

# Couroupita guianensis Aubl. (Lecythidaceae): A Medicinal Plant: Ayurvedic and Modern View

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## Abstract:

The plant kingdom has long served the main resources base for the traditional medicines. Traditional medicine is used in prevention, diagnosis and elimination of physical, mental and social impairment. One important plant that is used in traditional medicine is *Couroupita guianensis* Aubl. is a tree belonging to the family Lecythidaceae. It is native to rainforest of Central and South America and it is cultivated in many other tropical areas throughout the world like India, Sri Lanka etc. because of its beautiful fragrance and large interesting fruit and is commonly known as Naglinga pushpam in Tamil. Various part of the tree have been reported to contain oils, keto-steroids, glycosides, couroupitine, indirubin, isatin and phenolic substances.

**Keynote:** Naglinga pushpam, anukta dravya, Samhita, Nighantu etc.

## Introduction:

*Couroupita guianensis* Aubl. is a large deciduous evergreen tree growing to a height of 20 meters. Leaves are alternate, oblong-obovate, upto 20 cm long, entire to slightly serrate and hairy on the veins beneath. Inflorescence is racemose, arising from the trunk and other large branches. Flowers are reddish with a yellow tinge on the outside, fragrant with stamens borne on an overarching androphore. Fruit is a large, reddish-brown globose, 15 to 24 cm with a woody capsule and each containing 200 to 300 seeds<sup>[1]</sup>

It is known that one of the active constituents of medicinal plant *Couroupita guianensis*, namely isatin, is known to exert cytotoxic activity against certain cancer cell lines, being a potential source of new chemotherapeutic agents. In a study performed using extracts of *Couroupita guianensis* against human polymyelocytic leukemia (HL60) cells, isatin showed antioxidant activity and was cytotoxic to HL60 cells due to induction of apoptosis a natural cell death. These results suggest that isatin can be further evaluated to be used as a prophylactic agent to prevent the free radical induced cancer and as a chemotherapeutic agent to kill the cancer cells.<sup>[2]</sup>

## Aims and Objectives:

### 1. Historical Review:

Determination of *Anukta dravya* (undocumented drug or unexplored drug or extra pharmacopoeial drug) has no directly classical guidelines are available. Therefore, compile the scattered references which explain the basic concepts for determination of *Anukta dravya* through classical Ayurvedic method.

**Timeline for introduction of new plants:**

1. **Vedic Kala:** Rigveda – 67; Yajurveda – 81; Atharvaveda – 289.
2. **Samhita Kala:** Charaka Samhita <500; Sushruta Samhita <550; Astanga Hridaya <600.
3. **Nigantu Kala:** 650-800 medicinal plants.
4. **Modern era:** 1000 plants; but only 300 are in trade.
  - **11<sup>th</sup> Century:** Chakradutta – 59
  - **15<sup>th</sup> Century:** Basavrajyayam – 14
  - **19<sup>th</sup> Century:** Shaligram Nighantu – 58; Arya Vaidya Sala – 120; RAV – 145.
  - **2000-2016:** Total 2780 drugs/650 new RAV; 60 – Dravyaguna Vigyan P.V. Sharma.

**Examples of new plant introduced:**

- **7<sup>th</sup>-8<sup>th</sup> Century** – Astanga Hridaya – *Kumari, Kesar*
- **9<sup>th</sup> Century** – Paryaya Ratnamala & Vrinda madhava – *Japa, Parasik yavani*
- **10<sup>th</sup>-12<sup>th</sup> Century** – Dhanwantari Nighantu – *Jayapala, Kupeelu, Ahiphena*
- **17<sup>th</sup> Century** – Shaligram Nighantu – *Eranda karkati*
- **18<sup>th</sup>-19<sup>th</sup> Century** – *Tailaparni, Parnabija*
- **20<sup>th</sup> Century** – *Sadapushpa*.

**1.1 Review from Vedas and Purans:****Vedic Period: (1500- 6000)**

Vedas are ancient literature of whole world. Among the four Vedas, *Atharva Veda* deals with certain rudiments of medicine. Ayurveda is considered as the “*Upaveda*” of *Atharvaveda*. The therapeutic in Ayurveda is based entirely on the herbal drugs.

