

Unveiling The Therapeutic Potential of *Couroupita Guianensis*: An Overview of Its Phytochemistry And Pharmacological Activities.

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Abstract- *Couroupita guianensis* Aubl., commonly known as the Cannonball Tree, is a large deciduous tree from the family Lecythidaceae, celebrated for its rich medicinal and cultural significance. In India, it is known as Nagalingam in Tamil and Kailashpati in Hindi. Originally native to the tropical rainforests of Central and South America, the Cannonball Tree is now widely cultivated across India, Sri Lanka, and Southeast Asia. Almost every part of the plant including its flowers, leaves, bark, and fruit is used in traditional medicine to treat conditions such as wounds, inflammation, skin disorders, malaria, toothaches, and microbial infections. Scientific studies have shown that the plant contains a rich variety of bioactive compounds, including terpenoids, flavonoids, alkaloids, glycosides, tannins, phenolic compounds, and quinones. These constituents are responsible for several pharmacological effects, such as antioxidant, anti-inflammatory, antimicrobial, wound-healing, anticancer, and hepatoprotective activities. Some key compounds such as α -amyrin, β -amyrin, isatin, quercetin and couroupitine play a crucial role in these effects by reducing oxidative stress, suppressing inflammation, and triggering apoptosis in abnormal cells. Despite its long history of traditional use and promising pharmacological profile, *Couroupita guianensis* remains underexplored scientifically. This review aims to bring together existing research on its phytochemical composition, ethnomedicinal uses, and therapeutic potential, highlighting its promise as a valuable source for modern drug discovery and phytopharmaceutical development.

Keywords: *Couroupita guianensis*, ethnomedicine, phytochemicals, antioxidant, anti-inflammatory

I. INTRODUCTION

India has a wide range of plants and flora. Since ancient times, these natural resources have been utilized for a wide range of therapeutic and spiritual purposes. Traditionally, regional communities relied on the herbs and plants available in their immediate surroundings for medicinal needs. However, many of these plants remain without standardized

formulations, either because of limited scientific exploration or their abundance in nature has prevented commercialization. *Couroupita guianensis* or the cannonball tree, is a large tropical deciduous tree belonging to the Lecythidaceae family. It is indigenous to Central and South American rainforests, which stretch from northern Bolivia to Brazil and Costa Rica.[1] It grows up to 20-30 meters in height, and the leaves, up to 15 cm long, are simple with a serrate margin; the flowers are yellow, reddish and pink with a stunning fragrance.[2] In Tamil, this tree is known as Naglingam, and in Hindi, it is called Kailashpati. It is considered a sacred tree and is often found in South Indian Shiva temples. According to Hindu belief, the staminal sheath of its flower symbolizes less stigma and resembles the hood of the sacred snake Naga, which is believed to protect the Shivalingam. Because of this resemblance, the tree is called the Naglingam tree.[3]

Almost every part of the tree, including its flowers, leaves, bark, and fruit, is used in various traditional healing practices across South America, India, and Southeast Asia to treat a wide range of health conditions. [4,5] It is particularly common among tribes and rural dwellers, and it is widely used in traditional medicine. [2] The Native Amazonians used the infusions of bark, leaves and flower of this plant to treat hypertension, tumors and inflammatory processes. [6] The tree is rich in bioactive compounds such as terpenoids, flavonoids, quinones, glycosides, and alkaloids, all of which contribute to its strong pharmaceutical potential.[7] Beyond its medicinal uses, *Couroupita guianensis* also holds deep cultural and religious significance, particularly in Buddhism and Hinduism. In India and Sri Lanka, its flowers are often used in temple rituals and offerings, as they are believed to symbolize the cobra and Lord Shiva's lingam.[8] The cannonball tree is commonly mistaken for the sacred Sal tree (*Shorea robusta*) in Sri Lanka and India, although they are distinct species. This tree is very important to Buddhist traditions.[3] The blossoms on the tree are often found in Buddhist temples and have become part of religious stories, with the sections of the flower representing a stupa and the gods that people worship.[9] The affected skin of a dog with mange is treated

using the pulp of the cannonball tree fruit. It is believed that when the dog licks its skin, the remedy also provides internal healing benefits.[10]

Table 1: Taxonomical Classification of *Couroupita guianensis* Aubl

Kingdom	Plantae
Sub kingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Lecythidales
Family	Lecythidaceae
Genus	<i>Couroupita</i>
Species	<i>Couroupita guianensis</i> Aubl.

