



Review Article

PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW OF *CAESALPINIA BONDUCELLA*

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ABSTRACT

Caesalpinia bonducella is classified under the family of Caesalpiniaceae. It is also known as *C. bonducella* 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, alkaloids, saponins, phenols, glycosides, tannins, amino acids, proteins, cardiac glycosides, alkaloids, terpenoids, carbohydrates, flavanoids and resins.

Keywords: anti-inflammatory, *Caesalpinia bonducella*, anthelmintic, cardiac glycosides, flavanoids 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 Caesalpiniaceae. It is also known as *C. bonducella* Flem and *C. crista* Linn. Commonly it is called Fever Nut, Bonduc 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.

Synonyms^{2,5}

English: Nicker Seed, Bonduc Nut, Fever Nut, Nicker Nut.

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, Kalarcip paruppu, Kalarciver, Kalichikai, Kalarcik Koluntu, Kazharchikkaai and Kalachikai.

Sanskrit Name: Prakiriya, Vitapakaranja, Kakachika, Varini, Kantakikaranja, Tirini, Valli, Kantakini, Tinagachhika, karanja, Putikaranjah, Kuberaksah, Prakirnah, Kuberaakshi, Putikah, Lataakaranja, Krakachika and Karanjin.

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 Description¹⁰**Guna** – Tikshna (Sharp), Laghu (light) and Ruksha (dry)**Rasa** – Kashya (astringent), Tikta (bitter)**Veerya** – Ushna (hot)**Vipak** – Katu**Dosha** – tridosha**Action and uses**

Vat shamak, rakt sodhak, anuloman, krimighna, kapha, sotha har, dipan, mutral, swashhar, jwaraghan, krimighan¹.

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 3-8 pairs of leaflets having 1-2 small prickles between them on the lower sides. The flowers generate 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 or 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 germination¹¹.

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* (roxb.) is a medicinal plant. It belongs to the family Caesalpinaceae. It is observed in India as well as

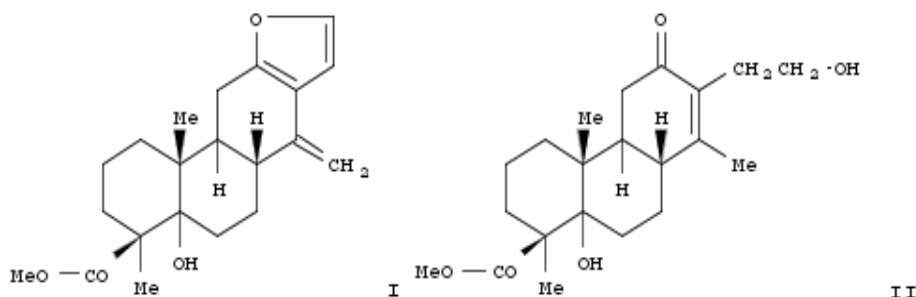
in tropical countries. It is widely used in the Indian traditional medicines, Ayurveda. It has medicinal properties like antidiabetic, anti-asthmatic, anti-oxidant, anti-inflammatory, anti-filarial, anti-bacterial, anxiolytic activity and anti-tumor. The plant *C. bonducella* is used to cure skin diseases, paralysis, leprosy, malaria, infectious diseases, rheumatism, inflammatory, pyretic, helminthiasis diabetes and estrogenic disorders¹². Traditionally the leaves of *C. bonducella* are used for the treatment on inflammation, tumor and liver disorder⁹. In folk core medicines, it is useful in the treatment of paralysis and seed oil of *C. bonducella* possesses anticonvulsant property⁶. It is reported that it functions as anti-asthmatic, anti-filarial, anti-oxidant, immunomodulatory, anxiolytic, hypoglycemic activity, antiarrhoeal, analgesic, adaptogenic, anticonvulsant, antispasmodic, antifeedant, insecticidal and antiamoebic⁸.

In India *C. bonducella* is used conventionally to treat diseases like leprosy, malaria, paralysis, convulsions, hydrocele and other diseases of nervous systems⁶. The powder of the leaves has the property to treat leucorrhoea and manorrhagia¹³.

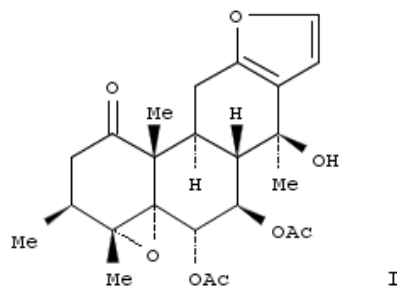
PHYTOCHEMICAL INVESTIGATION

Caesalpinia bonducella extract was subjected to various phytochemical tests, viz., saponins, amino acids, proteins, glycosides, cardiac glycosides, alkaloids, carbohydrates and flavanoids¹⁴. α -Tocopherol was the main tocopherol followed by γ - and δ - tocopherol in seed kernals. The main sterols were β -sitosterol, campesterol and stigma sterol. Also it was observed that, the kernel oil contains a high level of linoleic acid¹⁵. The Phytochemical screening of seed of *C. bonducella* shows the existence of different bioactive compounds like sterols, oils, alkaloids, saponins, phenols, glycosides, tannins and resins¹⁶.