In Vedas and Purans the drug *Kashipati, kailashpati, Nagalinga* is not mentioned namely. So the reference of this drug not found in this era.

**1.2 Samhita Period:**

*Samhita kala* is the period in which the drugs are classified into various *Ganas* according to their properties and actions. Beside this the mention of various drugs are found in various *yogas* for the treatments of diseases.

Charaka samhita – not mentioned by name

Sushruta samhita – not mentioned by name

Astanga samgraha – not mentioned by name

Astanga hridaya – not mentioned by name

Kashyap samhita – not mentioned by name

Bhela samhita – not mentioned by name

Harita samhita – not mentioned by name

Sharangdhar samhita – not mentioned by name

Madhava Nidan – not mentioned by name

Vangsenam samhita – not mentioned by name

Bhavaprakash samhita – not mentioned by name

Yoga Ratnakar – not mentioned by name

Regarding this drug following description not found in both *Brihatrayi* and *Laghutrayi*

### 1.3 Nighantu Period:

The era of *Nighantus* are very important for the aspect of systematic understanding the drugs. In “Samhita Period” majority of *granthakars* have mentioned many drugs as a “*Dravya*”.

1. Abhidhan manjari
2. Abhidhan ratnamala (12<sup>th</sup> to 13<sup>th</sup> century A.D.)
3. Chamatkar nighantu (10<sup>th</sup> century A.D.)
4. Laghu nighantu (18<sup>th</sup> century A.D.)
5. Shabda chandrica (11<sup>th</sup> century A.D.)
6. Shiv kosha (16<sup>th</sup> century A.D.)
7. Siddha mantra (13<sup>th</sup> century A.D.)
8. Siddhasar nighantu (9<sup>th</sup> century A.D.)
9. Saushruta nighantu (5<sup>th</sup> century A.D.)
10. Hridaya Deepak nighantu ( 13<sup>th</sup> century A.D.)
11. Astanga Nighantu (8<sup>th</sup> century A.D.)
12. Dhanvantari Nighantu (11<sup>th</sup> century A.D.)
13. Amar kosha (11<sup>th</sup> century A.D.)
14. Shodhala Nighantu (12<sup>th</sup> century A.D.)
15. Madanpala Nighantu (14<sup>th</sup> century A.D.)
16. Kaiyadeva Nighantu (1425 century A.D.)
17. Bhavaprakash Nighantu (16<sup>th</sup> century A.D.)
18. Raj Nighantu (14<sup>th</sup> century A.D.)
19. Rajavallabha Nighantu (18<sup>th</sup> century A.D.)
20. Shaligrama Nighantu (1896 century A.D.)
21. Nighantu shesh (12<sup>th</sup> century A.D.)
22. Paryaya Ratna Mala (9<sup>th</sup> century A.D.)
23. Madanadi Nighantu (10<sup>th</sup> century A.D.)
24. Madhava Dravyaguna (1250 century A.D.)
25. Saraswati Nighantu (16<sup>th</sup> century A.D.)

But in Nighantus this drug is not mentioned directly by name or any kind of synonyms.

### 2. Modern Review:

**1. The Wealth of India**– in this text described that the distribution, common name and botanical name, description of various parts of tree, ripening time of fruit and its uses and propagation of plant<sup>[3-4]</sup>.

**2. Compendium of Indian Medicinal Plant**– in this text described an alkaloid – couroupitine A – along with couroupitine B, stigmaterol and campesterol isolated from fruits (Tetrahedron Lett. 1974, 609); revised structure of couroupitine A proposed; couroupitine B found identical with indirubin (Tetrahedron Lett. 1977, 2625)<sup>[5-6]</sup>.

