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COUROUPITA GUIANENSIS – IT'S ETHANOBOTANICAL KNOWLEDGE, PHYTOCHEMICAL STUDIES, PHARMACOLOGICAL ASPECTS AND FUTURE PROSPECTS.

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ABSTRACT: *Couroupita guianensis* is a deciduous, huge, versatile tree flourishing with brown, green, pink, white colours and also with phytochemicals like alkaloids, flavonoids, Terpenoids, Saponins, tannins, carbohydrates that are ready to serve to the plant as well as humans. This huge plant also is seen to have some pharmacological activities like antimicrobial, antifungal, antioxidant, antidiabetic, anti-inflammatory and anticancer. Nanoparticles have also been derived from parts of the plant and has many applications with respect to future prospects.

KEYWORDS: *Couroupita guianensis*, Phytochemicals, Pharmacological activities.

Introduction:

Plants from forming of the world have been besides us with their some or the other useful activities helping in curing of various diseases. Parts of plants that is stem, leaves, barks, flowers are used in ailments of diseases due to their phytochemicals present. Wide range of plants show pharmacological activities like antibacterial, antifungal, antimicrobial, antiviral, antihelminthic, antidiabetic, anticancer and many more in number.

Plants around 270,000 in number have known to have been investigated for medicinal activity and also herbal medicine knowledge from local indigenous communities (Laruan *et al*., 2013).

Couroupita guianensis is a huge plant which is seen to be used since ancient times and still glow with its different abilities. This plant can be used in treatments of various diseases as well as for decoration purposes. Brown, pink, green, white are the colours that it flourishes with.

Classification:

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Lecythidales
Family	Lecythidaceae – Brazil nut family
Genus	CouroupitaAubl
Species	*Couroupitaguianensis*Aubl

(A)*Couroupita guianensis* tree at Mumbai University, Kalina Campus

(B) Cannonball fruit with its hard shell

(C) Actual cannonball fruit

(D) Leaves of Cannonball

(E) Flower on Cannonball tree

Habitat:

Cannonball, scientifically as *Couroupita guianensis*, is an evergreen tree which is inherent to tropical northern South America and Southern Caribbean. This tree is accounted as a sacred tree in Hindu and are grown widely in surroundings of Shiva Temples as the flower lookalike the hood of sacred snake Naga, that protects Shiva Lingam (Al-Dhabi *et al*., 2012). It is also planted in tropical and subtropical gardens as decorative tree.

Botanical Description:

*Couroupita guianensis*is a huge deciduous tropical tree of about 90' height. The leaves of the tree are 6' long and have serrate margins. The flowers are yellow, white, pink with spectacular fragnance and also they are 3' to 5' large in size, waxy, aromatic smell growing directly on the bark of the tall tree (Gousia *et al*., 2013). Fruits are cannonball like hanging in bunches, large, globose, woody containing small seeds and white unfriendly smelling edible jelly.

Traditional and Medicinal Uses:

Sundararajan *et al*. in 2014 researched that fruit and leaves of *C. guianensis* were used for treatements of skin diseases. Flowers were used for curing headache, scabies, dysentery like diseases. He also has reviewed that traditional use of cannoball flowers and leaves was also done for treating of tumors, hemorrhage, piles, scabies, dysentery.

This huge cannonball tree is wisely entrapped with rich phytochemical constituents because of which it has many medicinal uses against a wide range of pathogens and diseases too. As the methanolic extracts of flowers have antimicrobial, antioxidant activities it can prove as a boon for treatment of diseases but further studies need to be done (Devi Rajeswari *et al*., 2014).

Beautiful flowers of this tree are used for treatments of cold, intestinal gas, and stomach ache (Bafna *et al*., 2011).

Phytochemicals:

Phytochemicals are constituents like alkaloids, flavonoids, tannins, sterols, phenols, carbohydrates, glycosides, saponins due to which the plants have activities and prove to be useful in medicinal field. These are secondary metabolites which are not useful to plants much but are of much higher use to mankind.

Alkaloids are a wide class of naturally occurring organic nitrogen containing compounds derived from plants. About 20% of plant species show presence of alkaloids helping them for working of defense mechanism against herbivores (Qurat *et al*, 2016).

