



## Review article

### **Caesalpinia crista L.: A review on traditional uses, phytochemistry and pharmacological properties**

Pooja Upadhyay<sup>1</sup>, Bhuwan Chandra Joshi<sup>1\*</sup>, Ankush Sundriyal<sup>1</sup> and Sushmita Uniyal<sup>2</sup>

<sup>1</sup>School of Pharmaceutical Sciences, Sardar Bhagwan Singh University, Balawala, Dehradun, Uttarakhand-248001, India

<sup>2</sup>Gyani Inder Singh Institute of Professional Studies, Dehradun, Uttarakhand-248003, India

\*Corresponding author. E-mail: [bhuwan.joshi000@gmail.com](mailto:bhuwan.joshi000@gmail.com); Tel: +91-70601728340; Fax: 0135-2686286.

#### Article history

Received : March 03, 2019

Accepted : March 28, 2019

#### Keywords

*Caesalpinia crista*

Pharmacology

Phytochemistry

Traditional uses

#### ABSTRACT

*Caesalpinia crista* L. (Caesalpiniaceae) is a well-known medicinally useful plant. The plant grows mainly on the river banks in tidal forests near the eastern sea-coast from Orissa, and western sea-coast from Konkan southwards, and in the Sunderbans in West Bengal, in Bhopal and Himachal Pradesh. It is traditionally valued and reported for treating anthelmintic, tumour, removing the placenta, anti-microbial, liver disorders, febrifugal, pain, inflammation, rheumatism, respiratory disorders, fever, stone in the bladder, malarial fever treatment of hernia, swellings, asthma and colic. *Caesalpinia crista* contains alkaloids, cassane-diterpenes, flavonoids, nor-cassane diterpenes, proteins, saponins, triterpenoids, etc. Root, stem, leaves and seed are used as anthelmintic, anti-inflammation, analgesic activity, antioxidant, anti-tumour, anti-malarial activity. This review aims to provide a detailed overview of the traditional and ethnomedicinal uses, chemistry and biological activities of *Caesalpinia crista* possibly make recommendations for further research.

© 2019 Global SciTech Ocean Publishing Co. All rights reserved.

#### INTRODUCTION

Thousands of years ago plant and plant products were used in folk medicine in treating a wide spectrum of ailments. The use of medicinal herbs is as ancient as man. The first written proofs of the plants used in medicine are to be found in the Bible itself. Traditional remedies are prepared as poultices, decoctions, ointments, churnas, infusions and teas (Halmai and Novak, 1963).

*Caesalpinia crista* Linn. (*C. crista*) also known as Fever nut belongs to family Caesalpiniaceae. It is a popular medicinal herb distributed throughout the tropical and subtropical regions of Southeast Asia. Commonly the plant is known as “Bagore” in Indonesia. The decoction of the root has been used for its significant health benefits such as in the treatment of rheumatism, backache and as a tonic.

The plant is a large woody climber height up to 15 m grows mainly on the river bank in tidal forests near the eastern seacoast from Orissa and western sea coast from Konkan southwards, and also in the Sunderbans in West Bengal, in Bhopal and Himachal Pradesh. It is usually grown throughout India up to 800 meters elevation (Al Snafi, 2015). Branches are finely grey- downy, armed hooked