3. Glossary of Vegetative Drugs in *Brihatrayi*
4. Ayurvedokt Aushadha Nirukta Mala
5. Ayuvedic Flora Medica by Vayaskara
6. Medicinal flowers; Pushapayurvea; Medicinal Flowers of India and Adjacent Regions
7. The Ayurvedic Pharmacopoeia of India

8. The Flora of British India
  9. Indian medicinal plants
  10. A hand book of Medicinal Plants
  11. Indian Materia Medica
  12. Materia Medica of Hindus
  13. George, Watt, Dictionary of “The Economic Products of India”
  14. Useful Plants of India and Pakistan
  15. Paschatya Dravyaguna Vigyan
  16. Database on Medicinal Plants used in Ayurveda
  17. Glossary of Indian Medicinal Plants
- Above book no. 3-17, *Couroupita guianensis* Aubl. not mentioned.

### Some Previous Research Work:

#### Research work on *Couroupita guianensis* Aubl. -

1. Badri-nath S.-Study on *Couroupita guianensis* (Aubl.) Trivendrum, 1991.
2. In-vitro anti-oxidant activity of ethyl acetate fraction of water extract of flower of *Couroupita guianensis*, 2011.
3. A short review on therapeutic uses of *Couroupita guianensis* Aubl., 2011.
4. Vinod H. Gupta et al. Neuropharmacological evaluation of the methanolic extract of *Couroupita guianensis* Aubl. flower in mice, International Journal Of Pharmaceutical And Phytopharmacological Research, 2012, vol I(5), Pp.242-246.
5. Anti-depressant like effect of *Couroupita guianensis* Aubl. Flowers in animal model of depression, 2012.
6. Anti-oxidant, Phytochemical screening and anti-microbial activity of *Couroupita guianensis* flower extract, 2014.
7. Production of silver nano particles synthesis of *Couroupita guianensis* plant extract against human pathogen and evaluations of anti-oxidant properties, 2015.
8. Isolation and characterization of phytoconstituents using low polar solvents from the flowers of *Couroupita guianensis*, 2015.
9. Qualitative characterization of phytochemicals and in-vitro anti-microbial evaluation of leaf extract of *Couroupita guianensis* Aubl.- A threatened medicinal tree, 2015.
10. Impact of auxins on vegetative propagation through stem cuttings of *Couroupita guianensis* Aubl. A conservation approach, 2016.
11. Anti-oxidant activity of *Couroupita guianensis* Aubl.
12. Anti-microbial, wound healing and anti-oxidant potential of *Couroupita guianensis* in rats.
13. Phytochemical screening, antioxidant and anti proliferative activities of successive extracts of *Couroupita guianensis* Aubl. Plant, 201

### 3. *Couroupita guianensis* Aubl. (Lecythidaceae )

#### 3.1 Synonyms

##### 3.1.1 Definition of Synonyms:

Synonym may be understood as the words which are related to each other. Synonym is derived from two Latin words like; Syn = alike and noma = name. Synonyms served the indication of specific characters of plants, which helps their proper identification.

During earlier times the only method for identification of plants was through their synonyms. Because the synonyms given were based on their structure, source, habitat, season of flowering & fruiting, properties, actions, historical importance or sensory perception.

##### 3.1.2 Importance of Synonyms:

1. *Paryaya* (synonym) help in identification of medicinal plants. Most of the synonyms given are based on the morphology like based on the shape of leaf, inflorescence, flowers and their colour, shape and size of fruit. By virtue of various synonyms it is possible to finalize the herb.

2. Synonym help in recognizing properties and utility of the medicinal plants as many synonyms are given to the plant based on their properties (*rasa, guna, veerya, vipaka & prabhava*), *Dosha Shamana* (passifying Dosha), *Karma* (Action) and *Rogaghnta* (indications).

3. Many synonyms are given to medicinal plants based on their habitat or distribution which helps the person for collection and also indicate the possible properties of the drug.