Flavonoids are also type of secondary metabolites more useful in defense to plants. They are synthesized via phenylpropanoids pathway. Over of 6000 different flavonoids have been identified which are being studied for their activities. flavonoids give colours to seeds, fruits, flowers of the plant (Ferreyra *et al*., 2012).

Tannins are water soluble polyphenolic compounds present in plant foods. Tannins help plant fight against microbial infections. They help plant showing anticarcinogenic activity, antimicrobial activity, reducing blood pressures in humans (Chung *et al*., 2010).

Plant part	Phytochemicals
Leaf	Flavonoids, Alkaloids, Glycosides, Tannins, Steroids, Terpenoids, Saponins.
Fruit	Alkaloids, Carbohydrates, Tannins, Glycosides, Proteins, Steroids, Triterpenes, Polyphenolic compounds.
Bark	Phytosterols, Alkaloids, Saponins, Tannins, Glycosides
Flowers	Carbohydrates, Alkaloids, Glycosides, Tannins, Flavonoids, Saponins, Triterpenoids, Stigmasterol.

Leaf:

Jasmine and Moorthy, 2017 have said that aqueous extracts of *C. guianensis* secure phytochemicals like flavonoids, alkaloids, glycosides, tannins, steroids and terpenoids. Acetonic and methanolic extract of *C. guianensis* leaf extracts have presence of saponins which would act as beneficiary in treating of diseases (Singh *et al*., 2015).

Singh *et al*., 2015 have reported presence of phytochemical constituents in leaf extract of *Couroupita guianensis*, were alkaloids are strongly present; glycosides, phlobatannins, steroids, terpenoids, tannins were present and flavonoids were detected at moderate level. Shah *et al*., 2013 has stated that juice from leaves of this plant were used for curing of skin diseases.

Devi Rajeswari and Swapnalatha, 2014 have said that crude methanol extracts of leaves of this cannonball tree are found to have presence of secondary metabolites like carbohydrates, proetins, alkaloids, terpenoids, flavonoids, phenolic compounds.

Fruit:

The pulp of fruit of *C. guianensis* contains phytochemicals like alkaloids, carbohydrates, tannins, glycosides, proteins, steroids, triterpenes (Ranjit *et al*., 2014). In alcoholic fruit extract of *C. guianensis* has phytochemicals like tannins, sugars and polyphenolic compounds (Shah *et al*., 2013).

Bark:

The benzene extract of bark of *C. guianensis* showed presence of phytosterol as phytoconstituent. Alkaloids, saponins, tannins, glycosides were present in water extract of bark (Ranjit *et al*., 2014). Bark of *C. guianensis* has antimicrobial and antifungal activity (Shah *et al*., 2013).

Flowers:

Flowers of the tree *Couroupita guianensis* are yellowish, white and pink in colour with spectacular aroma, 3'to 5' in size, grows single direct on bark of the tree (Gousia *et al*., 2013).

Ranjit *et* al., 2014 has reviewed that the aqueous and methanolic extracts of flowers of *C. guianensis* have reported to have carbohydrates, alkaloids, glycosides, tannins, flavonoids and saponins while ethanolic extract of flowers showed presence of carbohydrates, flavonoids and saponins.

Ramalakshmi *et al*., 2013 also reported that methanol extract of flowers exhibit phytoconstituents like carbohydrates, protein, alkaloids, terpenoids, phenolic compounds and tri terpenoids.

Prabhu and Ravi., 2017 have discovered new phytoconstituents from flower extracts of *Couroupita guianensis* viz. cycloart-24-en-3-ol-4'-exomethylene heptadeconate along with stigmasterol.

The metholic extract of *Couroupita guianensis* was showing phytochemicals like carbohydrates, alkaloids, phenols, saponins, tannins, glycosides, flavonoids and terpenes (Devi Rajeswari *et al*., 2014).

Flowers when treated using methanol gave showed presence of some phytochemicals like carbohydrates, proteins, alkaloids, terpenoids, reducing sugars and triterpenoids (Sundarrajan *et al*., 2014).

