

Review Article

“CANNONBALL TREE”: THE ALCHEMIST PLANT

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ABSTRACT

Couroupita guianensis Aublet (Family: Lecythidaceae) commonly known as Naglingam or a Cannonball tree, found throughout India in plains. The flowers are used to cure cold, intestinal gas formation and stomachache (Wealth of India). It is also called as “Cannonball tree” or “Sal tree” or “Ayauma tree”. The tree has an enormous medicinal values since most of the parts like leaves, flower, fruit and stem are used as medicine to cure various diseases. This plant is very important in traditional veterinary medicine because it is used commercial since a very long time ago. During the last few decades it has been observed that there are numerous reports on anti-inflammatory activity, anti-ulcer activity and anti-cancer activity of this plant. It is enriched with a number of compounds such as oils, keto-steroids, glycosides, couroupinine, indirubin, isatin and phenolic substances. The extract of various parts of *Couroupita guianensis* showed significant pharmacological activities so it is necessary to perform further investigation to isolate such pharmacological active compounds which can be used in production of novel drugs for various diseases. Future research using its part to ascertain its activity in various illnesses will provide an attractive niche to scientists.

Keywords: *Couroupita guianensis*, anti-cancer, pharmacological activity, phytochemical constituents, antidiabetic.

INTRODUCTION

Medicinal plants have been of age long remedies for human diseases because they contain components of therapeutic value.[1] *Couroupita guianensis* Aubl. (family: Lecythidaceae), commonly known as cannonball tree, grown in Indian gardens as an ornamental tree for its beautiful flowers. It is also known as Nagalingam in Tamil and Kailaspati in Hindi.[2] Almost all the parts of the plant, namely leaves, flowers, fruits, roots, stem and seeds are known to have various medicinal properties. The trees are grown extensively in Shiva temples in South India. Hindus revere it as a sacred tree because the staminal sheath resembles the hood of the Naga, a sacred snake, protecting a Shiva Lingam, represented by reduced stigma. Hence, the name “Naga Linga” tree. The “Cannonball Tree” is so called because of its brown cannon-ball-like fruits. The majority of these trees outside their natural environment have been planted as a botanical curiosity, as they grow very large with distinctive flowers. The genus *Couroupita* represents more than 30 recognized species throughout the world. In French it is known as Calabasse Colin. It is native to South India and Malaysia. The Puduchery Government has announced cannonball flower (Nagalingam flower) as the State Flower.[3]

The fruit contains small seeds in a white, unpleasant smelling jelly, which are exposed when the upper half of the fruit goes off like a cover. The hard shells are used to make containers and utensils. Cannonball flowers are considered of special significance in Buddhist culture in Sri Lanka. The long dangling fruity branches give the tree an unkempt appearance. *Couroupita guianensis* is a large deciduous evergreen tree growing to a height of 20 meters. Leaves are alternate, oblong-ovate, up to 20 cm long, entire to slightly serrate and hairy on the veins beneath. Inflorescence is racemose, arising from the trunk and other large branches. It flowers in racemes which are cauliflorous. The amazingly complex, yellow, reddish and pink flowers of the cannonball tree are heavenly scented - a cross between a fine expensive perfume and a wonderful flower scent. These are 3" to 5" waxy, pink and dark-red flowers growing directly on the bark of the trunk. The tree bears large globose woody fruits, directly on the trunk and main branches. They look like big rusty cannonballs hanging in clusters, like balls on a string. Fruits are edible and are occasionally eaten, but the smell of the white flesh discourages most people from trying them. This plant has been used widely in traditional medicine and grown in Indian gardens as an ornamental tree. It is a gigantic tree with deeper roots holding out delicate flowers for the world to see.[4]

COMMON NAME

It is commonly known as Naglingam or a Cannonball tree, found throughout India in plains. It is also called as “Cannonball tree” or “Sal tree” or “Ayauma tree” or “Coco de mono (Span.)”. [5] Other common names include *macacarecuia* (Portuguese), *coco sachapura* (Colombia, Panama), *bala de cañón* (Costa Rica, Panama), *kanonskogelboom* (Dutch), *arbre à boulet de canon* (French), *kouroupitoumou* (French Guiana), *nagkeshar* (Bengali), *Nagalingam* or *Lingam* (Tamil), *Nagamalli* (Telugu), *sala* (Indonesia), *granadillo de las huacas* (Panama), *ayahuma* (Peru), and *boskalebas* (Suriname) called also Naaga danthee in Malayalam.