##### 3.1.3 Synonyms of Cannon ball tree:

- *Couroupita pedicellaris* Rizzini
- *Couroupita acreensis* R. Knuth
- *Couroupita antillana* Miers
- *Couroupita froesii* R. Knuth
- *Couroupita guianensis* var. *surinamensis* Eyma
- *Couroupita idolica* Dwyer
- *Couroupita membranacea* Miers
- *Couroupita peruviana* O. Berg
- *Couroupita saintcroixiana* R. Knuth
- *Couroupita surinamensis* Mart. ex Berg
- *Courupita venezuelensis* R. Knuth
- *Lecythis bracteata* Willd.
- *Pekea couroupita* Juss. ex DC., nom. Inval. (<https://indiabiodiversity.org> 04/02/20210)

TABLE NO.3.3.2

#### 3.2 Vernacular Names

Languages	State	Name
Common name	-	Cannon ball tree, Snake flower
Hindi	-	Tope Gola, Naglinga, Ayahuma
Gujrati	Gujrat	Kailasapati, Shivalingi
Kannada	Karnataka	Tope Gola, Naglinga, Ayahuma

Malayalam	Kerala	Kailasapati, Shivalingi
Marathi	Maharashtra	Kailasapati, shivalingam
Odia	Orissa	Nagakesara, Nageshwara
Sanskrit	-	Not mentioned
Tamil	Tamil nadu	Naglingam
Bengali	Bengal	Kaman Gola
Assameses	Assam	Naglingam, Nag-Champa
Telugu	Andhra Pradesh	Mallikarjuna, Nagamalli
Telangana	Telangana	Nagalingam

### 3.2.1 Meaning of Vernacular Names:

**Cannon ball tree** – the tree bears large globose woody fruits; they look like big rusty cannon ball.

**Tope gola** – looks like *gola of tope*.

**Naglingam and Shivalingam** – the *shivalingam* shape is visible at the center of the flower and snake shaped pollen is the specialty of this flower. (<http://www.flowersofindia.net>) accessed on 05/01/2021

### 3.3 Taxonomical Classification

Kingdom : Plantae - Plants

Subkingdom : Tracheobionta – Vascular plants

Superdivision : Spermatophyta – Seed plants

Division : Magnoliophyta – Flowering plants

Class : Magnoliopsida - Dicotyledons

Subclass : Dillenidae

Order : Lecythidales

Family : Lecythidaceae – Brazil-nut family

Genus : *Couroupita* Aubl. – Cannonball Tree

Species : *Couroupita guianensis* Aubl. – Cannonball Tree

(National Plant Database 2004/ National Tropical Botanical Garden)

### Materials and Methods:

### 3.4 Pharmacognosy

#### 3.4.1 Family characteristic: Lecythidaceae

- **Diagnostic character** – Trees; without essential oils; both surfaces of leaves are usually anisocytic; the secondary phloem usually stratified into fibrous and parenchymatous zones; flowers when irregular, zygomorphic; perianth with distinct calyx and corolla; calyx not persistent, valvate; corolla-imbriate; androecium coherent and to form flat ligule or a hoodling structure; gynoecium inferior and seed non-endospermic.
- **Habitat** – Neotropical. Subtropical to tropical. Tropical America.
- **Habit** – Trees, without essential oils.
- **Root** – Tap and branched.