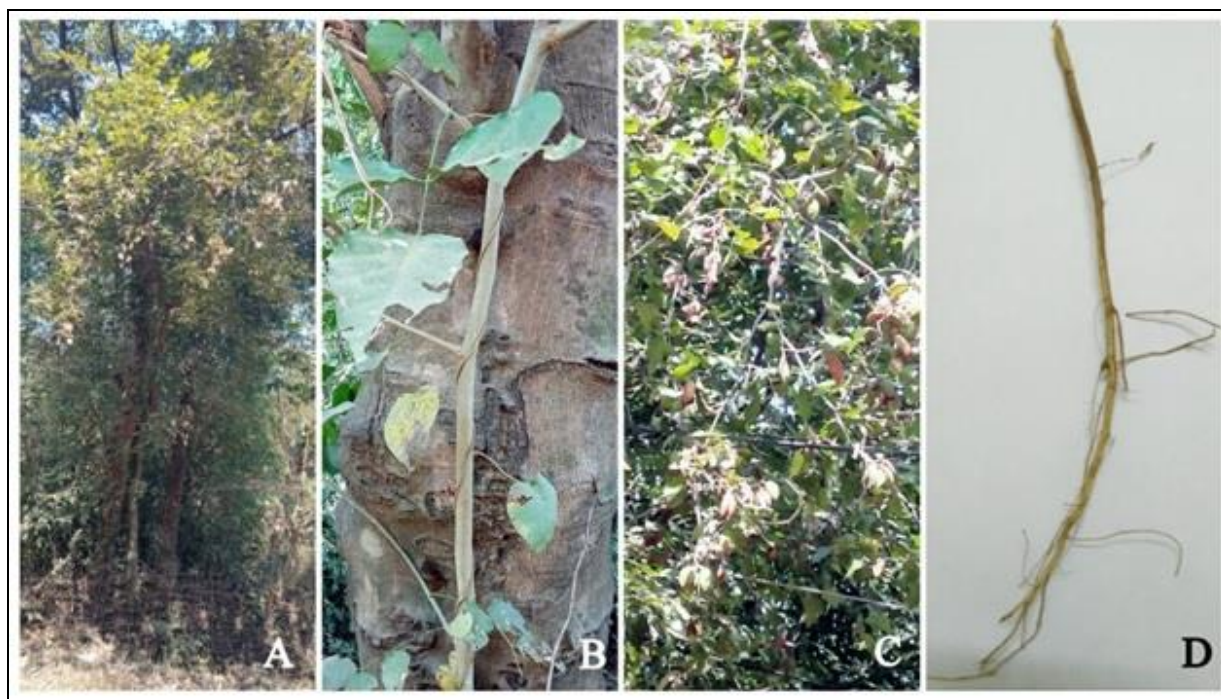
and straight hard yellow prickles on them. The bark is black, branchlets are glossy with recurved prickles; leaves are large bipinnate with recurved prickles at the base of pinnae 2-5 pairs, often armed; leaflets; 2-3 pair coriaceous, acute or obtuse, ovate or elliptic, upper surface shining, lower dull (Phoneke,1992) (Fig. 1).

As per Ayurveda, the heartwood is bitter, astringent, sweet, constipating, sedative, and hemostatic. It is useful in conditions of burning sensation, wounds, ulcers, leprosy, skin diseases, diarrhoea, dysentery, epilepsy, convulsions, menorrhagia, leucorrhoea, diabetes and haemorrhages (Kirtikar and Basu,1989). The present review intends to summarize a comprehensive study on ethnomedicinal uses, phytochemistry and pharmacological activities of *C. crista*.

#### TAXONOMICAL CLASSIFICATION

Kingdom	:	Plantae
Phylum	:	Magnoliophyta
Class	:	Angiospermae
Order	:	Fabales
Family	:	Caesalpiniaceae

Genus	:	<i>Caesalpinia</i>	Sanskrit	Karanja, Kantaki, Kuberakshi,
Species	:	<i>crista</i>		Latakaranj, Prakirya, Putrakaranj
<b>VERNACULAR NAMES</b>			Gujarati	Kanchaki, Kankachia
English		Teri pods, Fever nut	Bengali	Lata Karancha
Hindi		Katuk Ranja, Karanjava	Kannad	Gujugu, Gaduggu
Marathi		Sagargoti, Gajra, kanchak	Tamil	Kalarkodi, Kalichikai
			Telugu	Guchepikka Kachkai, Gachakaya (Suryawanshi and Patel, 2011)



**Fig 1.** (A) *Caesalpinia crista* L. (B) Stem (C) Leaves (D) Root

## MORPHOLOGY

### Leaves

The plant has large bipinnate leaves, leaflets are present in 2-3 pairs, leaves are ovate or elliptic in shape, with upper surface shining and lower surface dull.

The leaves are 30-60 cm long, petioles are prickly; stipules a pair of reduced pinnae 6-8 pair 5-7.5 cm long, with a pair of hook stipulary spines at the back. Leaflets have 6-9 pairs, 2-3.8 by 1.3-2.2 cm, membranous, elliptic-oblong, obtuse, glabrous above, and more or less puberulent beneath (Phoneke, 1992).