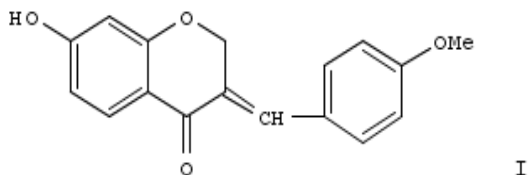
Two new cassane diterpenes, entitled caesaldekarins F (I) and G (II). They were separated from *Caesalpinia bonducella* roots. The just recently reported caesaldekarins C was also isolated from the *C. bonducella* roots. The 2D NMR spectroscopy reported the structures of caesaldekarins F and G are as follows¹⁷.



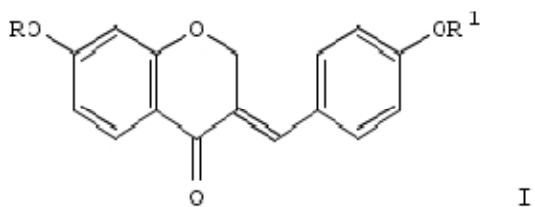
Four cassane furanoditerpenes, along with the known α -caesalpin and caesalpin F, were isolated from *C. bonducella* roots¹⁸. A novel rearranged cassane furanoditerpenes, caesalpinin (I), was isolated from *C. bonducella* roots. The 2D NMR spectroscopy reported the structures of rearranged cassane diterpenes¹⁹.



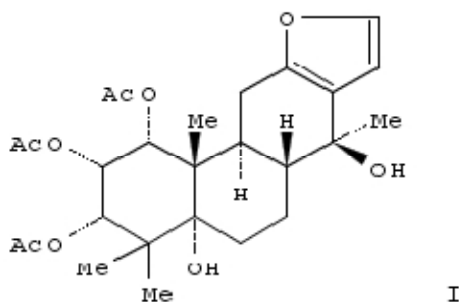
Until now unreported homoisoflavone, called bonducellin (I) was isolated from *Caesalpinia bonducella*. The structure was drawn on the basis of UV, IR, ¹H-NMR, and mass spectral data²⁰.



The structure of bonducellin was confirmed to be I from *C. bonducella*²¹. (R = H, R1 = Me)



The furanoditerpene caesalpin F (I) was isolated from *C. bonducella* seeds has m. p. 236.5-237.5²².



Leaves of *C. bonducella* have potential as biosorbent for removal of Cu²⁺ from waste water²³. Seeds of *Caesalpinia bonducella* contained 25.3% protein. The *C. bonducella* seeds lack in tryptophan and adequate quantity in leucine, lysine, methionine, isoleucine and threonine²⁴. 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 isolated²⁵. Protease, amylase, urease, catalase, peroxidase and oxidase enzymes are present in *C. bonducella* seeds. Invertase and lipase are absent in it²⁶.

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^{11,27}.

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 activity²⁸.

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 possess powerful antioxidant activity²⁹.

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^{9,30}.

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 drug³¹.

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 to the presence of proteins, saponins, carbohydrates, homoisoflavone and sterols⁶.

Antibacterial Activity

The methanol extracts and chloroform, ethyl acetate and petroleum 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 bacteria⁸.

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* leaves⁸.

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*³².

Antipyretic Activity

The seed oil of *C. bonducella* is good source for antipyretic agent³⁰.

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 flavonoides in seeds of *C. bonducella*¹⁶.

Antispermatic Activity

The treatment of aqueous seed extract of *C. bonducella* decreases sperm density in male albino rat. It indicates antispermatic activity of *C. bonducella*. Seeds may be secure and effective contraceptive³³.

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- affected mice.

In the stem bark of *C. bonducella*, the quantities of phenolics and flavonoides are abundant which is responsible for its anti-inflammatory anticancer activity³⁴.

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, flavonoides, steroids and tannins was detected in the aqueous extract of CBD and it was found that flavonoides possessed anti ulcer activity. The methanolic extract of *C. bonducella* (Linn.) Flem. leaves have considerable anti-ulcer activity³⁵.

Antipsoriatic Activity

Traditionally *Caesalpinia bonducella* leaves are used to treat psoriasis in Malabar region³⁶.

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 dependant 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 ailments³⁷.

Anticataract Activity

The ethanolic extract of seed kernals of *Caesalpinia bonducella*(L) Fleming has anticataract and antioxidant activities, which might be useful to prevent or slowing the progress of cataract. The extract reduced opacity and tissue malondialdehyde (MDA) level and raised catalase and superoxide dismutase (SOD) activities. There was increase in water soluble protein levels and total proteins³⁸.

Anthelmintic Activity

Helminth is gastrointestinal disease caused by *Pheretima posthuma*, *Ascaridia galli*, *Perionyx excavates* and *Amplostoma 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 worms³⁹.

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 flavonoides in noticeable amount it may cause the anticancer properties⁴⁰.

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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