- **Leaf form** – Leaves medium-sized, or large; alternate; spiral (aggregated at the tips of the twigs); ‘herbaceous’, or leathery; petiolate; non-sheathing; simple. Lamina entire; pinnately veined; cross-venulate. Leaves exstipulate. Domatia occurring in the family (Combretodendron); manifested as pits.
- **General anatomy** – Plants with silica bodies
- **Leaf anatomy** – The leaf lamina dorsiventral.
- Stomata mainly confined to one surface (abaxial, usually), or on both surfaces; usually anisocytic. Hairs present; eglandular; simple, unicellular, or multicellular. Unicellular hairs simple (occasionally tufted). Adaxial hypodermis usually absent. Lamina without secretory cavities. The mesophyll containing crystals. The crystals druses and solitary-prismatic.
- **Axial (stem, wood) anatomy – stem** - Cork cambium present; initially superficial. Nodes unilacunar. Primary vascular tissues in a cylinder, without separate bundles; collateral. Internal phloem absent. Cortical bundles present (these usually conventionally oriented). Medullary bundles absent. Secondary thickening developing from a conventional cambial ring.
- **Wood** - The wood diffuse porous. The vessels very small to medium (but mostly medium sized); solitary, radially paired, and in radial multiples, or clustered. The vessel end-walls simple, or scalariform and simple (rarely). The vessels without vestured pits. The axial xylem with tracheids (allantoma), or without fibre tracheids; with libriform fibres, or without tracheids (usually); without vasicentric tracheids; with fibre tracheids, or without libriform fibres; including separate fibres. The parenchyma usually abundant, apotracheal, or apotracheal and paratracheal (typically mostly in apotracheal bands). The secondary phloem usually stratified into hard (fibrous) and soft (parenchymatous) zones. ‘included’ phloem absent. The wood not storied. Tyloses commonly present.
- **Reproductive type** – Unisexual flowers absent. Plants hermaphrodite. Floral nectarines present. Nectar secretion from the disk.
- **Pollination** – Pollination entomophilous; via hymenoptera (bees).
- **Inflorescence** – Flowers solitary or aggregated in ‘inflorescence’. The ultimate inflorescence units when flowers aggregated, racemose.
- **Flower** – Flowers regular to very irregular; when irregular, zygomorphic (sometimes the androecium spectacularly so). The flower irregularity involving the androecium. Flowers cyclic; polycyclic. Free hypanthium absent (always with complete fusion of receptacle and ovary). Perianth with distinct calyx and corolla; 8-12; 2 whorled; isomerous.
- **Calyx** – Usually 4-6; 1 whorled; polysepalous; not persistent (on the fruit); valvate.
- **Corolla** – 4-6; 1 whorled; polypetalous (usually), or gamopetalous; imbricate; unequal but not bilabiate to regular; deciduous (with the stamens).
- **Androecium** – Many 40-1000. Androecial members maturing centrifugally; free of the perianth; coherent (more or less united below, the connate parts sometimes produced on one side of the androecium to form a flat ligule or a hooding structure); 3-5 whorled.

Androecium exclusively of fertile stamens, or including staminodes (by abortion of some anthers, in association with one-sided development of the union).

Stamens 40-1000; polystemonous; inflexed in bud. Anthers usually versatile; dehiscent via longitudinal slits; tetrasporangiate. Endothecium developing fibrous thickenings. Anther epidermis persistent. Microsporogenesis simultaneous. The initial micropore tetrads tetrahedral, or isobilateral. Anther wall initially with more than one middle layer; of the ‘basic’ type. Tapetum amoeboid. Pollen grains aperturate; 3 aperturate; colpate (or colpoidate, not syncolpate); 2-celled (in *Gustavia*).

- **Gynoecium** – Syncarpous; synstylovarious; partly inferior, or inferior. Ovary 2-6(-10) locular. Epigynous disk present. Gynoecium stylate. Styles 1; apical.
- **Placentation** – Basal (Eschweilera), or basal to axile, or axile to apical, or apical. Ovules 1-50 per locule; pendulous, or horizontal, or horizontal, or ascending; arillate (often, with a funicular aril), or non-arillate; anatropous; bitegmic; tenuinucellate. Outer integument not contributing to the micropyle. Endothelium differentiated. Embryo-sac development polygonum type. Antipodal cells formed; 3; not proliferating; ephemeral. Synergids pear shaped. Endosperm formation nuclear.
- **Fruit** – Often large, fleshy, or non-fleshy; dehiscent, or indehiscent; woody, a capsule, or capsular-indehiscent, or berry. Capsules when dehiscent, circumscissile ('monkeys pots').
- **Seed** – Seeds non-endospermic. Embryo large, rudimentary at the time of seed release to weakly differentiated (as in Bertholletia- the Brazil nut), where it consists mainly of the much thickened hypocotyls), or well differentiated. Cotyledons 2. Seedling germination phanerocotylar, or cryptocotylar.
- **Physiology, phytochemistry**– Sugars transported as sucrose (Lecythis), Cyanogenic or not cyanogenic. Alkaloids absent (2 species), Iridoids not detected, Saponins/ saponinins present, Proanthocyanidins present or absent; when present- cyaniding and delphinidin. Flavonols present or absent; kaempferol or quercetin. Ellagic acid present (3 genera, 3 species).<sup>[7]</sup>