### Flowers

Flowers are fragrant, yellow, with axillary and terminal racemes inflorescence combined into a 20-40 cm long panicle. Flowers are dense (usually spicate) long peduncled terminal supraaxillary racemes dense at the top, lax downwards, 15-25cm long; pedicels very short in the bud, elongating to 5 mm calyx 6-8 mm long, fulvous-hair lobes obovate, oblong and obtuse. Petals are oblanceolate and yellow coloured (Phoneke, 1992).

### Pods

The pods are greenish brown or dark brown to black in colour, 5cm long and usually one-seeded. Pods shortly stalked, oblong, 5-7.5 by 4.5cm, densely arm on the faces with wiry prickles (Phoneke, 1992; Kirtikar and Basu, 1989).

### Seeds

Seeds are black, orbicular to ovoid or reniform, flat, beaked. Seeds 1-2 in number, oblong, in shape, lead colour, 1.3 cm long (Phoneke, 1992; Kirtikar and Basu, 1989).

### Bark

The colour of the Bark is black, branchlets are glossy, armed with recurved prickles (Phoneke, 1992).

## MICROSCOPY

### Transverse section of leaf

The leaf transverse section showed characteristics like cork, phelloderm, cambium,

phloem, xylem, epidermal cells, stomata, trichomes, fibres, vascular tissues, prismatic crystal and cluster of calcium oxalate crystal (Suryawanshi et al., 2011).

### Transverse section of root

The root transverse section revealed the outlines like a cork with several layers of the thin-walled cells, flat, and polygonal parenchymatous cells followed by thin-walled epidermal cells. The cortex comprises of an elongated parenchyma cell containing starch grains. The phloem is consisting of a sieve tube and a bundle of fibres with calcium oxalate crystal. Entire central portion occupies by xylem with prominent vessels, biseriate medullary rays and pith (Upadhyay et al., 2019).

### TRADITIONAL USES

On the basis of literature, reports suggest that *C. crista* is beneficial to plant in improving cognition disorders. The traditional uses of parts the plant are discussed.

#### Root

The root has diuretic properties and is useful in bladder stone. A decoction of the root is prescribed in a fever. A decoction of the root has been used for its important health benefits such as in the treatment of rheumatism, backache and as a tonic (Phoneke, 1992).

#### Bark

The bark is reported to be anthelmintic, and used as a febrifuge, and externally in inflammation. The root-bark is for tumours and for removing placenta (Phoneke, 1992).

#### Wood

The wood contains the natural food-colouring agent known as brazilin. According to Ayurveda, the heartwood is bitter, astringent, sweet, constipating, sedative, and hemostatic. It is useful in conditions of burning sensation, wounds, ulcers, skin diseases, diarrhoea, dysentery, epilepsy, convulsions, menorrhagia, leucorrhoea, diabetes and haemorrhages (Phoneke, 1992).

#### Stem and fruit

The stem and roasted fruits are used in eye diseases. Fruits are reported to contain tannins and flavonoids. In the Hawaiian Islands, the pulp of the pods is used as a laxative, for purifying the blood and in congestion. The fruit is acrid, heating to the body; astringent to the bowels, aphrodisiac, anthelmintic; cures urinary discharges, piles,

leucorrhoea and wounds. The oil from the fruit is good for indolent ulcers (Phoneke, 1992).

#### Leaves

The fine powder of the leaves is prescribed as a uterine tonic after childbirth. Juice of the leaves is anthelmintic, good in elephantiasis and smallpox; the boiled leaves are used as a gargle for a sore throat. The juice of the leaves or powder of the roasted seeds is given along with Palasa, Amra and Haridra in worm infestations. The leaves fried in ghee, eliminate vata and relieve constipation, hence valuable in piles. It is used as a bitter tonic. It is also a useful remedy for a cough and asthma. For this purpose, the tender leaves (fresh juice) are given along with the honey to ward off the mucous secretions. The oil prepared from the leaves is valuable as a nervine tonic. It is the best panacea for abdominal pain due to flatulence, as it effectively alleviates the Vata Dosha. Another recommended combination for the treatment of malaria is the powders of marica and latakaranja. The splenic enlargement due to malaria, responds well to latakarnja (Phoneke, 1992; Kirtikar and Basu, 1989).

