



A REVIEW ON EVALUATION OF PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITY OF PAULLINIA PINNATA

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ABSTRACT

African woody vine *Paullinia pinnata* L. (Sapindaceae) is traditionally used to cure itch and pain-related illnesses including rheumatoid arthritis. Infectious diarrhoea, subacute toxicity, biochemical measures, histological analysis, and *Paullinia pinnata* have all been linked to folkloric medicine use. Investigations into the leaves confirmed various therapeutic potentials and several claims made in conventional medicine. These substances come from a variety of secondary metabolite classes, including as tannins, flavonoids, and alkaloids. The report of *P. pinnata* list the scientific findings as well as the traditional uses of *P. pinnata* leaves. The powdered leaves of the plant tested positive for steroids, triterpenes, alkaloids, saponins, tannins, and anthraquinones in the phytochemical research of the plant. The activity of *P. pinnata* shows results in antihypertensive, antimalarial, analgesic and antioxidant. phytochemical studies of this plant extract revealed in the presence of phenols, steroids, flavonoid, triterpenes, tannins, ceramides, steroidal glycosides, saponins, cerebroside.

KEYWORDS: *Paullinia pinnata*, Phytochemical Constituents, Anti Diarrhoeal, Anti Typhoid, Anti-Malarial,

1. INTRODUCTION

Medicines made from plants have been used for thousands of years. Medicinal plants can be utilized therapeutically and serve as building blocks to produce medicines. Old literature, mythological tales, folklore, medical treatises, epic poetry, thousands-of-year-old manuscripts, copper plates, palm leaves, and other information on these societies that is still preserved today all contain information about medicinal plants.^[1] Algae, which primarily dwell in water, are not included in the contemporary definition of plants, which includes organisms that live primarily on land and occasionally in water. The use of medicinal plants for income generating and the treatment of various illnesses and disorder. In the world, the use of medicinal plants predates the introduction of modern drugs into the African continent, and in many instances, these modern drugs are carbon copies of chemicals identified in plants.^[1]

Paullinia is a genus of flowering shrubs, small trees, and vines in the Sapindaceae family, native to tropical South America, Central America, and the Caribbean. The genus is named after the German medical botanist Christian Franz Paullin, who discovered the genus in the Caribbean in the 18th century. We have discovered several species new to science from the Neotropical genus *Paullinia*. It is one of the largest families of Sapindaceae, with more than 200 species.^[2]

- * *Paullinia alata*
- * *Paullinia cupana*
- * *Paullinia cururu*
- * *Paullinia fuscescens*
- * *Paullinia navicularis*
- * *Paullinia paullinioides*
- * *Paullinia pinnata*
- * *Paullinia plumieri*
- * *Paullinia weinmannifolia*
- * *Paullinia yoco*

Multiple uses are registered. The fruits of several species are edible, the most popular is *P. cupana* (Guarana). Other species, especially *P. yoco* (Yoco), are used as herbal medicines in various therapeutic methods. The juice of some species, especially *P. cururu*, is very poisonous and is used as arrow poison by Native American tribes in South America. The long stems of *Paullinia pinnata* are used to poison fish in shallow ponds, as described by the English naturalist Henry Walter Bates.^[3]

Paullinia cidiii differs from *P. bipinnata* Poir., *P. filicifolia* Cuatrec. and *P. hondurensis*. the only three genera that have leaves with partially triangular outlines due to the globose, long-striped wingless capsules. It is unique in *Paullinia* because it has the combination of characters mentioned. Stems terete, striated, slightly

hairy, smooth, becoming dark brown with blackish-reddish-brown lens lines when ripe, cross-section simple. bulbs long, pubescent. Leaves partly three-lobed, triangular contours; stem narrowly winged or marginal, long, winged 3.8–5 cm long, midrib ciliate or glabrous or puberulent on both surfaces, sometimes glandular abysally, attenuated at the peduncle and stem, obtuse, rounded, or truncate apex, toothed.^[21] Capsule compressed globose, wingless, reddish, weakly 6-colored, crusty, puberulent taste, with a slightly visible network of veins and a groove 3–6 mm long; mesocarp 0.1–0.2 mm thick; endocarp glabrous. Seeds per capsule, compressed globose, dark brown, pilose, white, bifoliate aril in lower third; the embryo is a depressed ovule, the cotyledons are suberect.^[4]

South America and Africa are home to the *Paullinia Pinnata* (Fig.1) species of flowering plant, which belongs to the *Paullinia* genus.

