicrobial activity have to be carried out.

Antioxidant Potential of *Capparis zeylanica* Leaf Extracts

Cancer is recognized as a leading cause of death. Many cancer treatments such as chemotherapy, surgery and radiotherapy are available to treat cancer, although severe side effects remain a concern. Cancer is usually associated with accumulation of mass of cells resulted from poor signal transduction across pathways due to overexpression of epidermal growth factor receptors.

Breast cancer generally occurs in women and rarely in men. As per Globocan 2018, breast cancer stands second of all cancers for a cause of death. The International Agency for Research on Cancer released the estimates in 2018 on the global burden of cancer. The global burden was raised to 18.1 million new cases and 9.6 million deaths in 2018.^[75] In India, more than 11.5 million cases were detected with all types of cancers. Out of which, 14% deaths were associated with breast cancer. Since then, newer techniques in detection and treatments were developed, such as chemotherapy, radiation therapy and surgery. But these were contributed with severe side effects. Chemotherapy is the treatment of choice in most of the cancer cases rather than radiation and surgical operations.^[76-77] Medicinal plants have always remained a choice of treatment in many diseased conditions with the availability of isolated novel phytoconstituents with minimum side effects. According to the World Health Organization reports, 252 drugs were approved for cancer treatment, out of them 11% drugs were of plant origin.^[78]

The free radicals are reactive oxygen species responsible for the cause of cancer.^[79] Antioxidants are the chemical constituents which either delay or prevent the oxidation process of free radicals in the body.

The preliminary screening of phytoconstituents responsible for antioxidant activity was done based on the total phenolic and flavonoid content of the extract. The plant was not researched out for the anticancer activity in human breast cancer cells. Thus, an attempt was made to evaluate antioxidant activity by 2,2-diphenyl-1-picrylhydrazyl assay and anticancer activity of *C. zeylanica* Linn. leaf extract against MCF-7 cells. The molecular docking studies of phytoconstituents of *C. zeylanica* Linn. on human epidermal growth factor receptor protein revealed the binding affinity with the

amino acids within proximity of active sites of human epidermal growth factor receptor protein.^[80]

The free radicals are causing several diseases in human especially cardiovascular diseases and cancer. The plant develops defence mechanism against free radicals. The result of these three *in vitro* antioxidant model reveals that the leaf powder extracts of *Capparis zeylanica* L. had significant antioxidant activity. The *Capparis Zeylanica* leaf methanolic extract showed a strong antioxidant activity by inhibiting DPPH, superoxide radical-scavenging and Hydroxyl radical scavenging activities when compared with the standard ascorbic acid. In addition, the *Capparis Zeylanica* leaf was found to contain a noticeable amount of total phenols and flavonoids, which play a major role in controlling oxidation. *Capparis Zeylanica* leaf can be used as an easily accessible source of natural antioxidant.

CONCLUSION

Capparis zeylanica has been ethnomedicinally used as a therapeutic agent for a variety of diseases, as we have explained in this article. Various compounds which were isolated from this plant may be responsible for its pharmacological activities.

Major push by whole of the pharmaceutical industry is focused towards design and development of new novel and indigenous plant based drugs through investigation of leads from traditional system of medicine. In recent years, ethno-botanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. Review of *Capparis zeylanica* L. depicted the fact that it is a popular remedy among the various Traditional systems and Ayurvedic practitioners for cure number of ailments. It is a need to explore this plant thoroughly for more therapeutic potential.

The present study attempts a modest comprehensive investigation of the leaves of *Capparis zeylanica*. Since the leaves of *C.zeylanica* as the folklore claims have therapeutic qualities, the present investigation has laid down a set of anatomical features of the leaf which can be employed for its botanical diagnosis. Preliminary phytochemical analysis indicated presence of saponins, tannins, alkaloids and flavonoids which could make the plant useful for treating different ailments as having a potential of providing useful drugs of human use.

The present study on physicochemical parameters and preliminary phytochemicals analysis provides importance information which may be help in authentication and adulteration for quality control of raw material. The present study adds to the existing knowledge of *Capparis zeylanica* and it will be very useful for development of a formulation for treating various diseases.

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