MORPHOLOGY:

The deciduous tree (*Couroupita guianensis*) grows up to 35 meters (110 feet) tall.[5] Its leaves are clustered at the ends of branches, typically measuring between 8 to 31 cm, though they can occasionally reach lengths of up to 57 cm. The leaves are simple, arranged alternately or spirally, with an entire margin, pinnate venation, and a leathery texture. [1,5] Its flowers are orange, scarlet and pink in colour, and form large bunches measuring up to 3m in length. Large, woody, spherical fruits with a diameter of 15 to 24 cm and up to 200 or 300 seeds each are produced by them.[11] Each flower has six fleshy, waxy petals that are yellow on the outside and crimson to orange on the inside, and can grow up to 6 cm in diameter. The floral structure consists of two sets of stamens—one forming a prominent, hood-shaped structure and the other forming a central ring. The blossoms emit a strong, pleasant fragrance, especially noticeable at night and in the early morning. [12,13] The flowers are traditionally used to relieve colds, reduce intestinal gas, and ease stomach aches.[14] The fruit and the flower grow from stalks that sprout from the trunk of the tree.[12] The fruits of the tree are large, round, and woody, resembling cannonballs, with diameters of up to 25 cm. These fruits have a hard shell that encloses seeds embedded in a white pulp, which turns blue upon exposure to air due to oxidation.[13]

COMMON NAMES:

Because of its wide distribution and long history of use, *Couroupita guianensis* is known by many regional names. These names reflect the plant's cultural importance and its diverse applications in various traditional healing systems.

The abundance of local names also highlights how valued and versatile this herb is as a medicinal plant. For generations, local communities have relied on *Couroupita guianensis* to treat a variety of health conditions, making it an essential part of their traditional medicine practices. Different vernacular names of *Couroupita guianensis* known throughout the country are listed in Table 2.

Table 2: Vernacular names of *Couroupita guianensis* [11,12]

Vernacular names	Language/ Region
<i>Nagalingam, nag-champa b</i>	Assamese/ Assam
<i>Kaman gola</i>	Bengali/ Bengal
<i>Kailas pati, shivalngi</i>	Gujarati/ Gujarat
<i>Lingada mara, nagalingam</i>	Kannada/ Karnataka
<i>Kailaspati</i>	Marathi/ Maharashtra
<i>Naaga danthee</i>	Malayalam/ Kerala
<i>Nagakesara, nageshwara</i>	Odia/ Orissa
<i>Naagalingam</i>	Tamil/ Tamil Nadu
<i>Mallikarjuna, naagamalli, nagalingam</i>	Telugu/ Andhra Pradesh, Telangana

ETHNOMEDICINAL USES:

In both South American and Indian traditional medicine, the plant's leaves are widely used. Because of its potent antibacterial, antiseptic, and wound-healing qualities, the leaf juice is applied topically to treat scabies, wounds, ulcers, and skin issues.[5] South American shamans have traditionally used parts of the tree to treat malaria, while its flowers are often used to relieve stomach-aches, intestinal gas, and colds.[6] Additionally, flower infusions are used as analgesics and for treating conditions such as gastritis, bleeding haemorrhoids, and inflammatory reactions. In some regions, flower extracts are also employed to treat malaria, scorpion stings, and in fertility-regulating therapies.[4] When applied topically, the bark can help relieve skin problems and reduce swelling. Its extracts are also valued for their ability to control excessive bleeding and inflammation and are sometimes used in treating bacterial and viral infections.[5,13] Young leaves are traditionally used to relieve toothaches, while the fruit pulp is applied to clean wounds. Additionally, the fresh fruit pulp is used to prepare cooling medicinal drinks and to help treat headaches.[6] In traditional medicine, fruit extracts known to have properties similar to certain common pharmaceutical drugs are used to treat toothaches, malaria, scorpion bites, and various microbial infections.[13]