Country: plantae

Paullinia is a Genus

Paullinia pinnata is Species.

Sapindales, in that Order

“Family” Sapindaceae

Local Name: Tuantini

Synonyms: Semariilaria Ruiz&Pav



Fig. 1: Leaves of *Paullinia pinnata*.

Plants are eukaryotes, mainly photosynthesizing and form the kingdom Plantae. Many are multicellular. In the past, all organisms that were living but weren't animals were part of the flora. Sapindales are flowering plants. Citrus, maples, horse chestnuts, lychees, and rambutans; mangoes and cashews; frankincense and myrrh; mahogany and cape cod are well-known examples of the Sapindales.^[5] Sapindaceae is a family of flowering plants in the Sapindaceae family known as soapberry. It contains 138 genera and 1,858 recognized species. For example, horse chestnut, maples, acacia. Sapindoideae is a family of sap plants in the Sapindaceae, a subfamily of flowering plants. It contains several fruit trees, including lychees, longans, rambutans and quenepas.^[5]

Paullinia pinnata, also known as sweet gum, hannu biyar, and itakun-okere, is a woody African vine that is indigenous to Cuba, Central America, South America, and tropical Africa. Its fruits are frequently consumed.

South America, specifically Argentina, Bolivia, Peru, Paraguay, the Caribbean, and Central America, is where the plant can be found. South to Zimbabwe in tropical Africa, from Senegal to Sudan. Common names include Timbo, Tie tie, Leyland Cypress, Basket Wiss, Barbasco, and Bread and Cheese.^[6] According to the English scientist Henry Walter Bates' book, *Paullinia pinnata*'s long, flexible stems are used to poison fish in small pools. Tietie is a climbing shrub that develops woody stems that can climb and are at least three meters long. The primary element of this species identified by Linnaeus was not included in the usage of the name *Paullinia pinnata*. The name *Paullinia* would be rejected if it were typeset by this element. It is a climbing shrub distinguished by winged rachis, petiole, and leaflets with prominent serrated veins. When ripe, the fruits are red or dark pink and the flowers are white. Different *P. pinnata* parts are used to treat various diseases in conventional medicine. The University of Ibadan in Oyo State, Nigeria's environment is where the fresh leaves of *P. pinnata* were found.^[6]

Studies on the phytochemistry of this plant extract showed that phenols, flavonoids, triterpene, saponins, tannins, steroids, steroidal glycosides, cerebroside, and ceramide were all present. Additionally, the phytosterols friedelin, sitosterol, and sitosterol glucoside as well as several fatty acids were discovered to be present in the leaves and roots. The leaves have also yielded a cardiogenic tannin, ceramides, cerebrosides, several triterpenoids, trioxaphenanthrene, and two unusual flavone glycosides.^[7]

Secondary metabolites from the stem have received less attention from studies, but it has been claimed that they contain oleanane-type triterpenoid saponins that have antibacterial and antifungal properties. However, it has been claimed that the stem contains antibacterial and antifungal triterpenoid saponins of the oleanane type. For semi-polar to polar extracts, the presence of condensed tannins in *P. pinnata* has been documented numerous times. There are three triterpenes in *P. pinnata*: a Fig.2 flavotanin, a triterpene glycoside, and a Fig.3 triterpene saponin.^[8]