#### Seeds

Powdered seeds with sugar and goat's milk are reported to cure liver disorders. The kernels are used as a tonic for intermittent fever, asthma and colic. The oil from the preserved seeds is reported to possess anti-microbial property, whereas that from fresh seeds does not show this action. The sprouts are useful in the treatment of tumours. The seed is hot and dry; styptic, antiperiodic, anthelmintic, prevent contagious diseases; cures inflammations; useful in colic, malaria, hydrocele, skin diseases, leprosy.

In Madras, an ointment is made from the powdered seeds with castor oil and applied externally in hydrocele and orchitis. Roasted seed powder, asafoetida, ghee and a small amount of salt remove abdominal pain during the postpartum period. The seeds powder given with milk will control diarrhoea. The skin of the seed being astringent is used as a medicament for diarrhoea, dysentery and colitis. The seeds are stimulant to the uterus, improves the menstrual discharge in oligomenorrhoea. The skin of the seed is extremely useful in the treatment of leucorrhoea. The seeds of the plant have contraceptive activity. The skin of the seed being astringent is beneficial as a medicament for diarrhoea, dysentery and colitis. Latakaranja (combination of its roasted seeds powder and pippali (1:1) with honey) is the best medication for malarial fever.

Dried seed kernels of *C. crista* extract have potential as a learning and memory enhancer (Phoneke, 1992; Kirtikar and Basu, 1989). Pounded seeds are considered vesicant; the powdered

seeds are found to possess feeble antiperiodic properties (Phoneke, 1992).

### Flower

The flower is bitter, cures kapha, vata; the ash is used in ascites (Phoneke, 1992).

## PHYTOCHEMISTRY

The preliminary phytochemical screening of the ethanolic and aqueous extracts of *C. crista* showed the presence of flavonoids, tannins, proteins, alkaloids, carbohydrates, reducing sugars, phytosterols, saponins, coumarins and triterpenoids (Al Snafi, 2015). Many furano-cassane diterpenes were isolated from the seeds of cassane diterpenes (caesalpines) including (caesalpinin C-P), nor-cassane diterpenes (nor-caesalpine A-F) and neo-cassane diterpenes (neocaesalpines H and I), which is characterized by  $\alpha$ , and  $\beta$ -butenolide hemiacetal ring that is rare in nature, while they lack 5-hydroxy group which distinguishes them from cassane diterpenes (caesalpines). Taepeenin A-I, the cassane-type diterpenes were also isolated from the plant (Awais, 2008).

Kumar et al. (2014) reported two novel compounds, 2 hydroxytrideca-3,6-dienyl-pentanoate and octacos-12,15 diene along with known compounds 3-O-methylsuccinic acid 3'-O- $\alpha$ -rhamnopyranoside,  $\beta$ -sitosterol and sucrose isolated from a methanolic extract of *C. crista*.

The plant seeds contain 49% carbohydrates including pentosan (16.8%), starch (6.1%) 54 and water-soluble mucilage (4.4%). 4-O-methyl myoinositol hydrate was isolated from *C. crista* grown in China (Chopra, 1933). The leaves contain pinitol (4.1%), glucose and minerals like calcium (2%) and phosphorous (0.3%) (Watt and Breyer, 1962).

## PHARMACOLOGICAL INVESTIGATIONS

### Hepatoprotective activity

Methanolic extract (70%) of *C. crista* is reported to exert hepatoprotective activity by upregulating antioxidant enzymes and chelating iron to excrete from the body. It may be seen as an effective hepatoprotective agent in liver diseases associated with iron overload (Sarkar et al., 2012).

### Antidiabetic activity

Ethanolic and aqueous seed extracts of *C. crista* have shown antidiabetic activity in streptozotocin-induced diabetes in 2 days old pups models (Gupta et al., 2013).

### Alzheimer's disease

Aqueous extracts of *C. crista* inhibit the amyloid fibril formation and disaggregate the pre-formed

fibrils while *C. asiatica* partially inhibited the amyloid fibril formation. *C. crista* leaf extract exhibited better antioxidant and anti-inflammatory activities compared with *C. asiatica* extract, which may be due to the differences in their polyphenol composition and other bioactive compounds (Ramesh et al., 2014).