Table 3: Ethnomedicinal Uses of *Couroupita guianensis*

Country	Plant part	Plant preparation	Ethnomedicinal uses	References
Bolivia, India	Leaves	Juice	Treat skin problems, wounds, ulcers and scabies	[5]
Costa Rica	Flower	Extract	Used to relieve stomach-aches, intestinal gas, and colds.	[6]
India	Flower	Infusion	Used for treating conditions such as gastritis, bleeding haemorrhoids, and inflammatory reactions.	[4]
India	Flower	Extract	Treat malaria, scorpion stings, and in fertility-regulating therapies.	[4]
Brazil	Bark	Extract	Controls excessive bleeding and inflammation and is used in treating bacterial and viral infections.	[5]
Uruguay	Fruit	Pulp	Used to prepare cooling medicinal drinks and to help treat headaches.	[6]
India	Fruit	Extract	Used to treat toothaches, malaria, scorpion bites, and various microbial infections.	[13]

PHARMACOLOGICAL ACTION OF *COUROUPITA GUIANENSIS*:

Anti-inflammatory Activity: The cannonball tree, *Couroupita guianensis*, traditional Amazonian medicine is used as a due to its anti-inflammatory properties. The bioactive compounds responsible for this effect include α -amyrin and β -amyrin (triterpenoids), along with flavonoids and phenolic compounds, are present in the leaves of *Couroupita guianensis*. [15] In a rat paw edema model, the leaf extract of *Couroupita guianensis*, which contains triterpenoids (α -amyrin, β -amyrin), flavonoids, and phenolics, decreased inflammation by preventing NF- κ B activation, lowering I κ B α phosphorylation, and reducing inflammatory mediators. This supports the plant's traditional use in wound healing and anti-inflammatory therapy. It also is responsible for inhibition of inflammatory mediators like prostaglandins. [15,16]

Anti-Microbial Activity: The plant *Couroupita guianensis* (Aubl.) has strong antimicrobial activity: its leaf extracts inhibit *Streptococcus mutans* and *Staphylococcus aureus* [17] its fruits' isatin-based compounds have broad antibacterial and antifungal effects [18]; and its leaves' NdO₃ nanoparticles have strong, biocompatible antimicrobial activity. [19]

Wound Healing: In keratinocyte cell cultures, it promoted wound healing and reepithelialization by activating ERK and AKT and upregulating MMP2, promoting tissue regeneration. [16] The leaf extract of *Couroupita guianensis* supports its traditional use as a safe natural treatment by promoting wound healing in animal models, including Wistar rats, by lowering inflammation and oxidative stress and increasing fibroblast proliferation, collagen synthesis, tissue regeneration, and epithelialization. [5,16]

Antioxidant Activity: *Couroupita guianensis* (Aubl.) exhibits strong antioxidant activity: its leaf and fruit extracts scavenge free radicals in vitro, and the floral essential oil also demonstrates potent radical-quenching effects. [20,21] In animal studies, methanol leaf extract administered to rats

improved antioxidant enzyme levels, reduced lipid peroxidation, and protected against oxidative tissue damage. [22] These findings support its traditional use in wound healing, tissue protection, and inflammation reduction. [20,21,22]

