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A Review On Therapeutic Potential Of *Caesalpinia crista.*

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ABSTRACT

Caesalpinia Crista L. is a medicinal plant belongs to family Fabaceae (Caesalpiniacea). It is prickly shrub distributed in all over world especially in India, Shri Lanka and Andaman and Nicobar Islands, In India specially found in tropical region. In Indian traditional plant system it has been considered as an important remedy for treatment of several diseases. All parts of plant have medicinal properties so it is a very valuable medicinal plant which is utilized in traditional system of medicine. The plant have been reported to possess used antidiarrheal, antidiabetic, antitumor, anticolic, anthelmintic, anticonvulsants, antifertility, anxiolytic, anti-inflammatory, analgesic, Immunomodulatory and anti-viral activity. Phytochemical analysis reveals the presence of alkaloids, flavonoids, terpenoids, glycosides and saponins. The present review attempts to encompass the available literature on *Caesalpinia Crista* L. with respect to its pharmacognostic characters, chemical constituents and summary of its various pharmacological activities.

Keywords: *Caesalpinia Crista,* Pharmacognostic, Phytochemical, Traditional medicine, Pharmacological activities.

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INTRODUCTION

From olden days people have been using parts of different plants as helpful remedies. The study of medicinal plants has paying attention of many researchers, owing to the useful applications of plants for the treatment of various diseases in humans. However there is need to know which constituents in the medicinal plant are responsible for therapeutic uses [1]. Medicinal properties of plants are explained in Rig-Veda and in Atharvaveda. Charaka Samhita and Sushrusha Samhita give wide description on different medicinal plants [2]. However, a meaning of the medicinal plant would be "Medicinal plants are those plants which are used in official and various traditional systems of medicines throughout the world" [3]. Information on medicinal plants in India has been systematically organized [4]. A review of the most common plants is rich in a variety of compounds such as alkaloids, flavonoids, carbohydrates. Many are secondary metabolites and include aromatic substances, most of which are phenols or their oxygen-substituted derivatives such as tannins and rest of the other compounds. Many of these compounds have antioxidant properties. These secondary metabolites are used as pharmaceuticals, agrochemicals, fragrances, flavors, pesticides, and colors [5, 6]. Many compounds which are medicinally useful were developed from plants which explore huge scope for phytochemical study [7]. The herbal products today symbolise safety in contrast to the synthetics that are regarded as dangerous to human and environment [8]. *Caesalpinia crista* (L.) belongs to family Fabaceae, contained tannins, proteins, carbohydrates, alkaloids, flavonoids, reducing sugars, phytosterols, saponins, coumarins, triterpenoids, furano It exerted anticonvulsant, antianxiety, adaptogenic, antimicrobial, hepatoprotective, anticancer, antioxidant effects. The present review is therefore; try to give a detailed survey of the literature on its Pharmacognosy, phytochemistry, medicinal properties, traditional uses and pharmacological activities of *C. crista.*

DESCRIPTION

General characteristics and Taxonomy:

C.crista (L.) Fleming (Syn. *C.bonduc* (L.)Roxb, Syn. *C.bonducella* Linn, *C.paniculata*), belongs to family Fabaceae little ball which indicates the shape of the seed [9]. *C.crista* is a prickly shrub distributed throughout India (fig.1). The name of the species bonducella is derived from the Arabic word "Bonduce" meaning and generally in the tropical areas. The plant grows in sea coast and in many forests and up to 2500 fit on the hills. It is mostly found around the marshy land, plain land. It is a woody vine reaching length of 6 m or more.
It is also known by different names. The taxonomic Hierarchy and commomn names *C. crista* are given in Table 1.

Traditional Uses:

The plant *Caesalpinia crista* parts traditionally used in various systems for diagnosis and treatment of disease conditions. Roots were used in treatment of tumor, small Pox, colic fever, malaria, menstrual complaints, pulmonary tuberculosis, uterine disorders, diabetes and asthma. Leaves were used as rheumatism, colic, gastric tonic, anticonvulsant, liver disorders, and toothache; piles, antioxidant and anti-inflammatory. Seeds were used in colitis, dysentery, malarial fever, menstrual disorders, skin diseases, leprosy. Fruits were used as aphrodisiac, astringent, anthelmintic, cures urinary diseases, leucorrhoea, piles, wounds and ulcers [10].

