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Review Article

COUROUPITA GUIANENSIS: THE RESERVOIR OF MEDICINAL COMPOUNDS OF HUMAN WELFARE

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ABSTRACT

Medicinal plants play a role in the traditional form of providing relief to several diseases. *Couroupita guianensis* is also a type of medicinal plant which has antibacterial, antimycobacterial, antimicrobial, antioxidant, antitumor, antiulcer, antinociceptive, anthelmintic, antifertility, and antifungal activities. The chemical constituent of *C. guianensis* such as indirubin serves as an antibacterial and antifungal agent because it particularly cures fungal diseases. It is active for the treatment of chronic myelocytic leukemia. The extract of isatin from the flower of *C. guianensis* is also a chemical component that has been used as prophylactic agent, prevents free radial-induced cancer, acts as a chemotherapeutic agent to kill cancer cells, and it has antioxidant (act as major defense) and anticancer activities against human promylocytic leukemia 60 cells. The extract of chloroform of fruit of *C. guianensis* shows good antimicrobial activity but low antimycobacterial activity. The plant extract of *C. guianensis* is equipotent to standard drugs such as paracetamol in its analgesic activity and indomethacin in its anti-inflammatory activity.

Keywords: Couroupita quianensis, Antibacterial activity, Anti tumor activity, Antioxidant activity, Anti biofil.

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INTRODUCTION

Couroupita guianensis Abul is commonly known as Ayahuma and Cannonball tree. It belongs to the family Lecythidacea having 325 tropical Trees belong to 15 genera. One of the species *C. guianensis* is found in the tropical regions of South America. In Brazil, it is popularly known as macaco cuida, abrico-de macaco, castanha-de-macaco, and amendoa-dos-anoles. In Hindi, it is said to be Kailashpati [1], in Telugu, it is said to be Mallikarjuna flower, and in Tamilnadu, it is said to be Nagalingam flower because the center of the flower resembles Sivalingam shape. It has snake-shaped pollen and very good fragrance [2]. The *C. guianensis* trees are 90' tall and indigenous to Amazon forest; leaves are up to 6" long, with serrate margin and flowers are Racemes; yellow, reddish, and pink with stunning fragment. Large 3" to 5" waxy aromatic smelling can be seen on the bark of the trunk (Cauliflory). Fruits are large, globose woody in nature, and look like big rusty cannon balls hanging in cluster and seeds are small, white, and have unpleasant smell with edible jelly. The hard shells are used to make containers and utensils. Medicinal uses of *C. guianensis*, in Chinese medication, constitute antipyretic, antidepressant, analgesic, antiseptic, anti-inflammatory, antiprotozoal, anticancer, and antiulcer activities. In Ayurveda, they are used extensively for its anti-inflammatory property. The flower of *C. guianensis* comprises antibacterial activity and antifungal property. The tree contains antibiotic, antifungal, antiseptic, and analgesic qualities. *C. guianensis* was used as an ingredient in many ways for curing gastritis, scabies, bleeding piles, dysentery, and scorpion poison. The various parts of *C. guianensis* such as leaves, flowers, and barks are used to treat hypertension, tumor, pain, and inflammatory reactions. Leaves are used to make juice which is used to treat skin diseases, and South Americans use each part of the *C. guianensis* tree to treat malaria. The studies of chemical constituents show the presence of α-amirin, β-amirin, β-sitosterol, nerol, tryptanthrine, indigo, indirubin, isatin, linoleic acid, carotenoids, and sterols [3-8]. Singh *et al*. [9] reported that aqueous extract of *C. guianensis* is endowed with flavonoids, alkaloids, phlorotannins, glycosides, tannins, steroids, and terpenoids. Isatin is also a chemical constituent of *C. guianensis* that has antioxidant activity, is cytotoxic to human promylocytic leukemia (HL60) cells, and it is used as a prophylactic agent to prevent free radial-induced cancer and as a chemotherapeutic agent to kill cancer cells.

