Review Article

PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW OF CAESALPINIA BONDUCELLA

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ABSTRACT

Caesalpinia bonducella is classified under the family of Caesalpiniaeae. It is also known as C. bonduculla Flem and C. crista Linn. The plant is found in the tropical and the subtropical parts of Asia. It is also found in Andaman, Nicobar islands and in all over India. The plant is a large prickly shrub. The branches are finely gray downy armed with hooked and hard prickles. Leaves, seeds, roots and bark of this plant are useful parts as a medicine. Caesalpinia bonducella (roxb.) shows antipyretic, anti-inflammatory, anthelmintic, antimalarial, antioxidant, antibacterial, antitumor and antidiabetic activities. The Phytochemical screening of C.bonducella shows the existence of different bioactive compounds like sterols, oils, alkaoids, saponins, phenols, glycosides, tannins, amino acids, proteins, cardiac glycosides, alkaloids, terpenoids, carbohydrates, flavonoids and resins.

Keywords: anti-inflammatory, Caesalpinia bonducella, anthelmintic, cardiac glycosides, flavonoids and resins.

INTRODUCTION

The herbal medicines play very important role in the health system for humans as well as animals. In therapy, medicinal plants are used not only in prevailing ailments of the person but also as potential source to maintain good health. It is required to understand the specific constituents in the herbal medicines which are effective in the different therapies. There are many proofs indicating the importance of herbal plants used in the different conventional systems. The realization that the herbal medicines are safe and more reliable has increased the interest in these medicines1. It is observed that many medicinal plants are used to cure diseases like digestive problems, cardiovascular disorders, metabolic problems, liver disorders and the disorders of central nervous systems. The plant extract is predominantly used as a source of many western drugs2. There are many therapies. The medicinal plants are very important in some of the therapies traditionally. The standard of the medicine, the safety and the effectiveness is to be assured to make the safe use of the traditional herbal plants. Phytochemicals are very important for the protection of plants as well as protection of human beings from various diseases3.

At the most 5% of the 300,000 species of the plants worldwide have been studied scientifically for their medicinal use. It is noticed by the researchers that the developing countries depend on the herbal plants to cure the diseases particularly in the region where there is the lack of hospitals4. Caesalpinia bonducella is classified under the family of Caesalpiniaeae. It is also known as C. bonducella Flem and C. crista Linn. Commonly it is called Fever Nut, Bonduec Nut and Nicker Nut also5. Leaves, seeds, stem, bark, nuts and roots are useful as herbal medicines. It is found in hotter parts of India especially in west Bengal and the southern states of India. In conventional system of Indian medicine, Ayurveda, Caesalpinia bonducella (roxb.) is largely used for its antiperiodic, antipyretic, anti-inflammatory, anthelmintic, antimalarial and also for different diseases like skin diseases, hydrocele, leprosy, convulsions, orchitis, paralysis and analogical nervous complaints. It is also described to have antioxidant, antibacterial, antitumor and antidiabetic activities6. It is useful to prepare the lotion for the treatment of pain-type cellulitis in Chinese traditional medicines7.

Synonyms2,5

Hindi Name: Kantikaranja, Sagar Gota, Kantkarej.
Urdu: Akitmakit.
Telgu Name: Gaccakayai, Mulluthige.
Marathi Name: Gajaga.
Unani: Karanjwaa.
Kannada Name: Kiri gejjuga, Gajjiga, Gajikekayi.
Tamil Name: Kazarci, Kalareci paruppu, Kalareciyer, Kalichikai, Kalareci Koluntu, Kazharchikkaai and Kalachikai.

Geographical Distribution

The plant is found in the tropical and the subtropical parts of Asia8. It is distributed in Shrilanka, Bangladesh, Myanmar, China and Vietnam9. It is also found in Andaman, Nicobar Islands and in India especially in the tropical region2.

Useful parts

All the parts like leaves, seeds, roots and bark are useful as a medicine.
Ayurvedic Description

Guna – Tikshna (Sharp), Laghu (light) and Ruksha (dry)
Rasa – Kashya (astringent), Tikta (bitter)
Veerya – Ushna (hot)
Vipal – Katu
Dosh – tridosh

Action and uses

Vat shamak, rakt sodhak, anuloman, krimighna, kapha, sotha har, dipan, mutral, swashhar, jwaraghan, krimighna.