Ayurvedic uses:

In Ayurveda root and bark of *Caesalpinia crista* used in treatment of tumors. The juice of leaves is used in prevention of elephantiasis, pain and edema. It also used in ulcers, gynecologic diseases, worms, vat samak, kapha, sotha har, krimighan, dipan, anuloman, rakt sodhak, swashar, mutral. Combination of roasted seeds powder of *C. crista* and pippali (1:1) with honey is the best medication for malarial fever. In asthma treatment a decoction of the roasted seed is used [11, 12].

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PHARMACOGNOSTIC STUDIES

Macroscopical character:

Leaves - There are 6 to 9 pairs of opposite leaflets. 36 to 60 cm long, bipinnate and having short prickly petioles and pair of stipules at the base of leaf which in believed to be pinnae. 7 pairs of pinnae and these are 5-7 cm long, Main leaf is sharp and stout. Leaflets are 1.4-2.2 cm, elliptic-oblong, membranous, strongly mucronate, obtuse, glabrous above, less or more puberulous beneath; very short petiolules; stipels of short hooked spines. Leaflet blade is about 18-75×12-40 mm, and stalks is 1-2 mm long. Twigs armed with straight and recurved spines. In upper and lower blade surface of leaflets pale golden hairs are present (fig.2).

Flowers – They are yellow in colour, axillary, panicled or simple raceme and about 15-25 cm long. The pedicles are short in bud, elongating to 5 mm in the flower and 8 mm in the fruit, acute, reaching 1 cm long, fulvous-hairy. Yellow color Petals having 10-12 mm long, declinate filaments, flattened at the base, clothed with long white silky hairs. Pods are shortly stalked oblong (fig.2).

Seeds – They are dry and rounded. Seed coating is hard, glossy, and greenish in colour. It has rounded and vertical faint markings of the cracks, forming even rectangular to squarish rectulations all over the surface. Seeds are 1-2 cm oblong, lead-colored and 1.3 cm long. In dry seed kernel gets detached from the testa. Testa is about 1-1.25 mm thick and it contains three distinct layers, the outermost layer is thin and brittle, the middle one layer is broad, fibrous and dark – brown and the innermost layer is white and papery. The kernel surface is hard, ridged, pale yellowish – white in colour, circular to oval, flattened and 1.23- 1.75 cm in diameter (fig.2).

Fruits – They are inflated pod, covered with wiry prickles, armed with rigid spines. Pods are shortly stalked, oblong, 5-7 by about 5cm. densely armed with wiry prickles [13, 14, 15] (fig.2).

Microscopically characters:

The leaves show cork, phelloderm, phellogen, cambium, xylem, phloem, straight-walled epidermal cells, unicellular covering trichomes, paracytic stomata, fibres, prisms and cluster type of calcium oxalate crystals [16, 17, 18].

Seeds have a palisade layers which are composed of vertical, columnar, laterally closed compressed cells. There are thickenings present on the walls of palisade cells. These cells in lateral section appear as 6- 10 denticulate projections into lumen and after that it has layer of bearer cells and a thick zone of parenchymatous cells. Maximum bearer cells are T-shaped, thick walled and non-lignified cells. The powder characteristics of seeds show like columnar palisade cells, bone shaped thick walled parenchymatous cells and starch grains.

Transverse section of stem bark consists of layers of radially tiered cork, it covered by degenerated dark layers of dead cells, followed by 16-22 layers of phelloderm, parenchymatous cells, starch grains that are spherical in shape and having different size, with a centric hilum, prismatic crystals of calcium oxalate. Stone cells are present in the form of a continuous ring; secondary phloem consists of sieve cells, companion cells; phloem parenchyma and thick walled phloem fibres in groups. Section traversed by vertical medullary rays; simple, rarely compound starch grains and in secondary phloem region clusters of calcium oxalate crystals are found [19, 20].