ANTIBACTERIAL ACTIVITY

Extract of *C. guianensis* has been proved to have an excellent antibacterial activity. Ethyl alcohol extract of fruit (pulp) of *C. guianensis* has reported to have an excellent antibacterial activity against Gram-positive (*Staphylococcus aureus* and *Bacillus subtilis*) and Gram-negative (*Escherichia coli* and *Pseudomonas aeruginosa*) bacteria [2]. Similarly, chloroform extract of fruit of *C. guianensis* tested using disc diffusion method has found to be active against Gram-positive and Gram-negative bacteria. In this, the chloroform extract of *C. guianensis* exhibited 26 and 20 mm of zone of inhibition (ZOI), respectively, against *S. aureus* and *Shigella flexneri*. In case of clinical isolates, *E. coli* (ESBL-3984) was highly susceptible to chloroform extract of *C. guianensis* with 20 mm ZOI. The ZOI of other isolates was ESBL-3904 (18 mm), ESBL-3971 (14 mm), ESBL-75799 (16 mm), ESBL-3894 (15 mm), ESBL-3967 (12 mm), and MRSA (18 mm) [10]. Similarly, Singh *et al*. [9] reported the susceptibility of Gram-positive bacteria against chloroform extract of *C. guianensis* compared to Gram-negative bacteria. The minimum inhibitory concentrations (MICs) of ethanol, methanol, and chloroform extracts of *C. guianensis* were 25, 50, and 100 mg ml^{-1}, respectively [9]. Antibacterial activity of plant extract of *C. guianensis* was observed in two different solvents, namely dichloromethane and acetone. The acetone extract of *C. guianensis* showed 25 mm ZOI against *Staphylococcus* sp., whereas in dichloromethane extract, it was 28 mm. The bioactive compound of *C. guianensis* that possesses antibacterial activity was also assessed. Indirubin was used as an antibacterial agent. In particular, it was effective against fungal diseases such as dermatophytic and skin lesion diseases [2]. Al-Dhabi *et al*. [9] reported that chloroform extract of fruit *C. guianensis* has a sensible antimicrobial activity at 0 to 26 mm of ZOI. Methanol and aqueous leaf extracts of *C. guianensis* were screened against six bacteria and four fungal pathogens to check for antifungal activities. The methanol extract of *C. guianensis* showed ZOI between 31-12 mm and 19-8 mm against bacteria and fungi, respectively [11]. Antimicrobial activity against Gram-positive bacteria such as *S. aureus* showed 11 mm of ZOI and antimicrobial activity against Gram-negative bacteria such as *coli* showed 16 mm of ZOI, *P. aeruginosa* showed 15 mm of ZOI, and *Klebsiella*. These antimicrobial activities were compared in the review [12]. The Dichloromethan and acetone extract of C. quianensis showed 25 and 28mm ZOI against S. aureus. with ZOI

of 25 and 28 mm, respectively, and the compound responsible for this antibacterial activity was also partially purified. Shah *et al*. [14] have also recorded the antibacterial activity of ethanol extract of pulp of *C. guianensis* and found susceptibility of *B. subtilis* (18 mm) compared to *S. aureus* (13 mm) and *E. coli* (12 mm). A similar study was also done by Azimi *et al*. [15]. Regina *et al*. [16] Reported the antibacterial property of solvent extracts of fruit rind of *C. guianensis.* Similarly, Ramalakshmi *et al*. [17] reported the similar kind of activity in methanolic extract of fruit of *C. guianensis.*

ANTIBIOFILM PROPERTY OF *C. GUIANENSIS*

Biofilm-associated diseases are caused by Gram-positive bacteria including caries, gingivitis, peritonitis, endocarditis, and prostatitis. Indirubin is one of the important chemical components of *C. guianensis* which is used as an antifungal agent, particularly to cure fungal diseases, dermatophytic and skin lesion diseases. It is active for the treatment of chronic myelocytic leukemia. It suppresses the autophosphorylation of fibroblast growth factor receptor-1 but stimulates extracellular signal and regulates kinase (ERK1/2) activity through P38 mitogen-activated protein kinase. An inhibition of biofilm formation was obtained at low concentrations with 52% inhibition [23].

ANTIMYCOBACTERIAL ACTIVITY

The chloroform extract of fruit of *C. guianensis* was tested against *M. tuberculosis* H37RV and rifampicin. The MIC was determined using microdilution assay. This was performed in sterile MiddleBrook 7H9 broth supplemented with 10% albumin-dextrose-catalase. The plates were incubated at 37° C under 5% CO_2 for 2 weeks [2]. Chloroform extract of *C. guianensis* has antimycobacterial activity at 0 to 26 mm of ZOI and it is effective against *Plesiomonas shigelloides*, *Cocci aureus*, *Vibrio mimicus*, and *Proteus vulgaris* and there was a moderate activity against *E. coli*, *Klebsiella pneumonia*, *and Salmonella typhi* [10]. Chloroform, hexaneane, and ethanol extracts of fruit of *C. guianensis* showed vital antibacterial (10 mg/ml) and antifungal activities (10 mg/ml). The concentration (10 mg/ml) during fermentation of ethanol extract showed sensible restrictive activity against *Candida albicans* [16]. In fungi, the chloroform extract of *C. guianensis* shows moderate activity against *C. albicans* (18 mm) and *Malassezia pachydermatis* shows 16 mm of ZOI. *C. albicans*, which causes candidacies, is an opportunistic pathogen, mostly found in patients with AIDS [10].

WOUND-HEALING PROPERTY

Ethanol extract from whole plant (barks, leaves, flowers, and fruit) of *C. guianensis* hurries wound healing by increasing the enduringness [24]. Umachigi *et al*. [24] reported that the wound-healing activity in ethanolic extract of whole plant of *C. guianensis* accelerates wound healing by decreasing the surface area of wound and increasing the tensile strength [11].