Pharmacological Activity:

Plant part	Pharmacological activity
Fruit pulp	Antimicrobial activity, Antifungal activity
Leaves	Antimicrobial activity, Antifungal activity, Anti-inflammatory activity
Flowers	Antimicrobial activity**,** Antioxidant activity, Antidiabetic activity, Anti- inflammatory activity, Anti cancer activity

Antimicrobial activity:

Jasmine and Moorthy, 2017 have reviewed that extract of *C. guianensis* have super antibacterial activity. The ethyl alcoholic extracts of fruit pulp of the tree showed outstanding antibacterial activity against Gram positive and Gram negative bacteria. The chloroform extract of fruit pulp also showed antibacterial activity with disc diffusion method ranging upto 26mm-20mm against Gram positive and Gram negative bacteria.

Chloroform extracts of leaves of *C. guianensis* show high values of zones of inhibition against Gram positive bacteria *S. aureus* (Singh *et al*., 2015). The known pathogenic bacteria namely, *S. aureus, S. typhimuriam, S. faecalis* were also inhibited by leaf extracts of *C. guianensis* (Singh *et al*., 2015).

The ethanolic extract of fruit pulp of *C. guianensis* have shown susceptibility widely against *Baciilus subtilis* than *S. aureus* and *E. coli* (Jasmine and Moorthi, 2017). Ethanolic, aqueous and ethyl acetate extracts of *C. guianensis* flowers have antibacterial activity against both Gram positive and Gram negative bacteria (Ranjit *et al*., 2014).

Ramalakshmi *et al*., 2013 has recorded that methanol extract of *C. guianensis* medicinal plant flowers have antimicrobial activity effective against clinical pathogens *Staphylococcus aureus* (NCIM 5201), *Proteus vulgaris* (NCIM 2027) and moderate activity against *E. coli* (NCIM 2065), *Salmonella typhi* and *Klebsiella pneumonia* (NCIM 2019).

Shah *et al*., 2013 had experimented on fruit pulp extract of *C. guianensis*, also standardized the fruit pulp by WHO guidelines and found that alcoholic fruit pulp extract was having antibacterial activity against bacteria like *E. coli, S. aureus, B. subtilis, P. aeruginosa*. Most noteworthy activity was against *B. subtilis* from other three test cultures.

Gousia *et al.*, 2013 has stated that methanolic extract and aqueous extract of *C. guianensis* leaves was tested against some human pathogens which showed valuable amount of zones of inhibition in agar well diffusion method. The methanolic extract of leaves showed a better range of zone of inhibition indicating more effective with a range of 31mm to 12mm than aqueous extract.

The highest zone of inhibition of about 31mm was seen in methanolic extract against *Salmonella typhi* bacteria, 29mm against *E. coli*, 12mm against *Streptococcus aureus*. The aqueous extract showed 30mm inhibition against *E. coli* and smallest zone of inhibition against *Pseudomonas aeruginosa*.

Devi Rajeswari *et al*., 2014showed antimicrobial activity of flower extracts of *C. guianensis* by agar well diffusion method against four bacterial strains namely; *Escherichia coli* MTCC 1698, *Staphylococcus aureus* MTCC 3160, *Bacillus subtilis* MTCC 9878, *Salmonella enteric* MTCC 9844. Ethyl acetate extract (95%) of *Couroupita guianensis* exhibit antibacterial activity against gram positive and gram negative bacteria (Sundararajan *et al*., 2014).

As reviewed by Sundarrajan *et al*., 2014, methanolic extracts of flowers and chloroform extracts of fruits of cannonball tree has antimicrobial activity. In another review done by Devi Rajeswari and Swapnalatha, 2014, they have stated that methanol extracts of leaves of *Couroupita guianensis* were screened for its antimicrobial activity against pathogenic bacterias.

Antifungal activity:

C. guianensis leaf extract exhibited antifungal activity against *Candida parapsilosis* (Singh *et al*., 2015). Ethanolic extract of *C. guianensis* showed effective antifungal activity against *Candida albicans* (Jasmine and Moorthi, 2017). Sundarrajan *et al*., 2014 has reviewed that ethanolic extract of fruit of this huge cannoball fruit shows antifungal activity.

Methanol extract was more effective than aqueous extracts of cannonball leaf against four fungi. More number of strains were inhibited by ethyl acetate extracts of cannonball leaves (Devi Rajeswari and Swapnalatha, 2014).

Antioxidant activity:

Alcoholic extracts of *C. guianensis* show property of wound healing due to presence of stigmasterols and flavonoids that lower the surface area of wound and help heal (Gousia *et al*., 2013). Extracts of flowers of *C. guianensis* have antioxidant activity (Jasmine and Moorthi, 2017).