PHYTOCONSTITUENTS

The literature study reveals that whole plant contain various compounds like contains sitosterol, steroidal saponins, fatty acids, hydrocarbons, phytosterols, caesalpins, bonducin, caesane, flavonoids, isoflavones, caesalpinianone and 6-O-methylcaesalpinianone, hematoxylin, stereochenol-A, 6-O-acetylloganic acid, 4-O-acetylloganic acid, 2-O-β-D-glucosyloxy-4-methoxybenzenepropanoic acid, diterpenoids, neocaesalpin-H, cordylane-A, caesalpinin-B, bonducellpin-E, caesalpinolide-A, derivatives of amino acids and phenolic compound[21,22.23,24]. Leaves contain pinitol glucose and calcium, bonducin, Cysteric acid [25].

Seed contains Natin, Bonducin (Bonducellin), Steroidal saponins, 14-Voucapanepentol derivative, Caesalpin (1-ketone 6, 7-diacetylcassane), myristic acid, vinaticole, vouncapen and cassaic acids, Caesalpins-E, caesalpin-F, caesalpin-Y, α-caesalpinin 4-o-methyl myoinositol hydrate, phytosterinin, homoisoflavone-bonducillin, cassane furanoditerpenoid as bonducellpin E, F and G, amino acids like aspartic acid, lysine, glycine, leucine, histidine, isoleucine, serine, tyrosine, citrulline, glutamic acid, threonine, arginine, proline, L-alanine, methionine, phenyl alanine, cystine, valine, and tryptophan, r-ethylidene glutamic acid, r-methylene glutamic acid, r-ethyl glutamic acid [26, 27].

Root contains cassane furano-diterpene, caesalpinin, caesaldekarins F and G, caesaldekarin A, Bonducellpins A, B, C and D, steroidal saponin like Diosgenin [28].

Bark contains 6-o-methylcaesalpinianone, caesalpinianone, hematoxylol, 6-o-acetylloganic acid, 4-o-acetylloganic acid and 2-o-glucosyloxy-4-methoxybenzenepropanoic acid [29].

Stem contains peltogynoids, pulcherrimin, 6-methoxypulcherrimin, 8-methoxybonducellin, 2, 6-dimethoxybenzoquinone, 2', 4, 4'-trihydroxychalcone and 2', 4-dihydroxy 4'-methoxy chalcone [30] (fig.3).

PHARMACOLOGICAL ACTIVITY

Antimalarial activity:

Kalauni S et al., (2006) isolated 44-cassane- and norcassane-type diterpenes from *C.crista* and evaluated for their antimalarial activity against the malaria parasite *Plasmodium falciparum* FCR-3/A2clone *in vitro*. Most of the tested diterpenes showed antimalarial activity, and norcaesalpinin E showed the potent activity with an IC_{50} value of 0.090mm, more potent than the clinically used standard chloroquine (IC_{50}, 0.29mM)[31].

Analgesic/Anti-Inflammatory activity:

Kannur DM et al., (2012) studied the Analgesic and Anti-Inflammatory activity of ethanolic seed extract of *C.crista*. in writhing reflexes and by tail immersion method in mice and carrageenan induced paw edema method. At a dose of 300ug/ml showed 71% potent analgesic activity by writhing reflexes and by tail immersion method in mice. At a dose of 300mg/kg extract showed maximum inhibition of 74.2% by carrageenan induced paw edema method as compared with standard dicolfenac [32].

Antipyretic activity:

Sharma I et al., (2013) studied the Antipyretic activity in rabbits and wistar rats using aqueous and ethanol seeds extracts of *C.crista*. After administration of aqueous and ethanolic extracts, when the rectal temperatures were recorded 0 hour temperature and for six hours at a 1 hour time of interval, Result decrease in body temperature by the test extracts and standard drug (Paracetamol). In aqueous and ethanol extracts flavonoids are present which decreases lipid peroxidation by preventing the onset of cell necrosis and by increasing the vascularity. The anti-pyretic action of *C. crista* may be due to the inhibition of prostaglandin synthesis. The study shows that aqueous and ethanolic extracts have potent antipyretic activity [33].

Antioxidant activity:

Kumar R et al., (2005) reported antioxidant activity of *C. crista* leaf extract. All extract was evaluated for their antioxidant potential. Antioxidant activity was studied using DPPH and free radical scavenging methods [34]. Methanolic leaf extract of *C. crista* act as potent antioxidant and reactive oxygen species scavenger [35].