### Neurodegenerative disorder

*C. crista* can improve disorders like dementia (Kshirsagar, 2011). Traditionally, extracts of the plant have been used as stress relaxation health drink and health tonic for rheumatism and backache. The extracts of *C. crista* have a diversity of bioactivities, namely, anti-inflammatory, anti-helminthic, memory enhancer, free radical scavenging activity, anticancer, and hepatoprotective. *C. crista* can inhibit the amyloid  $\beta$  aggregation from monomers and oligomers and disaggregate the preformed fibrils (Ravi et al., 2018).

### Antimalarial activity

*In vitro* antimalarial activity of 44 cassane- and norcassane-type diterpenes isolated from *C. crista* of Myanmar and Indonesia has been reported. The most of diterpenes displayed significant inhibition of growth of *P. falciparum* FCR-3/A2 clone *in vitro*. Norcaesalpinin E, a C-17 norcassane-type diterpene showed the most potent activity ( $IC_{50}$ , 0.090 mM) stronger than an antimalarial drug, chloroquine ( $IC_{50}$ , 0.29 mM). The inhibitory activity exhibited by these diterpenes supports the use of the seed kernels of *C. crista* as an antimalarial drug in traditional medicine (Kalauni et al., 2006).

### Nootropic activity

The aqueous extract of dried seed kernels of *C. crista* was examined as learning and memory enhancer. The memory retention in mice treated with 50 mg/kg aqueous extract against scopolamine-induced amnesia was found to be 33.09 % in radial arm maze task performance. The memory retention was increased up to 45.29% in mice treated with 150 mg/kg. The plant extract could be beneficial in various neurodegenerative disorders as per reported literature (Kshirsagar, 2011)

### Anticancer activity

A novel cassane-type diterpenes compound (1 $\alpha$ -acetoxy-5 $\alpha$ , 7 $\beta$ -dihydroxycassa-11, 13(15)-diene-16, 12-lactone) isolated from *C. crista* has evaluated for antitumor activity against T47D human cell line, DU145 prostate cancer cell line, it showed significant inhibitory activities (Tian et al., 2013).

### Antitumour activity

The ethanolic extract of *C. crista* root-bark possesses significant antitumour activities in the Ehrlich ascites carcinoma (EAC) bearing mice. At the dose 50 mg/kg, the weight of mice was not reduced significantly, indicating that this is not an effective dose. At the 100 mg/kg the weight of animal was reduced significantly indicating less effective dose. At the dose of 150 mg/kg, the weight of animals was reduced significantly indicating that the extract is effective at this dose (Liu et al., 2015; Bodakhe et al., 2015).

### Anthelmintic activity

*C. crista* has shown anthelmintic activity against trichostrongylid nematodes of sheep. Seed kernels were used to determine the anthelmintic activity. Crude aqueous methanolic extract (AME) are used for the *in vitro* anthelmintic activity study. Sheep naturally injected with mixed species of gastrointestinal nematodes evaluated by administering crude powder (AME 1.0-3.0 g/Kg). Plant exhibited dose and time-dependent anthelmintic effect by causing mortality of worms and inhibition of egg hatching. *C. crista*  $LC_{50}$  = 0.134 mg/mL has shown more significant anthelmintic activity than *Chenopodium album*  $LC_{50}$  = 0.449 mg/mL. The AME of *C. crista* was more effective against egg hatch as compared to *Chenopodium album* (Abdul et al., 2007).

### Antioxidant Activity

In this study, the potential antioxidant activity of chloroform and methanol leaf extract of *C. crista* was determined in different established *in vitro* experimental models. A methanolic extract showed moderate 50% inhibitory concentration  $IC_{50}$  value (103.7ug/ml) in DPPH assays (Afrin et al., 2016).

### Antibacterial activity

The *C. crista* leaf methanolic extracts exhibited the zone of inhibition at 250 and 500µg/disc, respectively, against various pathogenic bacterial strains while the MIC values ranged from 62.5 to 500 µg/ml (Afrin et al., 2016).

### Cytotoxic activity

Chloroform and methanol leaf extracts of *C. crista* was found to be 5.794 µg/mL and 2.972 µg/mL, compared to positive control Vincristine sulphate with an  $LC_{50}$  value of 0.128 µg/mL. A methanolic leaf extract was proximal to the standard indicating the strong cytotoxic activity (Kalauni et al., 2004).