Anticancer Activity: *Couroupita guianensis* has anticancer properties in vitro. Using DNA fragmentation and FACS-confirmed pathways, isatin, which was extracted from its flowers, demonstrated potent cytotoxicity against the cells of human promyelocytic leukaemia (HL60) with a CC₅₀ of 2.94 μ g/mL and caused apoptosis. [23] Likewise, the bark decoction demonstrated notable cytotoxicity (IC₅₀ = 14.11 μ g/mL) in gastric adenocarcinoma (AGS) cells, induced G₁/S-phase arrest, and induced apoptosis through p53, p21, and caspase activation. [24]

Anti Helminthic Activity: -Extracts from the leaves of *Couroupita guianensis* show potent anthelmintic action against the earthworm model *Pheretima posthuma* (Indian Worm). [25] Both chloroform and aqueous extracts paralyzed and killed worms in a dose-dependent manner (100–200 mg/mL), much like albendazole (20 mg/mL). [10,25] Chloroform extract showed more potency than the water extract. Active phytochemicals like alkaloids, flavonoids, glycosides, terpenoids, and tannins are most likely what cause the action. [10]

Anti-Ulcer Activity: -*Couroupita guianensis* leaf ethanolic extract (EECG) showed strong antiulcer efficacy in Wistar rats using pyloric ligation and ethanol-induced ulcer models. At dosages of 150 and 300 mg/kg, EECG significantly reduced ulcer index, stomach acidity, and volume, showing up to 81% protection, which is comparable to ranitidine (20 mg/kg). Its flavonoids and glycosides, which enhance mucosal protection and reduce acid production, attest to its potent gastroprotective action. [14]

USAGE IN TRADITIONAL SYSTEM OF MEDICINE:

Couroupita guianensis which exists as an evergreen tree serves as a shamanic tool for Peruvian Amazonian curanderos, and as an ayurvedic medicine through various preparation methods including decoctions, infusions, and teas. The plant *Couroupita guianensis* from India exhibits antibacterial and anti-inflammatory, and antioxidant characteristics which scientists have proven through laboratory experiments. Research on Amazonian *Couroupita guianensis* remains limited but shows that the plant has pain relief effects together with anti-inflammatory properties and wound repair capabilities. The research on Indian *Couroupita guianensis* plants shows that they possess antibacterial and

anti-inflammatory, and antioxidant qualities through laboratory experiments and animal studies. Research about Amazonian *Couroupita guianensis* remains limited but scientists have discovered its pain relief capabilities along with its ability to reduce inflammation and support wound healing.[24]

Researchers have recently discovered that the bark decoction of *Couroupita guianensis*, a remedy traditionally used in Peruvian Amazonian medicine, contains a unique mix of natural compounds. This includes high levels of polyphenols, such as glycosides and special sulfate forms of catechins and ellagitannins—types of plant antioxidants. These findings are noteworthy because these particular substances have not previously been found in any other members of the Lecythidaceae plant family. Shamans across South America have long used parts of the tree to treat malaria. The fruit's pulp is known to disinfect wounds, while the young leaves are used to ease toothaches.[15]

PHYTOCHEMICAL COMPOSITION:

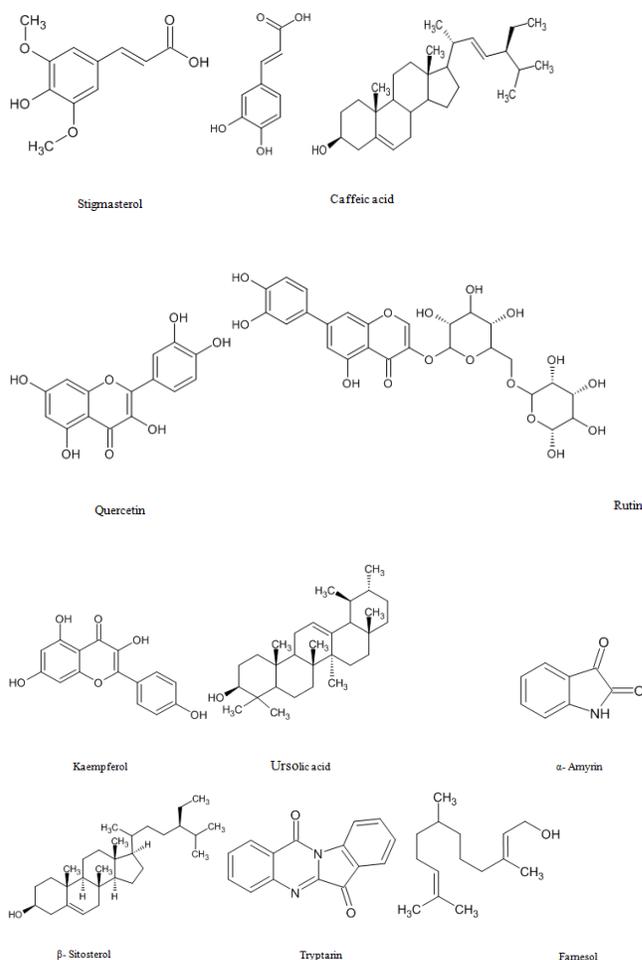
Phytochemical research plays a vital role in making sure that traditional medicines made from medicinal plants are reliable and effective by analyzing their chemical makeup. By identifying the active compounds and studying how they work in the body, scientists can validate traditional remedies, ensure consistency and safety for users, and even uncover new therapeutic uses for plant-based medicines.[26] This process helps bridge centuries-old knowledge with modern healthcare, providing confidence that herbal medicines deliver the intended health benefits.[19]

The leaf extracts of *Couroupita guianensis* contain flavonoids, tannins, terpenoids, and alkaloids, all of which contribute to various health benefits. These natural compounds are known for their antiviral, antifungal, antiprotozoal, antioxidant, and anti-inflammatory properties.[27] Furthermore, they help prevent bacterial growth and the formation of biofilms on surfaces by inhibiting cell growth and division.[26] This combination of properties makes these phytochemicals valuable for fighting infections and supporting overall health through multiple therapeutic actions.[19,27]

In case of fruit extract of *Couroupita guianensis*, various solvents can be used for extraction such as water, ethanol, methanol, acetone. The reason behind the use of various solvents is that the solubility of phytoconstituents in the given solvents.[27] The common phytoconstituents we get from fruit extracts are carbohydrates, proteins, tannins, phenolic compounds. Also, from aq. Extract we get alkaloids

and glycoside while from ethanolic and methanolic extract we get anthraquinones.[19]

PHYTOCHEMICAL STRUCTURES:



II. CONCLUSION

The Cannonball Tree (*Couroupita guianensis* Aubl.), a large deciduous tree in the Lecythidaceae family, is well-known for its many ethnomedicinal and pharmacological uses. This revered tree, known as Nagalingam in Tamil and Kailashpati in Hindi, is a rich source of bioactive compounds and has significant cultural significance in Buddhism and Hinduism. Originally from the tropical rainforests of Central and South America, it is currently grown extensively in Southeast Asia, India, and Sri Lanka. Traditional medicine uses nearly every part of the plant, including the flowers, leaves, bark, and fruit, to treat conditions like wounds, inflammation, skin conditions, toothaches, malaria, and microbial infections. Numerous medicinal components, such as terpenoids, flavonoids, alkaloids, glycosides, tannins,

phenolic compounds, and quinones, have been identified by phytochemical studies. These substances have potent pharmacological characteristics, including hepatoprotective, anti-inflammatory, antimicrobial, wound-healing, and anticancer effects. Important components such as isatin, quercetin, α -amyrin, β -amyrin, and couroupitine A support these bioactivities by regulating oxidative stress, inhibiting inflammatory mediators, and inducing apoptosis. There is still little scientific research on *C. guianensis*, despite its widespread traditional use and proven pharmacological potential. In order to highlight its value as a promising candidate for contemporary drug discovery and phytopharmaceutical development, this review attempts to compile the most recent information on its phytochemical diversity, ethnomedicinal applications, and therapeutic potential.

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