Figure 1: Photograph of *Couroupita guianensis*.

CHEMICAL CONSTITUENTS

It is very rich with medicinal values; almost all part of the tree contains API. Flowers yield an aliphatic hydrocarbon, stigmaterol, alkaloids, phenolics and flavonoids.[6, 7] It contains active principles isatin and indirubin which are vital to its antimicrobial activity. Extraction of the dried fruits from the cannonball tree, *Couroupita guianensis* Aubl., yielded 6,12-dihydro-6, 12-dioxindolo[2,1-*b*]quinazoline (tryptanthrin), **1a** as well as indigo (**7**) indirubin (**8a**) and isatin. Compound **1a** could readily be synthesized by condensation of isatin with isatoic anhydride (**6**) in pyridine.[8] Some studies have proved the presence of α -amirin, β -amirin, β -sitosterol, tannins[8], ketosteroids and terpenoids, alkaloids, carbohydrates, proteins.[7] Among the flowers, it completely was gettable to recognize eugenol, volatile oil and (E, E)-

farnesol whereas triterpenoid esters of fatty acids as β -amirin palmitate were categorized among the leaves of *Couroupita guianensis* and dyes like indigo and indirubin.[9] Associate in nursing compound stigmaterol and campesterol were isolated from fruit of *Couroupita guianensis*. [10] one also isolated linoleic acid, nerol, tryptanthrin etc., from flowers, seeds, fruits, and leaves of *Couroupita guianensis*. The tree is also rich in providing anthocyanin, flavanoids, volatile constituents like eugenol and farsenol. The stem extracts of this plant is known to contain

flavonoids, tannins, steroids, saponins, glycosides, amino acids, phenols, anthraquinones and triterpenoids.[11]

PHARMACOLOGICAL UTILITY

Herbal and natural products of folk medicines have been used for centuries in every culture throughout the world. The infusion of *C. guianensis* flowers had been used to treat cold, intestinal gas formation, stomachache[12], barks used to treat hypertension, tumours, pain and inflammatory process.[13, 14] The fresh fruit pulp is used in preparation of cooling medicinal drink and various parts are useful in skin disease. This plant is very important in traditional veterinary medicine because it is used commercial since a very long time ago. Methanolic extract of the plant parts exhibited antimicrobial, antifungal, antiseptic[15, 16], antidepressant activities[17] whereas petroleum ether and chloroform extract showed antimalarial, antihelmintic[18], anticancer activity[19] and immune modulatory activity.[20] Leaves are widely used as an analgesic medicine by the rural population worldwide.[21] The trees are used to cure colds and stomach aches. Juice made from the leaves is used to cure skin diseases, and shamans of South America have even used tree parts for treating malaria. Traditionally, the leaves of this plant have been used in the treatment of skin diseases[22], while the flowers are used to cure cold, intestinal gas formation and stomachache. The fruit pulp can disinfect wounds and young leaves ease toothache.[23]

Cancer treatment

The flowers of *Couroupita guianensis* consists of compound isatin. The derivatives of this compound is known to have cytotoxicity against human carcinoma cell lines. This compound has a potential to be used as a chemotherapeutic agent against cancer. Isatin started the apoptotic process with fragmentation of DNA. Cleavage of DNA at the inter nucleosomal linker sites yielding DNA fragments is regarded as a biochemical hallmark of apoptosis.[4, 20]

Anti fungal activity

The activity of plant extracts on bacteria and fungi has been studied by a very large number of researches in different parts of the world. As a result, antifungal therapy is playing a greater role in health care and the screening of the traditional plants in search of novel antifungals. Due to the increasing development of drug resistance in human pathogens as well as the appearance of undesirable effects of certain antimicrobial agents, there is a need to search for new antifungal agent without toxicity and side effects. In the present study, the antifungal activities of hexane, ethyl acetate and chloroform extracts of 45 medicinal plants were investigated against dermatophytes and opportunistic pathogens. Most of the extracts inhibited more than four fungal strains, the ethyl acetate extracts inhibited large number of fungi.[4, 15, 16]

Antiulcer activity

The anti ulcer activity in ethanolic extract of *Couroupita guianensis* at a dose of 150 and 300 mg/kg produced significant inhibition of the gastric lesions induced by pylorus ligation induced ulcer and ethanol induced gastric ulcer.[24]