### Wound healing activity

The wound healing activity of different extracts and fractions of seed kernels of *C. crista* was

investigated in excision, incision and dead space wound models in albino rats. Ethyl acetate fraction has shown the significant wound healing activity in all models as compared to alcoholic extract and other fractions (Patil, 2005).

### Antipyretic activity

The aqueous and ethanolic seed extracts of *C. crista* was evaluated in experimental animal models using Brewer's yeast induced pyrexia in rats, TAB-vaccine induced pyrexia in rabbits and boiled milk induced pyrexia in rabbits models. The ethanolic seed extract of the plant was nearly equal to that of the standard paracetamol and showed significant antipyretic activity (Ishan et al., 2013).

### Cardioprotective activity

The aqueous and alcoholic extract of *C. crista* was evaluated for isoproterenol-induced myocardial infarction in albino rats. The heart damage induced by isoproterenol (85 mg/kg b.w.) was indicated by elevated levels of the marker enzymes. Pretreatment with an aqueous and ethanolic extract (400 mg/kg b.w.) reduced significantly the elevated marker enzyme levels in serum and heart homogenates (Kumar and Kumar, 2013).

### CONCLUSION

In a developing country, modern health care facility with costly medicines is still not in the reach of the rural segment. Therefore, it is very necessary to look for options in herbal drugs. Hence, ethnomedical studies have received much attention as they bring to light the abundant known and unknown medical virtues, especially of plant origin, which needs studies on modern scientific lines like phytochemical analysis, pharmacological screening and clinical studies.

*C. crista* possesses various important pharmacological activities as discussed in the present review. Additionally, it is of vital importance that more pre-clinical and clinical studies along with the establishment of better quality control methods is require to elucidate the unexplored potential of this plant.

### CONFLICT OF INTEREST

Authors declare no conflicts of interest.

### ACKNOWLEDGMENT

We express our sincere thanks to Shri S.P. Singh, Honorable Chairman, Sardar Bhagwan Singh Post Graduate Institute of Biomedical Sciences & Research, Balawala India for providing the facilities.