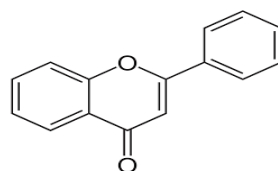


Fig.2 Flavotanin

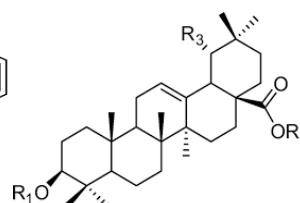


Fig.3 Triterpene

Traditional medicine treats erectile dysfunction, malaria, and dysentery with *P. pinnata* leaves and roots. The leaves are used to treat diseases like rabies, mania, mental illness, eye problems, blindness, and abdominal pain. Young children with metabolic disorders can be treated using a leaf infusion. In some scientific investigations, the stem bark of *P. pinnata* has proven to

have anticonvulsant properties.^[8] The roots are frequently soaked in a solution of alcohol and water. Aphrodisiacs contain roots. As a vegetable, leaves are prepared. In West Africa, the leaf decoction is used for diarrhoea, dysentery, and yellow fever, while the leafy twig decoction is used for jaundice, yellow fever, and heart irregularities. Leprosy, nausea, vomiting, sore throat, and black-coated tongue are all treated with roots, and fever is treated with an infusion.^[9]

The effects of the leaf ethanolic extract on malaria infections in *Plasmodium berghei*. These effects include wound healing, antivenom, and inhibitory effects against several infectious organisms. The impact of *P. pinnata* leaf fractions in methanol, ethanol, and chloroform on *Anopheles gambiae* larvae in their third and fourth instars. In the West Region of Cameroon, *Paullinia pinnata* Linn is a liana that is used to treat bacterial infections like typhoid fever, syphilis, gonorrhea, diarrhoea, and symptoms like stomachache and waist pain. The leaves are said to be used in east Africa to treat gonorrhea, wounds, and microbial infections.^[10]

Previous studies on phytochemistry have revealed the presence of cardiogenic catechol tannins and triterpene saponins in *P. pinnata* collected from various regions of Africa, as well as flavone glycosides, steroids, and steroidal glycosides, a cerebroside, and a ceramide, and antibacterial fatty acids. *P. pinnata* leaves were gathered at Nkoupa-Matapit in Cameroon's Western region. At the Cameroon National Herbarium, the plant was identified by comparison with specimen of *P. pinnata* Linn. *pinnata* leaves were cut from the twigs, gently rinsed to remove dirt and debris.^[10]

Paullinia pinnata root were gathered between April and June 2014 in the Ashanti region. A voucher specimen has been deposited in the herbarium of the Institute of Pharmaceutical Biology and Phytochemistry at the University of Münster in Germany following botanical identification. The University of Ibadan in Oyo State, Nigeria's environment provided the fresh *P. pinnata* leaves. They were identified at the Department of Botany, University of Ibadan's herbarium unit. A Soxhlet extractor with methanol was used to create plant extract from the powdered sample.^[11]

The side effects associated with the use of *P. pinnata* in the treatment of bacterial infections, which should be very useful for future in vivo studies and clinical trials of this medicinal plant. The methanol extract of *P. pinnata* leaves, although very effective in the treatment of typhus, is somewhat toxic, especially in high doses and in females. can restore typhoid-induced changes in liver histology in a dose-dependent manner. However, additional parameters need to be measured to confirm this. At higher doses, it has harmful side effects that cause liver changes in women. It negatively affects toxicity biomarker levels in female rats. Therefore, this herb should be used with caution in men and should

probably be omitted in the treatment of female patients.^[11]

2. PHYTOCHEMICAL EVALUATION OF PAULLINIA PINNATA

Quantitative phytochemical evaluation specifies that the leaves of all varieties contain significant concentrations of alkaloids, flavonoids, phenol, saponin and tannin. Sensory and phytochemical screening methods are used for identification and verification of crude and final herbal medicines to identify species-specific compounds and properties. Phytochemical screening was performed to identify secondary metabolites of the plant for possible medicinal purposes. This involved using established methods to screen for saponins, tannins, alkaloids, cardenolides and anthraquinones. The plant was found to include phenols, flavonoids, triterpenes, saponins, tannins, steroids, steroid glycosides, cerebroside, and ceramide according to phytochemical tests.^[12]