### 3.4.2 Taxonomical Description of *Couroupita guianensis* Aubl.

- **Habit:** A deciduous tree reaching about 15-20 m height.
  - **Stem:** Soft wooded straight stout trunk and rough brownish grey bark.
  - **Leaves:** Alternate, oblong, oblanceolate, entire, glabrous, nerves prominent, up to 30 cm long.
  - **Inflorescence:** Racemes produced from the upper part of the trunk or from the main branches.
  - **Flowers:** Large, pleasing combination of rose-pink, white and yellow colours, arranged in long racemes.
  - **Calyx:** turbinate.
  - **Petals:** 6, unequal, concave, pink inside but with a mixture of white, yellow and pink outside.
  - **Stamen:** Fertile stamens numerous, monadelphous, arranged on a band that arise from the base of the ovary and bends over it like a hood so that the anthers press down on the ovary. This structure looks like a hooded snake sheltering the shivalinga. Hence, the tree is also called snake-Flower tree.
  - **Fruit:** Remarkably large berry and round, with a rown hard shell, containing pulp, about the size of a man's head, up to 25 cm in diameter.
  - **Flowering and fruiting time:** January onwards
- Significance:**
- Occasionally grown in the garden for the peculiar flowers and fruits.
  - Also planted in parks around temple and along roads.
  - It is considered as a holy plant<sup>[8]</sup>. (reference: efloraofgandhinagar.in)

### 3.5 Origin and Distribution:

Native to tropical Northern South America, especially the Amazon rainforest and the southern Caribbean. As ornamental trees along highways and in parks. Also occurs in India, where it is probably native, and Thailand.



### 3.6 Red Listed Medicinal Plant –

Foundation for Revitalization of Local Health Tradition (FRLHT), presently known as university of Transdisciplinary Health Sciences and Technology (TDU) has established itself as a pioneering institute in the field of conservation of medicinal plants in India.

The IUCN red list categories are intended to be an easily and widely understood system for classifying species at high risk of regional to global extinction and to provide an explicit and objective framework for the classification of species according to their extinction risk.

The following are the various IUCN threat status with the brief definition.

- **Extinct (EX)**

There is no reasonable doubt that the last individual has died, meaning there is no individual of the particular species on the planet earth.

- **Extinct in the wild (EW)**

Species surviving only under cultivation, in captivity or as a naturalized population, meaning there is no individual of particular species is available in the wild.

- **Critically Endangered (CE)**

Facing an “extremely high” risk of extinction in the wild.

- **Endangered (EN)**

Facing a “very high” risk of extinction in the wild.

- **Vulnerable (VU)**

Facing a “high risk” of extinction in the wild.

- **Near threatened (NT)**

Close to qualifying for a threatened category or likely to qualify in the near future.

- **Least concern (LC)**

Not qualifying for CR, EN, VU, or NT. Widespread and abundant Taxa but facing various levels of threats are included in this category.

- **Data Deficient (DD)**

Inadequate data for assessment, although these species are facing various threats.

- **Not Evaluated (NE)**

The most threatened categories include Critically Endangered (CE), Endangered (EN) and Vulnerable (VU) which are assigned to a taxon based on fulfillment of at least one of the following 5 criteria:

- a. Population reduction
- b. Geographic range in the form of extent of occurrence (EOO) or area of occupancy (AOO).
- c. Small population size and decline
- d. Very small and restricted population
- e. Quantitative analysis indicating the probability of extinction in the wild.
- f. *Couroupita guianensis* Aubl. is listed under as Least Concern in the IUCN Red list of threatened species 2013. (<http://www.iucnredlist.org>)<sup>[9]</sup>