Anti microbial activity

The methanol and aqueous extracts of the *Couroupita guianensis* leaf were screened against six human pathogenic bacteria and four fungal pathogens to check antibacterial and antifungal activities by well diffusion method which showed valuable zone of inhibition. Methanol extract was better than the aqueous extract against bacteria as well as fungal pathogens. The maximum activity(31mm) was recorded from 200 mg of methanol extract of *Couroupita guianensis* against *Salmonella typhi* followed by 29 mm against *E.Coli* and minimum against *Streptococcus aureus* at 50 mg level whereas the aqueous extract showed the maximum activity (30 mm) was recorded from 200mg of leaf extract against *E.Coli* and minimum by 50 mg of extract against the above

bacteria. *Leuconostac lactis*, *Pseudomonas aeruginosa* and *Streptococcus pyogenes* did not showed any activity against both the extracts.[15, 16, 24]

Antioxidant

The alcoholic extract of *Couroupita guianensis* significantly stimulated the wound concentration this is due to the presence of stigmaterol and flavonoids in the extract. The results indicated that *Couroupita guianensis* accelerates the wound healing process by decreasing the surface area of the wound and increasing the tensile strength. The antioxidant activities of methanolic extracts of flower and fruit of young and matured stages were investigated spectrophotometrically against DPPH, ABTS, H₂O₂, NO, superoxide, hydroxyl radical and lipid per oxidation, along with ferric reducing power, metal chelating and β -carotene bleaching assay. Total phenols, flavonoids, ortho-dihydric phenols and anthocyanin were also determined. The methanolic extract obtained from young fruit was found to possess higher level of phenolic content, flavonoids as well as ortho-dihydric phenol content. The young stages were observed with highly potential free radical scavenging activity in comparison to that of matured one. The results demonstrated that the maturation process had profound impact on the antioxidant activity and polyphenol content of *C. guianensis* flower as well as fruit; also the young stages are suggested as the best harvest stage for medicinal purposes. A positive correlation was observed between polyphenolic contents and the antioxidant activity of the methanolic extracts.[25]

Anthelmintic activity

Rajamanickam and colleagues have reported the anthelmintic activity in chloroform, acetone and ethanolic flower extracts of *Couroupita guianensis* in *Pheretima posthuma*. The activity was assessed by worm motility assay which involved determination of time of paralysis and death of worms. The alcoholic extract was found to be more effective than the chloroform and acetone extract and the activity was comparable with the standard drug Piperazine citrate.[26]

Antinociceptive activity

Mariana and colleagues reported the antinociceptive effects of crude ethanol extract (CEE) and its fractions of *Couroupita guianensis* leaves in three analgesic models (acetic acid-induced contortions, tail flick, and hot plate). All fractions showed antinociceptive activity in the tail flick model, being the hexane and ethyl acetate the most potent and long acting fractions. In the hot plate method the highest effect observed was at the dose of 100 mg/kg from all fractions. Administration of naloxone inhibited the antinociceptive effect of fractions. Pre-treatment of mice with atropine reduced the antinociceptive activity of CEE and its fractions, the exception being the dichloromethane fraction. Mecamylamine didn't inhibit the effect of dichloromethane fraction. Naloxone reduced the anti-hyperalgesic effect of all fractions, but the most prominent effect was observed in the antinociceptive activity caused by CEE and butanol fraction.[27]

Immunomodulatory activity

Pradhan and colleagues have reported the immunomodulatory activity in methanol extract of *Couroupita guianensis*. The results of methanolic extract showed the significant dose related increase in the hyper sensitivity reaction in 100 and 200mg/kg. The successive methanol extract was found to stimulate cell mediated and anti body immune response in rats.[20]

Analgesic activity

Analgesic activity was evaluated using tail flick method and anti inflammatory activity was screened by measuring the reduction in carrageenan induced hind paw oedema. The potency of various extracts of flower and bark were compared with i) paracetamol (200 mg/kg) for analgesic activity. The peak analgesic effect of flower was seen after 1 hour while bark extracts showed peak effect after 2 hours. Maximum reduction in inflammation by the extracts was observed after 3 hours. They finally concluded that the plant is almost equipotent to paracetamol in its analgesic activity.[28]