Morphology Characters

The plant is a large prickly shrub found all over India. The branches are finely grey downy armed with hooked and hard prickles. The leaves are bipinnate, nearly 30 – 60 cm in length with rachis armed having tough recurved, sharp thorns. There is a pair of reduced pinnae at the base of the leaf. There are seven pairs of such pinnae with 3 a pair of reduced pinnae at the base of the leaf. There are seven pairs of leaflets having 1-2 small prickles between them on the lower sides. The flowers grow in terminal racemes having long peduncles supraaxillary racemes close at the top, 15-25 cm long. The pedicles are little in the buds lengthen to 5 mm in flowers and 8 mm in fruits. The calyx is 6-8 mm in length. Petals are 10-12 mm long and yellow in colour. The fruits are pods with prickles, short stalked, 5-7.5 cm long having 1-2 seeds. The seeds are globular, greenish to ash grey in color and shiny. The seed surface is smooth. Seed kernals are yellowish white in colour. The seed skin is thick and hard, so it requires several months to years for its germination.

TRADITIONAL AND MODERN USES

Herbal plants play important role in illness as well as in maintaining health. For thousands of years, it has been enhancing the quality of human life. In latest years, phytochemicals have been largely used as source of medicines. Caesalpinia bonducella is a medicinal plant. It belongs to the family Caesalpiniaceae. It is observed in India as well as in tropical countries. It is widely used in the Indian traditional medicines, Ayurveda. It has medicinal properties like anti-diabetic, anti-asthmatic, anti-oxidant, anti-inflammatory, anti-filarial, anti-bacterial, anxiolytic activity and anti-tumor. The plant C. bonducella is used to cure skin diseases, paralysis, leprosy, malaria, infectious diseases, rheumatism, inflammatory, pyretic, helminthiasis diabetes and estrogenic disorders.

Traditionally the leaves of C. bonducella are used for the treatment of inflammation, tumor and liver disorder. In folk core medicines, it is useful in the treatment of paralysis and seed oil of C. bonducella possesses anticonvulsant property. It is reported that it functions as anti-asthmatic, anti-filarial, anti-oxidant, immunomodulatory, anxiolytic, hypoglycemic activity, antiarrheoeal, analgesic, adaptogenic, anticonvulsant, antispasmodic, antifeedant, insecticidal and antiamaecic.

In India C. bonducella is used conventionally to treat diseases like leprosy, malaria, paralysis, convulsions, hydrocele and other diseases of nervous systems. The powder of the leaves has the property to treat leukorrhoea and manorrhagia.

PHYTOCHEMICAL INVESTIGATION

Caesalpinia bonducella extract was subjected to various phytochemical tests, viz., saponins, amino acids, proteins, glycosides, cardiac glycosides, alkaloids, carbohydrates and flavonoids. \(\alpha\)-Tocopherol was the main tocopherol followed by \(\gamma\) and \(\delta\)-tocopherol in seed kernels. The main sterols were \(\beta\)-sitosterol, campesterol and stigma sterol. Also it was observed that, the kernel oil contains a high level of linoleic acid.

The phytochemical screening of seed of C. bonducella shows the existence of different bioactive compounds like sterols, oils, alkaloids, saponins, flavonoids, glycosides, cardiac glycosides, alkaloids, carbohydrates and resins.

Two new cassane diterpenes, entitled caesaldekarins F (I) and G (II). They were separated from Caesalpinia bonducella roots. The just recently reported caesaldekarins C was also isolated from the C. bonducella roots. The 2D NMR spectroscopy reported the structures of caesaldekarins F and G are as follows.

Four cassane furanoditerpenes, along with the known \(\alpha\)-caesalpin and caesalpin F, were isolated from C. bonducella roots. A novel rearranged cassane furanoditerpenes, caesalpinin (I), was isolated from C. bonducella roots. The 2D NMR spectroscopy reported the structures of rearranged cassane diterpenes.
Antidiabetic Activity

The extra glucose absorption and decreases the BUN levels on large scale. (300 mg/kg) it causes antihyperglycemic action by blocking the antihyperlipidemic activity. When the extract is taken orally for the of seed kernel of Indian tribal people use it for blood sugar control. The powder It is used as traditional medicine for treatment of diabetics.

PHARMACOLOGICAL ACTIVITIES

Enzymes are present in Protease, amylase, urease, catalase, peroxidase and oxidase sitosterol and a hydrocarbon heptacosane are also isolated from the seed kern. Palmitic, lignoceric, stearic, oleic and linoleic acids are isolated from the seeds. Methionine, isoleucine and threonine contained 25.3% protein. The C. bonducella seeds has m. p. 236.5-237.5.