Anthelmintic activity:

Abdul J et al., (2007) studied the Anthelmintic activity of bark extract of *C.crista*. The adult earthworms were used for evaluation of anthelmintic activity. The bark extract of *C. crista* (L.) exhibited a spontaneous motility with 50 mg/ml of aqueous extract the effects were compared with 3% piperazine citrate.

There was no final improvement in the case of worms treated with aqueous extract in contrast to piperazine citrate, the worms recovered completely within 5 hrs. *C. crista* possesses anthelmintic activity *in vitro* and *in vivo* against trichostrongylid nematodes of sheep [36].

Analgesic/ Antipyretic activity:

Shukla S et al., (2010) studied the analgesic and antipyretic activity of *C. crista* seed oil on acute and chronic inflammation was determined in experimental animal model. The different doses like 100, 200 and 400 mg/kg of the seed oil of *C. crista* were given orally in carrageenan induced rat paw edema, brewer's yeast-induced pyrexia, acetic acid-induced writhing and hot plate reaction time in experimental rats. The paw volumes, pyrexia and writhes were reduced significantly ($p < 0.05$) in *C.crista* treated rats as compared with control [37].

Archana P et al., (2005) studied Analgesic and Antipyretic activity in adult albino rats or mice of either sex at 30, 100 and 300 mg/kg orally. Ethanolic extract of *Caesalpinia bonducella* seed kernel extract has been used for its activities. The ethanolic extract had significant central analgesic activity in hot plate and tail flick methods. It also exhibited marked peripheral analgesic effect in acetic acid induced writhing test in mice and Randall selitto assay in rats. The extract also exhibited marked antipyretic activity against Brewer's yeast induced pyrexia in rats. The study shows that ethanolic seed kernel extract of *Caesalpinia bonducella* possesses potent analgesic and antipyretic activities [38].

Antidiabetic activity:

Gupta N et al., (2013) studied Antidiabetic activity of ethanol and aqueous extracts of *C. crista* seed in streptozotocin induced diabetes in 2 days old pup's models. Both extracts of *C.crista* showed antidiabetic activity. Result showed the aqueous extract of *C.crista* showed more significant effect as compared to the ethanol extract. Ethanol and aqueous seed extracts caused significant reduce in serum glucose, cholesterol and triglyceride when compared with diabetic untreated group after 3 weeks treatment. Treatment with the ethanol and aqueous seed extracts also affected the physical parameters [39].

Effect on sperm:

Peerzade N et al., (2011) studied the effect of *C.bonducella* seeds on sperm. The alcoholic seed extract of *C.bonducella* showed morphological changes in the sperm of albino rats. The effect can be due to disturbances in proteins and change in the cauda epididymal milieu, most likely due to androgen deficiency due to *C. bonducella* treatment [40].

Antifilarial activity:

Gaur RL et al., (2008) studied the antifilarial activity of seed kernel extract and fractions of C*. bonducella*. The extract and fractions of C*. bonducella*- seed kernel showed microfilaricidal, macrofilaricidal and female-sterilizing efficacy against *L. sigmodontis* and microfilaricidal and female-sterilizing efficacy against *B. malayi* in animal models, indicating the potential of C*. bonducella* in new antifilarial drug development [41].

Anxiolytic Activity:

Ali A et al., (2008) studied the anxiolytic activities of seed extract of *Caesalpinia crista* in mice and rats were investigated by stair-case model. At a dose of 400, 600 and 800mg/kg showed a significant and dose dependent anxiolytic activity by using EPM, Hole-board, LDT, Mirror-chamber and OFT models. In all models, medium and high doses 600mg/kg and 800mg/kg but not the low dose 400mg/kg had more significant effect [42].

Anticonvulsant activity:

Ali A et al., (2009) studied the Anticonvulsant activity of different extract of *C. crista* seeds. For this study pentylenetetrazole, maximal electro shock strychnine- and picrotoxin-induced convulsions models were used. Petroleum ether, ethanol, methanol and water were used for successive extraction. Petroleum ether

extract of *C. crista* (600 and 800mg/kg) showed significant anticonvulsant activity as compaired with Diazepam [43].