## REFERENCES

- Abdul JMA, Zaman ZI, Muhammad Y, Asim S (2007). Anthelmintic activity of *Chenopodium album* (L.) and *Caesalpinia crista* (L.) against trichostrongylid nematodes of sheep. *Journal of ethnopharmacology*, 114, 86-91.
- Afrin S, Pervin R, Sabrin F, Sohrab MH, Rony SR, Islam ME (2016). Assessment of antioxidant, antibacterial and preliminary cytotoxic activity of chloroform and methanol extracts of *Caesalpinia crista* L. Leaf. *Bangladesh Journal of Botany*, 45, 1061-1068.
- Al-Snafi AE (2015). Pharmacology and medicinal properties of *Caesalpinia crista* - An overview. *International Journal of Pharmacy*, 5: 71-83.
- Awais M (2008). Medicinal plants of Pakistan. The faculty of mathematics and natural sciences, Oslo University, 137-163.
- Bodakhe SH, Agrawal A, Agrawal A, Shinde N, Namdeo KP (2015). Anticancer study on alcoholic extract of *Caesalpinia crista* root bark extract. *Journal of Research and Opinion*, 1, 126-128.
- Chopra RN (1933). *Indigenous drugs of India*, 1st ed. Calcutta: Ast. Press.
- Gupta N, Sharma I, Agarwal M, Mohammed SM, Chauhan P, Anwer T, Khan G (2013). Antidiabetic activity of seed extracts of *Caesalpinia crista* Linn. in experimental animals. *African Journal of Pharmacy and Pharmacology*, 7, 1808-1813.
- Halmay J, Novak I (1963). *Farmakognozia, Medicina konyvkiado, Medicina Koonyvkiado*, Budapest, Hungarian.
- Ishan S, Nakul G, Safhi MM, Agrawal M, Prerna C (2013). Antipyretic activity of *Caesalpinia crista* Linn. seeds extract in experimental animals. *International Journal of Current Research*, 5, 1202-1205.
- Kalauni SK, Awale S, Tezuka Y, Banskota AH, Linn TZ, Asih PBS (2006). Antimalarial activity of cassane- and norcassane-type diterpenes from *Caesalpinia crista* and their structure activity relationship. *Biological and Pharmaceutical Bulletin*, 29: 1050-1052.
- Kalauni SK., Awale S., Tezuka Y, Banskota AH, Linn TZ, Kadota S (2004). Cassane- and Norcassane-Type Diterpenes of *Caesalpinia crista* from Myanmar. *Journal of Natural Products*, 67, 1859-1863.
- Kirtikar KR, Basu BD (1989). *Indian Medicinal Plants*. Vol. II, Dehradun: International publishers.
- Kshirsagar SN (2011). Nootropic activity of dried seed kernels of *Caesalpinia crista* Linn against scopolamine induced amnesia in mice. *International Journal of PharmTech Research*, 3, 104-109.
- Kumar A, Garg V, Chaudhar A, Jain PK, Tomar PK (2014). Isolation, characterisation and antibacterial activity of new compounds from methanolic extract of seeds of *Caesalpinia crista* L. (Caesalpinaceae). *Natural Product Research*, 28, 230-8.
- Kumar SR, Kumar SA (2013). Cardio protective effect of *Caesalpinia crista* Linn. on isoproterenol induced myocardial necrosis in rats. *International Journal of Pharmacy and Pharmaceutical Sciences*, 3, 119-130.
- Liu QB, Huang L, Zhang L, Liu Q, Xu Q-Q, Qin X-J (2015). Two new cassane-type diterpenes from the seeds of *Caesalpinia crista*. *Journal of Asian Natural Products Research*, 17, 1073-8.
- Patil KS (2005). Wound healing activity of the seed kernels of *Caesalpinia crista* Linn. *Journal of Natural Medicines*, 5, 26-30.
- Phoneke GP (1992). *The Wealth of India: Raw Materials, a Dictionary of Indian Raw Material and Industrial Products*, Vol 3, New Delhi: Publications and informations directorate, CSIR; pp. 10-11.
- Ramesh BN, Girish TK, Raghavendra RH, Naidu KA, Rao UP, Rao KS (2014). Comparative study on anti-oxidant and anti-inflammatory activities of *Caesalpinia crista* and *Centella asiatica* leaf extracts. *Journal of Pharmacy and Bioallied Sciences*, 6, 86.
- Ravi SK, Ramesh BN, Mundugaru R, Vincent B (2018). Multiple pharmacological activities of *Caesalpinia crista* against aluminium-induced neurodegeneration in rats: Relevance for Alzheimer's disease. *Environmental Toxicology and Pharmacology*, 58, 202-211.
- Sarkar R, Hazra B, Mandal N (2012). Hepatoprotective potential of *Caesalpinia crista* against iron-overload-induced liver toxicity in mice. *Evidence Based Complementary and Alternative Medicine*, 896341.
- Suryawanshi HP, Patel MR (2011). Traditional uses, medicinal and Phytopharmacological properties of *Caesalpinia crista* Linn. *International Journal of Research in Pharmacy and Chemistry*, 1, 2231-2781.
- Suryawanshi HP, Patel MR, Patil JK, Sayyed H, Ahirrao RA, Pokal DM (2011). Development of quality standards of *Caesalpinia crista* leaves. *Journal of Pharmacy Research*, 4, 3372-3374.
- Tian QJ, Ou YH, He XB, Jiang YD (2013). One new antitumour cassane-type diterpene from *Caesalpinia crista*. *Natural Product Research*, 27, 537-340.
- Upadhyay P, Joshi BC, Sundriyal A, Mukhija M (2019). Pharmacognostic standardization and physicochemical evaluation of *Caesalpinia crista* L. root for quality control assessment. *Journal of Nature and Science of Medicine*. In press, DOI: 10.4103/JNSM.JNSM\_61\_18
- Watt JM, Breyer BMG (1962). *The medicinal and poisonous plants of Southern and Eastern Africa*, 2nd ed. Edinburgh: Church Livingstone.

**How to cite this article?**

Upadhyay P, Joshi BC, Sundriyal A, Uniyal S (2019) *Caesalpinia crista* L.: A review on traditional uses, phytochemistry and pharmacological properties. *Current Medical and Drug Research*, 3 (1), Article ID 191.

\*\*\*\*\*