Premanathan *et al*., 2012 reported antioxidant activity of the purified compound named isatin, showed inhibition of lipid peroxidation by radical scavenging activity. Methnolic extracts of flowers displayed radical scavenging activity by DPPH method in increasing order (Devi Rajeswari *et al*., 2014).

C. guianensis, ethyl acetate fraction of water extract shows significant antioxidant activity by scavenging radicals that harms tissue (Sundararajan *et al*., 2014). Alcoholic extract of *C. guianensis*, 2014 have antioxidant activity by showing fast wound healing process.

Antidiabetic activity:

Morankar *et al*., 2013 has reported antidiabetic activity of *Couroupita guianensis* flowers at normal levels in diabetes induced animals. Devi Rajeswari and Swapnalatha in 2014 have said that homeopathy medicine has approved this plant for its anti-diabetic activity in leaf extracts.

Anti-inflammatory activity:

C*ouroupita guianensis* elements have records that show anti-inflammatory activity partly due to reduction on cell migration and inhibition on cytokines and inflammatory mediators production (Gousia *et al*., 2013).

The flowers of *C. guianensis* have anti-inflammatory activity (Morankar *et al*., 2013). Ethanolic extract of leaves of cannonball tree have anti-inflammatory activities moderately due to reduction of cell migration and inhibition on cytokines and inflammation mediator production (Devi Rajeswari *et al*., 2014).

Benzene and ethanolic extracts of flowers, bark of the tree and leaves show anti-inflammatory activities (Sundarrajan *et al*., 2014).

Anticancer activity:

The flowers of *C. guianensis* have istain as a compound whose derivatives were seen to have cytotoxic activity against human carcinoma cell (Gousia *et al*., 2013). The methanolic extract of flowers of *C. guianensis* have anticancer activity against HeLa, NIH3T3 and HepG2 cell lines (Jasmine and Moorthi, 2017). Isatin, a compound found in *C. guianensis* shows cytotoxic activity against human promyelocytic leukemia HL60 cells with 50% cytotoxic activity (Premanathan *et al*., 2012).

Ranjit *et al*., 2014 reported that ethanolic and ethyl acetate extracts of flowers of *C. guianensis* have *invitro* cytotoxic activity against MCF-7 cell lines when compared with standard tamoxifen.

Due to presence of isatin in flowers of *C. guianensis*, this plant is capable of showing activity against human carcinoma cells (Devi Rajeswari and Swapnalatha, 2014).

NANOPARTICLES:-

Biosynthesis of Copper Nanoparticles Using *Couroupita guianensis:-*

CuNPs were made by dissolving 0.25 g of copper sulphate [CuSO4] in 50 ml of distilled water, then adding 4 ml of each *C. guianensis* extract dropwise and stirring for 10 minutes with a magnetic stirrer until a deep green colour appeared. The reaction mixture was then agitated for another 1–2 hours at 60°C. The resultant reaction mixture was stored at room temperature for 12–14 hours before being centrifuged for 10 minutes at 10,000 rpm. The precipitates were rinsed with deionized water, then washed with 100% ethanol (2–3 times) to eliminate any remaining contaminants, before being dried in a 70 °C oven for 10 hours (S. Logambal *et al*., 2022).

Biosynthesis of Silver Nanoparticles Using *Couroupita guianensis:-*

The synthesis of silver nanoparticles was accomplished by mixing 1 mM of aqueous silver nitrate solution (AgNO3) with cannonball leaf extract in a 1: 10 ratio and heating at 80°C until the colour of the solution changed from brown to reddish brown. The solution was then cooled to ambient temperature before being centrifuged for 10 minutes at 5000 rpm. The pellet was air dried in the incubator after the supernatant was discarded (Preetha Devaraj *et al.*, 2013).

Silver nanoparticles, can be produced via chemical and biological pathways; are the most in frequent being synthesized for studies I fields of medicine, pharmaceutical, agricultural industry and also in water purification.

Silver nanoparticles (AgNPs) have unique optical, electrical and thermal properties and also AgNPs are incorporated in molecular diagnostics and photonic devices. Devaraj *et al*, 2013 experimented synthesis of AgNPs in aqueous extract of cannonball leaves. They tested these silver nanoparticles against MCF-7 breast cancer cell line but further study needs to be done for using it as anticancer drug.