Anti diabetic activity

Homeopathic medicine has accepted the fact that the leaf extracts of the plant under study has shown positive results in inhibiting diabetics. The

fresh leaves of *Couroupita guianensis* were tested for its antidiabetic activity against four bacterial strains, *Escherichia coli*, *Pseudomonas putida*, *Staphylococcus aureus* and *Klebsiella pneumoniae* by agar well diffusion method and screened for Phytochemicals. The results proved that the leaf extracts showed positive results for anti diabetic activity.[29]

Food

Fruits are edible, but only occasionally eaten because of the unpleasant odor of the white flesh.[4]

Antidiarrheal Action

Antidiarrheal action of *Couroupita guianensis* leaves on Castrol oil evoked diarrhea in unusual person rats was disclosed by Elumalai and colleagues. It shows good antidiarrheal activity.[30]

Ovicidal Activity

Baskar and co-workers showed ovicidal activity in hexane, chloroform and ester extracts of *Couroupita guianensis* plant on the eggs of *Helicoverpa armigera*. [31]

Wound Healing Activity of *Couroupita guianensis*

Umachigi and colleagues showed wound healing activity in ethanolic extract of *Couroupita guianensis* whole plant (barks, leaves, flowers and fruits). Many parameters like incision wound, epithelization amount, scar area, enduringness and aminoalkanoic acid (hydroxyl proline) measurements beside wound contraction, were accustomed assess the impact of *Couroupita guianensis* on wound healing. The results indicated that *Couroupita guianensis* hurries the wound healing method by declining the expanse of the wound and increasing the enduringness.[23]

Antipyretic Activity of *Couroupita guianensis*

Antipyretic activity of flower and bark a part of *Couroupita guianensis* in chloroform, ethanol, water, ether, petroleum ether extracts was done by victimization yeast induces febrility methodology. This yeast induces febrility methodology suggesting that the antipyretic action of all the extracts was reflective; chloroform, ethanol, water extracts have vital onset of action on reduction of temperature (within 30 minutes) almost like that of paracetmol (30 minutes). On alternative hand petroleum ether and ether extract are showing somewhat late response[32].

Anxiolytic Impact of *Couroupita guianensis*

Vinod and colleagues showed anxiolytic impact in aqueous and methanolic extract of *Couroupita guianensis* flowers.[33] Elevated plus maze (EPM), light and dark (LD), and open field test (OFT) models were measured. From the results each the extracts (aqueous associate degreed methanolic) of *Couroupita guianensis* at a dose of 500 mg/kg showed an anxiolytic activity associated with vehicle management in LD, EPM and open field test in mice.

Antidepressant Activity of *Couroupita guianensis*

Wankhede and colleagues showed antidepressant activity in methanolic extract of *Couroupita guianensis* root. This study focused on measure of assorted parameters like tail suspension check (TST), forced swim check (FST) and antihypertensive antagonism in mice. Results of this study indicated that considerably decrease within the immobility time in TST and FST, almost like that of the imipramine (10 mg/kg). In antihypertensive antagonism exhibited deeply decline in period of hypersomnia & degree of ptosis in tested mice.[34]

Antifertility Activity Of *Couroupita Guianensis*

Benzene, ethyl alcohol and water extracts of bark and flowers of *C. guianensis* showed antifertility activity was studied for their impact on period of assorted stages of estrus cycle in female person rats and on the number implantation sites within the pregnant rats. The ethyl alcohol extract of *C. guianensis* bark and every one the extracts of its flower condensed the quantity of implantations. Supported the on top of criteria *Couroupita guianensis* extract shows protective activity in a very therapeutic vary.[21]

SIDE EFFECTS

Fruit may cause toxicity and can cause allergic reactions.[35]

COMMERCIAL USES

The hard shells of fruits are used to make containers and utensils. The infusion of *C. guianensis* flowers had been used to treat cold, intestinal gas formation, stomachache. The trees are grown extensively in Shiva temples in India. In Hindi it is called Shiv Kamal and also known as "Kailaspati". Fruits are edible, but only occasionally eaten because of the unpleasant odor of the white flesh. Fragrant flowers used to scent perfumes and cosmetics.[36]

CONCLUSION

The extensive literature survey revealed that *Couroupita guianensis* is important medicinal plant with diverse pharmacological spectrum. The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal property. Different active constituents such as steroids, glycosides, carbohydrates, couroupitone A, couroupitone B, isatin, triterpinoids, eugenol, linoleic acid, nerol, tryptanthrin linalool, phenolic resin substances and dyes are a unit to date according in *Couroupita guianensis*. In short in near future it seems to be attractive niche for the scientist and proves to be valuable for mankind.

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