Anti-Amyloidogenic / Alzheimer's disease:

Ramesh BN et al., (2010) studied the ability of *Caesalpinia crista* leaf aqueous extract on the prevention of (i) the formation of oligomers and aggregates from monomers (Phase I: A beta (42) + leaf aqueous extract co-incubation); (ii) the formation of fibrils from oligomers (Phase II: leaf aqueous extract added after oligomers formation); and (iii) dis-aggregation of pre-formed fibrils (Phase III: leaf aqueous extract added to matured fibrils and incubated for 9 days). In this study the aggregation kinetics was monitored using transmission electron microscope and thioflavin-T assay. The results showed that *C. crista* leaf aqueous extract was able to inhibit the A beta (42) aggregation from monomers and oligomers and also able to dis-aggregate the pre-formed fibrils [44].

Adaptogenic activity:

Kannur DM et al., (2006) evaluated the adaptogenic activity of seed extracts *C. crista* in swim endurance and cold stress models. The seed coat and kernel extract of *C. crista* administered orally at a dose of 300mg/kg significantly increased the swim endurance time. The seed coat and kernel extracts also corrected hyperglycemia, the depletion in serum cortisol level, increased total leukocyte count and controlling the hyperlipidaemic condition associated with stress [45].

Wound healing activity:

Patil KS et al., (2005) studied the wound healing activity of different extracts and fraction of *C.crista* seeds using excision, incision and dead space wound models in albino rats. The study shows that ethyl acetate fraction of seed kernel of *C. crista* has shown better wound healing activity as compared to alcoholic extract and ether fraction. [46].

Anti-estrogenic activity

Monika S et al., (2016) studied the anti-estrogenic activity of alcohol seed extract of *C.bonducella* in mice and rabbits, possibly acting via inhibition of estrogen secretion and an antifertility action in mice and rats [47].

Antifertility activity:

Lilaram et al., (2012) evaluate the effect of oral administration of the ethanol seed extract of *C.bonducella* on the reproductive system in Wistar female albino rat. The ethanol seed extract of *C. bonducella* administered orally at 100, 200, 300mg/kg dose significantly decrease hormone level, reproductive organs weight and alterations in histoarchitecture of reproductive organs might be due to anti-estrogenic nature of seed extract [48].

Immunomodulatory activity:

Shukla S et al., (2010) studied the effect of aqueous seeds extract of *C.crista* on cell mediated and humoral components of the immune system in rats were studied. The aqueous seeds extract of *C.crista* produced an increase in hemagglutinating antibody titer and a change in delayed-type hypersensitivity suggesting that the extract could be a promising immune-stimulatory agent [49].

Hepatotoxicity and Nephrotoxicity:

Ali A et al., (2011) studied the protective effect of methanol leaf extract of *C.bonduc* (L.) on gentamicin-induced hepatotoxicity and nephrotoxicity in rats. The effect of methanol leaf extract of *C.bonduc* at a dose level of 250 mg/kg and 500 mg/kg was compared in gentamicin-induced hepatotoxicity and nephrotoxicity. The study shows that the methanol extract of *C.bonduc* significantly attenuated the physiological and histopathological alterations induced by gentamicin [50].

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Anti Viral Activity:

Patil U et al., (2012) studied the effect of *Caesalpinia crista* crude extracts the drug mentioned in Ayurvedic literature for krimighna activity. The crude extracts of various solvent were prepared like aqueous, methanol, ethanol and chloroform. Antiviral activity against paramyxovirus and orthomyxovirus isolates recovered from disease outbreaks in poultry birds was tested. Aqueous, ethanol and methanol extracts of *C.crista* showed complete inhibition on paramyxovirus while showing highly significant inhibitory activity on orthomyxovirus. The study shows that the medicinal plant *C.crista* might be useful against viral pathogens of poultry birds [51] (Table: 2. Summary of Pharmacological Studies of *C.Crista*).

Figure 1: Plant *Caesalpinia crista*

Figure 2: *Caesalpinia crista* L. (a) Plant (b) leaf (c) leaflets (d) flower (e) fruits (f) seed