2.1 PHENOLS

Phenol is an antiseptic and disinfectant agent. It is active against many microorganisms, including some fungi and viruses, but is slow to act against spores. It was used to disinfect the skin and relieve itching. It is also used as an oral pain reliever or anaesthetic such as Chloraseptic to treat pharyngitis. The largest class of phytochemicals, known as phenols, is responsible for the majority of the antioxidant action in plants and plant-based products. *pinnata* root and leaf methanolic extracts are rich in phenolic compounds Phenol and similar compounds are used in surgical treatment of ingrown toenails called phenolization. Phenolic compounds are used to treat bacterial infection, anthelmintic, and hypertension.^[14]

2.2 FLAVANOID

Flavanoid is a secondary metabolite consisting mainly of a benzopyrone ring with phenolic or polyphenolic groups in various positions. They are found mostly in fruits, herbs, stems, grains, nuts, vegetables, flowers, blossoms, and seeds. It has several medicinal benefits, including anti-cancer, antioxidant, anti-inflammatory and antiviral properties. They also have neuroprotective and cardioprotective effects. These biological effects depend on the type of biological effect. The flavonoids exhibit potent anti-inflammatory Activity. These might be responsible for the analgesics.^[12]

2.3 TRITERPENES

Triterpenes are a subclass of terpenes that have the chemical formula $C_{30}H_{48}$ and six isoprene units. They can alternatively be thought of as having three terpene units. Squalene, the precursor to all steroids, is one of the triterpenes that are produced by animals, plants, and fungus. Almost 200 different skeletons have been identified. In general, these skeletons can be divided based on the quantity of rings present. In general, pentacyclic structures tend to predominate. Triterpenoids have been reported to exhibit various biological activities

such as antibacterial, antiviral, antitumor, antiosteoclastic differentiation, hepatoprotective, antioxidant, antihypertensive, cholesterol-lowering, and anti-aggregation activities. It is used for symptomatic treatment of ulcers and mouth ulcers.^[13] Triterpene glycosides, sometimes referred to as saponins, are poisonous, bitter-tasting plant organic compounds that froth when combined with water. They are widely distributed, but are especially found in soap root, flowering plant, soap peel and soybeans. They are utilized in carbonated beverages, soaps, medications, fire extinguishers, and especially as food supplements. Saponins have useful soapy characteristics since they are both fat- and water-soluble. Some examples of these chemicals are liquorice and quillaia, a bark extract used in beverages. Saponins reduce blood lipids, cancer risk and blood sugar response. A saponin-rich diet can be used to prevent dental caries and platelet aggregation, to treat hypercalciuria in humans, and as an antidote to acute lead poisoning.^[13]

2.4 TANNINS

A type of astringent polyphenolic macromolecules called tannins (or tannoids) attach to and precipitate proteins as well as a variety of other organic substances, such as amino acids and alkaloids. Tannin compounds are widespread in many plant species, where they play a defence against predators and can help regulate plant growth. The astringent effect of tannins makes the mouth feel dry and wrinkled after consuming unripe fruit, red wine, or tea. Tannins are used in photography, as dyes in dyeing, in the clarification of wine and beer by precipitation of proteins from them, and as astringents in medicine.^[14]

2.5 STEROIDS

Steroids, also called corticosteroids, are anti-inflammatory drugs used to treat several diseases. These are distinct from anabolic steroids, which some individuals frequently use illicitly to enhance muscular mass. Steroids reduce redness and swelling. It can help with inflammatory conditions such as asthma and eczema. Additionally, steroids weaken the immune system, the body's natural defence against illness and infection.^[14]