Pandurangan *et al*., 2018 prepared extracts of leaves and fruits from cannonball tree and also tested for presence of phytochemicals present in them. They also synthesized silver nanoparticles from the extracts that they made, showing antimicrobial activity against pathogens indicating it for future use in medicinal and industrial uses. Nanoparcticles were tested for antibacterial activity against gram positive and gram negative organisms (Gopu *et al*., 2017).

Potential Commercial Applications:

Cannonball is a huge fruit which has wide spectrum of pharmacological activities. These are activities against microorganisms, fungi, viruses and also has activity against cancerous cells. all these diseases are very prominent these days. This huge tree has many different activities which can prove to be boon for mankind due to presence of secondary metabolites in this tree.

These metabolites help in working of pharmacological activities but more studies upon this plant needs to be done for making it more appropriate to work.

CONCLUSION:

As this beautiful tree is been seen to have many benefits with respect to human concern and was also used during ancient times, it can be also used in our futures. The phytochemicals or the secondary metabolites that are present is being used by the tree as defense against hosts and can also be useful to mankind. It's pharmacological activities of being antimicrobial, antifungal, anticancer, anti-inflammatory, antidiabetic can be a boon for modern medicine. *Couroupita guianensis* is a tree which has to be studied more deeper and it can be implemented in cure of various diseases.

References:

1. Al. Dhabi. N. A., Balachandran. C., Raj. M. K., Duraipandiyan. V., Muthukumar. C., Ignacimuthu. S., Khan. I. A., Rajput. V. S. Antimicrobial, antimycobacterial and antibiofilm properties of *Couroupitaguianensis*Aubl. Fruit extract *BMC Complementary and Alternative Medicine*, 12, 2012.
2. Sheba. L. A., Anuradha. V. An updated review on *Couroupitaguianensis*Aubl.: A sacred plant of India with myriad medicinal properties *Journal of Herbmed Pharmacology*, 9(1), 2020, 1-11.
3. S. Sumathi., R. Anuradha. *Couroupitaguianensis*Aubl: An updated review of its phytochemistry and pharmacology *Asian Journal of Pharmacy and Pharmacology*, 3(1), 2017, 1-8.
4. S. K. Gousia, Ashok Kumar. K., Vinay Kumar. T., LavanyaLatha. N. J., Biological Activities and Medicinal Properties of *Couroupitaguianensis*International *Journal of Pharmacy and Pharmaceutical Science Research*, 3(4), 2013, 140-143.
5. F. Jasmine. S., Moorthi. R. V., *Couroupitaguianensis*: The reservoir of medicinal compounds of human welfare *Asian Journal of Pharmaceutical and Clinical Research*, 10(3), 2017, 50-52.