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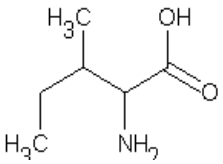
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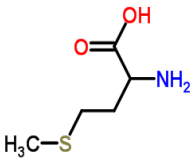
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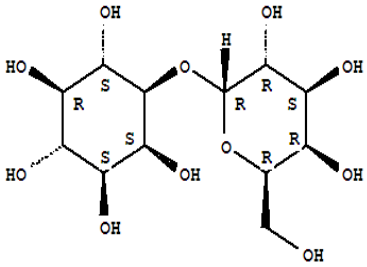
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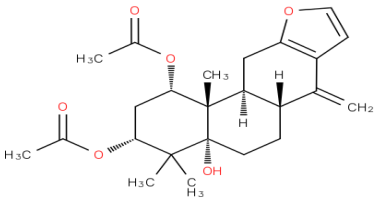
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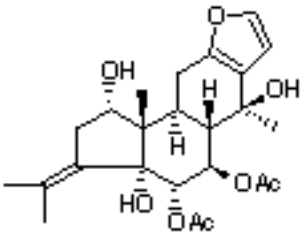
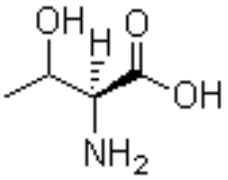
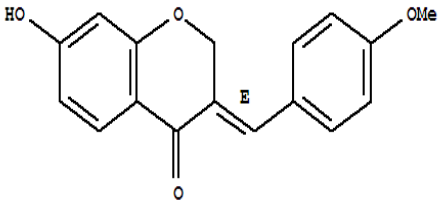
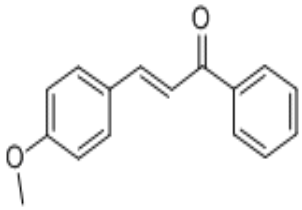
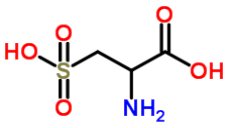

alpha caesalpinin


Threonine


Bonducellin


2', 4-dihydroxy 4'-methoxychalcone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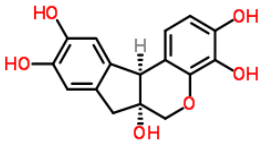
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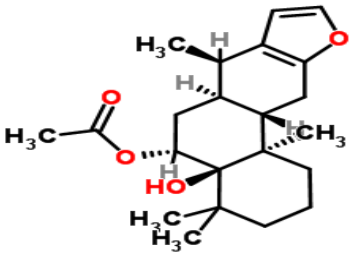
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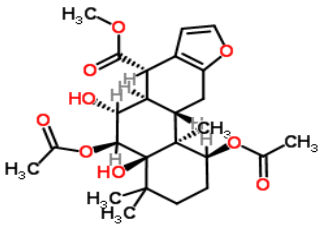
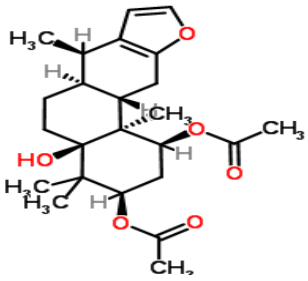

Bonducellpins A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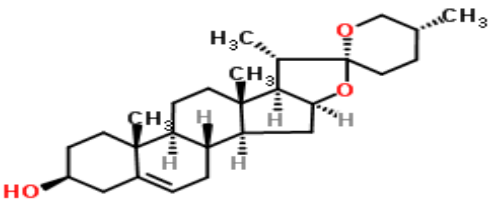
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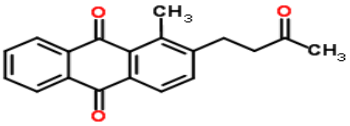

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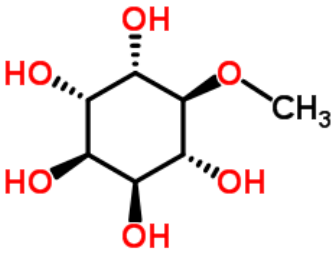

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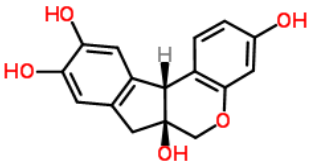
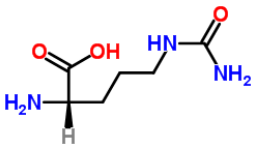
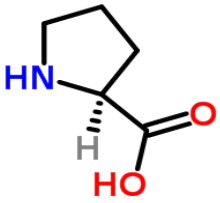