The furanoditerpene caesalpin F (I) was isolated from C. bonducella. The structure of bonducellin was confirmed to be I from Caesalpinia bonducella. (R = H, R1 = Me)

The structure of bonducellin was confirmed to be I from C. bonducella. (R = H, R1 = Me)

Leaves of C. bonducella have potential as biosorbent for removal of Cu from waste water. Seeds of Caesalpinia bonducella contained 25.3% protein. The C. bonducella seeds lack in tryptophan and adequate quantity in leucine, lysine, methionine, isoleucine and threonine. The glycerides of palmitic, lignoceric, stearic, oleic and linoleic acids are isolated from the seed kernels of C. bonducella. Two phytosterols i.e. sitosterol and a hydrocarbon heptacosane are also isolated. Protease, amylase, urase, catalase, peroxidase and oxidase enzymes are present in C. bonducella seeds. Invertase and lipase are absent in it.

PHARMACOLOGICAL ACTIVITIES

Antidiabetic Activity

It is used as traditional medicine for treatment of diabetics. Indian tribal people use it for blood sugar control. The powder of seed kernel of this plant is used by the local people of Assam for the diabetes treatment. The seed possesses antidiabetic and antihyperlipidemic activity. When the extract is taken orally (300 mg/kg) it causes antihyperglycemic action by blocking the glucose absorption and decreases the BUN levels on large scale. The extracts lowered the LDL level and elevated cholesterol in diabetes induced hyperlipidemia.

Abortifacient Activity

In rural India, the seeds of C. bonducella are used traditionally in the fertility regulations in females. The leaves are utilized as an emmenagogue and to smooth out the delivery in pregnant women. The mixture of seed powder of C. bonducella and sesame oil brings about abortion. It means that the plant has abortifacient activity.

Antioxidant Activity

The chloroform extract of Caesalpinia bonducella shows antioxidant activity. The ethanolic extract of C. bonducella possesses natural antioxidant activity. The ethanol and methanol leaves extract of Caesalpinia bonduc indicated free radical scavenging activity i.e. antioxidant activity against DPPH (1,1-Diphenyl-2, Picryl- Hydrazyl). The C. bonducella contains flavanoids and phenolic compounds and the antioxidant activity of it may be due to them. Caesalpinia bonduc (L) Roxb seed contains noticeable amounts of polyphenolic substances that posse’s powerful antioxidant activity.

Analgesic and Anti-Inflammatory Activities

The activities were studied by hot plate method and acetic – induced writhing response to albino mice and different doses of ethanolic extracts were given to them. The consequences observed confirm that C. bonducella has analgesic and anti-inflammatory activities. It may be due to the presence of phenols, tannins, oils, glycosides, saponins and flavonoids. It was observed that the action was dependent on proportion of doses. The seed oil of C. bonducella is good source for analgesic and anti-inflammatory agent.

Antifilarial activity

The extract of seed kernel of C. bonducella indicated macrofilaricidal, microfilaricidal, and female-sterilizing effectiveness against L. sigmodontis. It showed microfilaricidal and female-sterilizing effectiveness against B. malayi in animal models. It has proved that the plant has the potentiality of new Antifilarial drug.

Anticonvulsive Activity

Traditionally C. bonducella seed oil plays very important role in treating convulsions. The petroleum ether extract of seed kernels of C. bonducella was analyzed for its anticonvulsant effect in different experimental animal models. To assess anticonvulsant activity, MES (maximal electro shock), PTZ (pentylenetetrazole), picrotoxin and strychnine -induced convulsions models were used. Diazepam was applied as a standard reference for all models. But in MES phenytoin was utilized as a standard reference. Medium and high doses of petroleum ether extract of C. bonducella (600 and 800mg/kg) indicated noticeable anticonvulsant activity. It may be due the presence of proteins, saponins, carbohydrates, homoiso flavone and sterols.

Antibacterial Activity

The methanol extracts and chloroform, ethyl acetate and pet. ether fractions of the C. bonducella leaves with different concentrations (300, 500, and 800 μg/disc) against four gram-positive and five gram-negative bacteria are assessed. It was noticed that the 800 μg/disc concentration shows better activity against all bacteria. Only chloroform extract with all...
concentrations exhibited better antibacterial activity against all bacteria.

**Antidiarrhoeal Activity**

As traditionally the use of this plant is made to treat diarrhea, its antidiarrhoeal activity is also supported by the methanol extract of *C. bonducella* leaves.