6. R. Singh, Kumari. N., Gangwar. M., Nath. G., Qualitative Characterization of Phytochemicals and *in vitro* Antimicrobial Evaluation of Leaf Extract of *Couroupitaguianensis*Aubl. – A Threatened Medicinal Tree *International Journal of Pharmacy and Pharmaceutical Sciences* 7(7), 2015.
7. P. G. Morankar, Dhake. A. S., Kumbhare. M. R., Ushir. Y. V., Surana. A. R., Patil. S. D. An Evaluation of the Antidiabetic effects of *Couroupitaguianensis*Aubl. Flowers in experimental animals *Indo American Journal of Pharmaceutical Research*, 3(4), 2013.
8. Premanathan. M., Radhakrishnan. S., Kulangiappa. K., Singaravela. G., Thirumalaiarasu. V., Sivakumar. T., Kathiresan. K. Antioxidant and anticancer activities of isatin (1H-indole-2,3-dione), isolated from flowers of *Couroupitaguianensis*Aubl. *Indian Journal of Medical Research*, 2012, 822-826.
9. P. M. Ranjit, Harika. V., Soumya. M., Chowdary. Y. A., Phanikumar. K., Bhagyasri. T., Sunitha. B., Guntuku. G., *In vitro* Cytotoxic Activity and Antibacterial Activity of Various Flower Extracts of *CouroupitaGuianensis*, *International Journal of Pharmacognosy and Phytochemical Research*, 6(1), 2014, 113-117.
10. C. Ramalakshmi, Ranjitsingh. A. J. A., Kalirajan. K., Athinarayan. G., Mariselvam. R. A Preliminary Screening of Medicinal Plant *Couroupitaguianensis*for its Antimicrobial Agent against Clinical and Fish-borne Pathogens, *Elixir International Journal*, 57, 2013.
11. V. Prabhu, Subban. R. Isolation of Phytoconstituents from the flowers of *CouroupitaguianensisIndian Journal of Chemistry*, 56B, 2017, 709-713.
12. C. Ramalakshmi, Kalirajan. A., Ranjitsingh. A. J. A., Kalirajan. K. Bioprospecting of Medicinal Plant *Couroupitaguianensis*for its potential Anti-ulcer activity *International Journal of Applied Biology and Pharmaceutical Technology*, 5(3), 2014.
13. G. N. Shah, Shete. S. A., Patil. V. S., Patil. K. D., Killedar. S. G. Standardization of Anti Bacterial Activity of *Couroupitaguianensis*Fruit Pulp Extract *International Journal of Pharmacognosy and Phytochemical Research*, 4(4), 2013, 185-189.
14. S. Manimegalai, Sridharan. T. B., Rameshpathy. M and Devi Rajeswari. V. Antioxidant, phytochemical screening and antimicrobial activity of *Couroupitaguianensis*flower extract *Scholars Research Library*, 6(6), 2014, 251-256.
15. Murthy, S. K. (2007). Nanoparticles in modern medicine: state of the art and future challenges. *International journal of nanomedicine*, *2*(2), 129.
16. Devaraj, P., Kumari, P., Aarti, C., & Renganathan, A. (2013). Synthesis and characterization of silver nanoparticles using cannonball leaves and their cytotoxic activity against MCF-7 cell line. *Journal of nanotechnology*, *2013*.
17. Mariana M. G. P., Fernandes. S. B. O., Fingolo. C. E., Boylan. F., Fernandes. P. D. Anti-inflammatory activity of ethanol extract and fractions from *Couroupitaguianensis*Aublet leaves *Journal of Ethanopharmacology*, 146, 2013, 324-330.
18. A. R. Bafna, Mishra S. H., Deoda R. S., Bafna P. A., Kale. R. H. *In* vitro antioxidant activity of ethyl acetate fraction of water extract of flowers of*Couroupitaguianensis International Journal of Phatmacy and Pharmaceutical Sciences*, 3(4), 2011.
19. R. Sundararajan, Koduru. R. A complete profile on *Couroupitaguianensis* – Traditional uses, Pharmacological activities and phytoconstituents *Pharmacophore (An International Research Journal*), 5(1), 2014, 147-159.
20. Swapnalatha. S., V. Devi Rajeswari Antidiabetic activity of *Couroupitaguianensis*– A review *IOSR Journal of Pharmacy and Biological Sciences*, 9 (3), 2014, 41-43.
21. Ain. Q. U., Khan. H., Mubarak. M. S., Pervaiz. A Pant Alkaloids as anti-platelet agent: drugs of the future in the light of recent developments *Frontiers in Pharmacology*, 2016.
22. M. L. F. Ferreyra, Rius. S. P., Casati. P. Flavonoids: Biosynthesis, Biological functions and Biotechnological applications *Frontiers in Plant Science*, 2012.
23. K. T. Chung, Wong. T. Y., Wei. C. I., Huang. Y. W., Lin. Y Tannins and Human Health: A review *Critical Reviews in Food Science and Nutrition* , 38(6), 2010.

24. P. Devaraj, Kumari. P., Chirom. A., Renganathan. A. Synthesis and Characterization of Silver Nanoparticles Using Cannonball Leaves and Theiir Cytotoxic Activity against MCF-7 Cell Line *Hindawi*, 2013.
25. P. Pandurangan, Sahadeven. M., Sunkar. S., Dhana. S. K.N. Comparative Analysis of Biochemical Compounds of Leaf, Flower and Fruit of *Couroupita guianensis* and Synthesis of Silver Nanoparticles *Pharmacognosy Journal*, 10(2), 2018.
26. M. Gopu, Gurulakshmi. M., Estherlydia D. Screening of Nanoparticles blended *Couroupita guianensis* for its antibacterial activity against gram positive and gram negative bacterial pathogens *Journal of Pharmacognosy and Phytochemistry*, 6(6), 2017, 652-662.