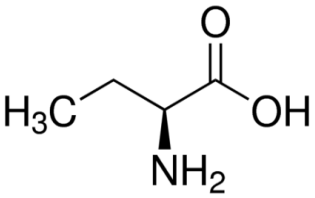
Brazilin



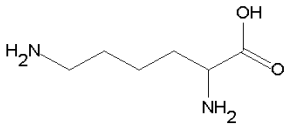
Citrulline



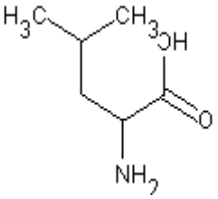
Proline



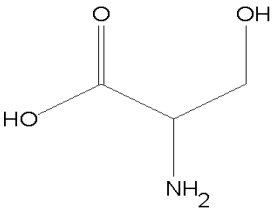
Aspartic acid



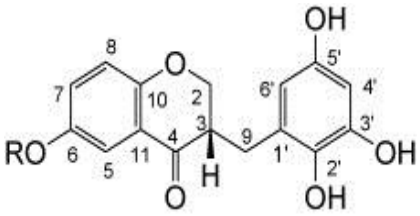
Lysine



Leucine

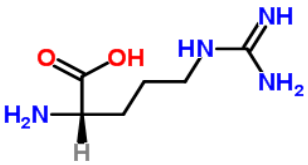


Searin



(1) R = H
(2) R = CH_3

Caesalpinianone (1) and 6-*O*-methylcaesalpinianone (2)



Arginine

Fig 3: Chemical structures of various phytoconstituents from *C.crista*

Table 1: Taxonomic Hierarchy and Commomn Names *C. Crista*

Taxonomic hierarchy		**Commomn names**	
Kingdom	: Plantae	Marathi	: Sagargoti
Phylum	:Magnoliophyta	Bangali	: Natakaranja, Nata
Division	: Magnoliopsida	English	: Fever Nut, Physic Nut
Class	: Angiospermae	Hindi	: Katkaranj
Order	: Fabales	Urdu	: Akitmakit
Family	: Fabaceae	Telgu	: Gaccakayai
Subfamily	: Caesalpiniacea	Gujrati	: Kankacha, Gajya
Genus	: *Caesalpinia*	Sanskrit	: Putrakaranj
Species	:*Caesalpinia crista*	Tamil	: Kalarkodi, Kalichikai

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Table 2: Summary of Pharmacological Studies of *C.Crista*

Activity	Part used	Extract
Antioxidant /Anti-Inflammatory/ Analgesic activity	Seed	Ethanol
Antioxidant activity	Seed	Ethanol
Antioxidant activity	Leaf	Chloroform, Methanol
Antipyretic activity	Seed	Ethanol ,Aqueous
Anthelmintic activity	Bark	Aqueous
Anti-Inflammatory /Analgesic/ Antipyretic Activity	Seed	Ethanol ,Aqueous
Antidiabetic activity	Seed	Ethanol
Sperm effect	Seed	Alcohol
Antifilarial activity	Seed	Various extract
Anxiolytic Activity	Seed	----
Antitumor Activity	Seed	Methanol
Anti-Amyloidogenic / Alzheimer's disease	Leaves	Aqueous
Adaptogenic activity	Seed	----
Wound healing activity	Seed	Alcohol
Antiestrogenic activity	Seed	Alcohol
Antifertility activity	Seed	Ethanol
Immunomodulatory activity	Seed	Aqueous
Hepatotoxicity and Nephrotoxicity	Leaves	Ethanol
Anti-carcinogenic activity	Leaves	Methanol
Anti-viral activity	Leaves	Various extract

CONCLUSIONS

From ancient time *C. crista* is traditionally very essential herb having various important pharmacological activities as discussed in present paper like antipyretic, analgesic, antifilarial, antidiabetic, anti-inflammatory hypolipidemic activity, antimalarial, anthelmintic, antiulcer and antioxidant property. The leaves, seeds and seed kernel are used for the treatment of various diseases. Various phytoconstituents like carbohydrates, alkaloids, glycosides, tannins, flavonoids responsible for the activity were isolated. The pharmacognostic parameters are useful in the identification and standardization of a crude drug. This demonstrates therapeutic importance of the plant. This type of systematic information about the plant is helpful for the new researchers. This review of *C. crista* that covered its description, distribution, traditional use, pharmacognostic parameters, phytoconstituents and pharmacology.

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