### 3.7 Part Used

- Flower
- Leaves
- Bark

- Seeds
- Fruit
- Root

**3.8 Action & Traditional uses of *Couroupita guianensis* Aubl.<sup>[10]</sup> :**

**TABLE NO. 3.3.8**

Parts of the plants	
<b>Flower</b>	Immunobooster and snuff. Cold, intestinal gas formation and stomach ache, diarrhea, hypertension, tumor, pain, inflammation, antibacterial, antifungal and asthma.
<b>Leaves</b>	Hair vitalizer, skin disorders, toothache, antiseptic, antibacterial, antifungal, antithrombotic, vasodilatory, dysentery, snake bite, arthritis, asthma, hypertension, tumor, pain, inflammation, rheumatic disorders and malaria.
<b>Bark</b>	Skin infection, antibacterial and antifungal, snake bite, hypertension, <b>tumor</b> , pain, inflammation, malaria and snake bite.
<b>Seeds</b>	Reproductive disorders and infertility.
<b>Fruit</b>	Cold, wound, headache, stomach ache, antibacterial, antifungal and medicinal drink.
<b>Root</b>	Malaria.

**TABLE NO. 3.3.8.1**

**Chemical Constituents of *Couroupita guianensis* Aubl.<sup>[11]</sup>**

Part of the plant	Chemical constituents
<b>Fruit</b>	Courouputine A (tryptanthrin), courouputine B (indirubin), malic acid, isocitric acid, stigmaterol, campesterol, hopane, rutin, quercetin, kaempferol, farmaricetin, luteolin and ursolic acid.
<b>Flower</b>	Eugenol, linalool, (E,E)- farnesol, nerol, geraniol, (Z, E)-farnesol, vanillin, geranial, (E, E)-farnesyl acetate, trans ocimene, nootkatone, geraniol, 2-isopropenyl-5-methyle-4-hexenyl acetate, cedr-8-en-13-ol, (E, Z)-far methyl(11E)-11-hexadecenoate, isatin, cycloart-24-en-3-ol-3'-exomethylene h stigmaterol, p-coumaric acid, o-coumaric acid, caffeic acid, quercetin, octyl4-(benzoate, myristoleic acid, linoleic acid, (8E, 10E, 12E)-icosa-8, 10, 12-triene.
<b>Leaf</b>	Tritepenic ester $\beta$ -amirin palmitate, hydroxycinnamic acid, caffeic acid, rosmarinicacid, kaempferol-3-O-neohesperidoside, 20, 40-dihydroxy-60-methoxy-30, 50-dimethylchalcone, 7-hydroxy-5-methoxy-6, 8-dimethylflavanone, 4-hydroxybenzoic acid.
<b>Seed</b>	Indigo, indirubin, stigmesterol, campesterol, linoleic acid, nerol, tryptanthrin.
<b>Stem and bark</b>	Phytosterol, $\beta$ -amirin, betulin-3 $\beta$ -caeate and lupeol-3 $\beta$ -caffeate, couropitone (stigmasta-4,23(E)-dien-3-one1), $\beta$ -amyryn, $\beta$ -amyrone, $\beta$ -amyryn acetate, stigmaterol, ergosta-4,6,8(14), 22-tetraen-3-one, $\beta$ -sitosterol and its glycoside.