ANTIOXIDANT ACTIVITY

Bafna *et al*. [25] reported the property of antioxidant present in the ethyl acetate fraction of *C. guianensis.* Extracts of *C. guianensis* (flower) have antioxidant and antitumor activities [26].

ANTITUMOR ACTIVITY

Cytotoxicity against HL60 cells was determined by (3-(4, 5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay. Isatin is a vital compound present in *C. guianensis* that shows solid inhibitory activity with Ec_{50} worth of 72.80 µg/ml and HL60 cells in a dose-dependent manner by CC_{50} worth of 2.94 µg/ml which lead eventually to caspase-mediated cell death confirmed by fluorescence-activated cell sorting analysis (Sundarajan and Koduru, 2014). The flower of *C. guianensis* consists of isatin compound that has cytotoxicity against human carcinoma cell lines. It has the potential to be used as a chemotherapeutic agent against cancer. Isatin isolated from floral parts exhibited cytotoxicity against HL60 cells [11]. Prabhu and Ravi [27] found that the methanolic extract of flower of *C. guianensis* showed an excellent anticancer activity against HeLa (202.6 µg/mL), NIH3T3 (280 µg/mL), and HepG2 (470.8 µg/mL). Prabhu and Ravi [27] extracted stigmasterol and quercetin from methanol leaf extract of *C. guianensis* and quantified as 242.14 and 188.97 $\mu g/ml^{-1}$, respectively.

ANTIULCER ACTIVITY

Ethanolic extract of leaves of *C. guianensis* shows an excellent antiulcer activity [28]. Ethanolic extract of *C. guianensis* (150 mg/kg and 300 mg/kg) has the ability to inhibit the leukocyte migration into peritoneal cavity after the carrageenan injection. Almost a dose of 100 mg/kg abolishes the cell migration. *C. guianensis* fractions have anti-inflammatory effect. Hence, they exhibit reduction on cell migration and inhibit cytokine and inflammatory mediator production [2]. Hence, there is gastric lesion formation due to gastric blood flow which contributes to the development of hemorrhage and narcotic aspects of tissue injury [11].

ANTINOCICEPTIVE ACTIVITY

Pinheiro *et al.* reported that ethanol extract of *C. guianensis* leaves exhibited antinociceptive activity [29], by three analgesic models (acetic acid-induced contortions, tail flick, and hot plate). CEE (crude ethanol extract) and fractions inhibited the number of contortions induced by acetic acid.

ANTHELMINTIC ACTIVITY

Chloroform, acetone, and ethanolic extracts of *C. guianensis* flower have good anthelmintic activity. However, the alcohol extracts are more effective than chloroform and acetone extracts. This activity was compared with the standard drug Piperazine citrate [2].

ANTIFERTILITY ACTIVITY

Benzene, ethyl alcohol, and water extracts of bark and flower of *C. guianensis* showed antifertility activity in assorted stages of estrus cycle in female rats [30]. Ethyl alcohol extract of flower of *C. guianensis* supports the quantity of implantations [2].

ANTIFUNGAL ACTIVITY

Despax *et al*. [31] proposed that granules formed cell along with serious structural and morphological damage on cellular membranes when fungi were treated with AgNPs granules composed of Ag, sulfur, phosphorous, and nitrogen on cellular walls and in the cytoplasm of yeast, with increased concentration of cellular walls. Ionic silver released from silver nanoparticles inhibits the respiratory enzymes that can induce oxidative stress upon the generation of reactive oxygen species [32].

PRECURSOR FOR NANOPARTICLE SYNTHESIS

Presence of highly active bioactive compounds paved the way for using *C. guianensis* as a precursor for the synthesis of various types of metal and other nanoparticles. Subramaniam *et al*. [33] have used flowers of *C. guianensis* for the synthesis of gold nanoparticles (AUNps) and reported the larvicidal property against *Anopheles stephensi.* Antiplasmodial activity of the AUNps synthesized from *C. guianensis* was also recorded by Subramaniam *et al*. [33]. Similarly, Vimala *et al*. [34] have used leaf and fruit extracts for the synthesis of silver nanoparticles (AgNps). In this, they observed an excellent larvicidal activity against *Aedes aegypti* with LC_{50} value of 2.1 and 2.09 ppm with respect to leaf and fruit extract-synthesized AgNps. Sathishkumar *et al*. [35] also used fruit extract of *C. guianensis* for the synthesis of AUNps and revealed its antioxidant activity. Kumar *et al*. [36] have used have used flower buds of *C. guianensis* for the synthesis of AgNps and reported their excellent antibacterial activity against *Micrococcus luteus* and *B. subtilis* with ZOI of 24 and 23 mm, respectively.

CONCLUSIONS

From this study, it can be concluded that *C. guianensis* has many medicinal values and has various homeostatic, antipyretic, anti-inflammatory, and sedative properties in the treatment of bacterial and viral infection. Thus, the plant can be further explored for its phytochemical profile to identify the active constituents responsible for the above-mentioned activities.

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