**Antimalarial Activity**

Cold ethanol, aqueous and hot ethanol extracts of seeds of *Caesalpinia bonducella* showed 56%, 65% and 76% growth inhibition of *P. falciparum* respectively. It supports antimalarial activity of *C. bonducella*.

**Antipyretic Activity**

The seed oil of *C. bonducella* is good source for antipyretic agent.

**Antifungal Activity**

The aqueous and ethyl acetate extracts of *C. bonducella* seeds show high to moderate antifungal activity against *Alternaria solani, Fusarium oxysporum, Candida albicans* and *Aspergillus niger*. It indicates *C. bonducella* possesses a potential to control important fungal pathogens. It may be due to the presence of several bioactive molecules that include oils, saponins, sterols, glycosides, tannins, alkaloids, phenols, resins and flavonoids in seeds of *C. bonducella*.

**Antispermatogenic Activity**

The treatment of aqueous seed extract of *C. bonducella* decreases sperm density in male albino rat. It indicates antispermatogenic activity of *C. bonducella*. Seeds may be secure and effective contraceptive.

**Antitumor Activity**

The methanol extract of *C. bonducella* leaves was assessed for the antitumor activity in Ehrlich ascites carcinoma (EAC)-bearing Swiss albino mice. It caused noticeable reduction in the volume of tumor, packed cell volume and viable cell count and it extended the life of EAC-tumor affected mice. It is observed that MECB plays very important role antioxidant and antitumor activity in EAC-tumor affected mice.

In the stem bark of *C. bonducella*, the quantities of phenolics and flavonoids are abundant which is responsible for its anti-inflammatory anticancer activity.

**Anti ulcer Activity**

The aqueous extract of *C. bonducella* played very important role in curing ulcer and show antisecretory effect. There is scope to use this plant to treat gastric disorders. The extract also noticeably decreased the gastric volume, total and free acidity, and raised the pH of the gastric fluid. The existence of saponins, alkaloids, triterpenes, flavonoids, steroidal and tannins was detected in the aqueous extract of CBD and it was found that flavonoids possessed anti ulcer activity. The methanolic extract of *C. bonducella* (Linn.) Flem. leaves have considerable anti-ulcer activity.

**Antipsoriatic Activity**

Traditionally *Caesalpinia bonducella* leaves are used to treat psoriasis in Malabar region.

**Immunomodulatory Activity**

The assessment of immunomodulatory potential of ethanolic extract of seed of *C. bonducella* caused noticeable increase in percent neutrophil adhesion to nylon fibers. There was also a dose dependent increase in antibody titer values. Myelosuppression in cyclophosphamide drug treated rats was prevented by the extract. *C. bonducella* contain immunomodulatory activity and it can be used to prevent autoimmune ailments.

**Anticataract Activity**

The ethanolic extract of seed kernels of *Caesalpinia bonducella* (L.) Fleming has antitumor and antioxidant activities, which might be useful to prevent or slowing the progression of cataract. The extract reduced opacity and tissue malondedehyde (MDA) level and raised catalase and superoxide dismutase (SOD) activities. There was increase in water soluble protein levels and total proteins.

**Anthelmintic Activity**

Helminth is gastrointestinal disease caused by *Pheretima posthuma, Ascardia galli, Perionyx excavates* and *Amplistoma caninum*. The parasites have become more resistant to commercial anthelmintic. Besides the scarcity and high cost of medicines led to the need of other methods to cure it. When Methanol, ethanol, hexane and aqueous extracts from leaves of *C. bonducella* were studied, it caused paralysis and death of parasites in different duration depending on doses. It was observed that it possessed good anthelmintic activity against the worms.

**Anticancer Activity**

It has been shown by in vitro anticancer assay that the petroleum ether fractions of ethanolic extract of *C. bonducella* seeds possess anticancer activity. It is capable of killing Ehrlich Ascites Carcinoma (EAC) cell lines by way of induced apoptosis. 78.4% growth inhibition against human breast cancer cells lines (MCF-7) was indicated by the methanol extract of *Caesalpinia bonducella* (L.) Roxb. seed. *Caesalpinia bonducella* possess Phenolics and flavonoids in noticeable amount it may cause the anticancer properties.

**CONCLUSION**

*Caesalpinia bonducella* is widely distributed and easily available plant throughout the India. It has various pharmacological properties. It is very important plant from medicinal point of view as it contains various phytochemicals. Still there is scope for further research.

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