### 3.9 Pharmacological (Biological) Activities:

- 1. Antimicrobial activities:** The screening of leaf extract (methanol and aqueous extract) of *Couroupita guianensis* Aubl. against six human pathogenic bacteria *E. coli*, *P. aeruginosa*, *P. mirabilis*, *A. baumannii*, *S. typhimurium*, *K. pneumoniae* and four fungal pathogens to check antibacterial and antifungal activities by well diffusion method which showed valuable zone of inhibition. The zone of inhibition against bacterial pathogen ranged between 08 to 22 mm in methanol extract. Leaves and stem bark extract showed inhibition only against the *P. mirabilis* 18 and 22 mm, respectively.<sup>[12]</sup>
- 2. Anti ulcer activity:** The dose of 150 and 300mg/kg ethanolic extract of *Couroupita guianensis* Aubl. produced significant inhibition of gastric lesions induced by pylorus ligation induced ulcer and ethanol induced gastric ulcer. Ethanol induced gastric lesion formation may be due to stasis in gastric blood flow which contributes to the development of the haemorrhage and narcotic aspects of tissue injury.<sup>[13]</sup>
- 3. Wound healing activity:** The alcoholic extract of *Couroupita guianensis* Aubl. shows significantly result of wound healing due to presence of stigmaterol and flavonoids in the extract. The result indicated that accelerates the wound healing process by decreasing the surface area of the wound and increasing the tensile strength.<sup>[14]</sup>
- 4. Anthelmintic:** Chloroform, acetone, and ethanolic flower extract of *Couroupita guianensis* Aubl. for anthelmintic activity against adult earth worm, *Pheritima posthuma*. The alcoholic extract was the most effect in an activity comparable with Piperazine citrate.
- 5. Skin fibroblast proliferation/Antioxidant:** Study of hydroalcoholic extract strongly indicated antioxidant activity attributed to phenolic content. Also, significant stimulation of HSF proliferation and absorption of UV radiation was noted.<sup>[15]</sup>
- 6. Antioxidant and anticancer activity:** The flowers of *Couroupita guianensis* Aubl. consists of compound isatin. The derivatives of this compound is known to have cytotoxicity against human carcinoma cell lines. This compound therefore, has a potential to be used as a chemotherapeutic agent against cancer. Isatin started the apoptosis process with fragmentation of DNA. Cleavage of DNA at the internucleosomal linker sites yielding DNA fragments is regarded as a biochemical hallmark of apoptosis. Apoptosis induced by isatin was confirmed by flow cytometry to further elucidate the extent and cause of apoptosis. Isatin was isolated from the floral part of cannon ball tree and it exhibited antioxidant activity and cytotoxicity against HL60 cells.<sup>[16]</sup>
- 7. Anti inflammatory activity:** The anti inflammatory activity of *Couroupita guianensis* Aubl. that the extract fractions significantly reduced the time that the animal spent licking the formalin-injected paw in first and second phases. Only the higher doses (30 and 100 mg/kg) were able to inhibit the leukocyte migration into the peritoneal cavity after carrageenan injection. At the same time the 100 mg/kg dose almost abolished the cell migration and a inhibition on cytokines and inflammatory mediators production.<sup>[17]</sup>
- 8. Antinociceptive:** CEE (crude ethanol extract) and fractions significantly inhibited the number of contortions induced by acetic acid. 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 100mg/kg from all fractions. Administration of naloxone inhibited the antinociceptive effect of fractions. Pre-treatment of mice with atropine reduced the actinociceptive activity of CEE and its fractions, the exception being the dichloromethane fraction. Mecamylamine did not inhibited the effect of dichloromethane fraction. L-NAME 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.<sup>[18]</sup>

**3.10 Ethanobotanical importance:** It is a medicinal plant which is endowed with curative properties including antifungal, antibiotic, anticeptic, analgesic, antimalarial, stomachache, toothache, scabies, gastritis, bleeding piles, dentistry, and scorpion poison.

The fresh fruit pulp is used in the preparation of cooling medicinal drink and various parts are useful in skin disease.

The leaf have been found to show antioxidant activity, anthelmintic activity, immunomodulator, and anti-nociceptive activity. Leaves of *Couroupita guianensis* Aubl. are widely used as an analgesic medicine by the Brazilian rural population.

The pulp of fruit of cannon ball tree is rubbed on the infected skin of the dog. It is claimed that when the dog licks its skin, this medicine will also work internally.

The flowers are used to cure cold, intestinal gas formation and stomach ache. Barks are used to treat hypertension, **tumors**, pain, and inflammatory process<sup>[19]</sup>.

### 3.3.11 Propagation and Cultivation:

Through seeds. Due to recalcitrant nature of the seeds, they have a short viable life, can not be dried well and can not withstand low temperatures<sup>[20]</sup>.

### Result and Discussion:

During the past decade, there has been an ever increasing demand especially from the developed countries for more & more plant drugs containing medicinally useful alkaloids, polyphenolics, steroids, glycosides and terpenoid derivatives.

According to a survey conducted by WHO, the uses of medicinal plant remedies are on the increase even in the developed countries especially among younger people.

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