2.6 STEROIDAL GLYCOSIDES

Cardiac glycosides are a group of chemical substances that slow down the sodium-potassium ATPase pump in cells to increase cardiac output and slow down the rate of its contraction. However, these compounds, which are most often found as secondary metabolites in several plants such as sedges, have various biochemical effects on heart cell function and have also been proposed for use in cancer therapy. They are selective steroid glycosides and important drugs in the treatment of heart failure and cardiac arrhythmias.^[15]

2.7 CERAMIDES

Ceramides are the main lipid substance of the laminae in the intercellular spaces of the stratum corneum. It plays a role in the development of the brain and nervous system, but they are also important to maintain healthy skin. They create a barrier that helps prevent moisture from evaporating keeping skin hydrated, firm, and supple. The barrier also protects the skin from harmful irritants, bacteria, and other environmental toxins.^[15]

2.8 CEREBROSIDES

Cerebrosides is the general name for a group of glycosphingolipids called monoglycosyl ceramides. They are important components of animal muscles and nerve cell membranes. They are made of 1-hydroxyl ceramide with a single sugar residue. The sugar residue can be either glucose or galactose; the two main types are therefore called glucocerebrosides and galactocerebrosides. Galactocerebrosides are usually found in neural tissue, while glucocerebrosides are found elsewhere. While glucocerebrosides can be found elsewhere, galactocerebrosides are typically found in neural tissue. In the skin, it plays a role in enabling the skin's protective function of water permeability.^[16]

3. PHARMACOLOGICAL ACTIVITY

Pharmacological activity in pharmacology refers to a drug impact on living things, either positively or negatively. This activity is manifested by the pharmacophore of the active ingredient or substance when the drug is a complex chemical mixture, although it can be modified by other substances.^[16] Pharmacological/biological activity is one of many properties of chemical compounds that are important because it indicates the use of the compounds in medical applications. However, chemical agents can have harmful and harmful effects that can prevent their use in medical procedures.^[16]

3.1 ANTI OXIDANT ACTIVITY

Antioxidants are compounds that stop oxidation, a chemical process that can generate free radicals (also referred to as autooxidation). Organic molecules, including those in living organisms, degrade due to oxidative stress.^[17] Antioxidants are frequently added to industrial products, such as polymers, fuels, and lubricants, to extend their usable lifetime. Additionally, antioxidants are added to food to stop food from going bad, especially the rancidification of oils and fats.^[17] Cells under oxidative stress can be protected from damage by antioxidants like glutathione, mycothiol, or bacillithiol as well as enzyme systems like superoxide dismutase. The risk of several diseases, such as heart disease and some types of cancer, may be decreased by eating a diet rich in antioxidants. Antioxidants remove free radicals from the body cells and stop or lessen oxidation-related damage.^[11] Antioxidants' protective effects are still being researched globally. Phenolic compounds such as flavonoids, phenolic acids, diterpenes and tannins are of particular interest to

researchers due to the high antioxidant activity of these compounds. They are very important in preventing the onset and progression of many human diseases.^[18]

This property has been reported to be due to the restoration of redox balance to an imbalance that may have been disturbed by various factors (such as diet, alcohol, and some drugs) and the consequent reduction of damage to cellular structures. In recent years, several antioxidants derived from polyphenols and other medicinal plants have become widely available. Phytochemical studies have shown that this plant contains cardiogenic catholytanins and triterpene saponins.^[18] Recently, two new flavonoid glycosides were isolated because of phytochemical studies of aerial parts of *P. pinnata*. In addition, previous researchers have shown that methanol works well in the extraction of antioxidants.^[11] Therefore, the aim of this study was to evaluate the possible positive antioxidant properties of the methanolic extract of this plant. Chemicals used in potassium ferricyanide, catechin, tannic acid, quercetin and ferric chloride were purchased from Sigma Chemical. The vanillin was from London, USA; and Folin-Ciocalteu phenol reagent and sodium carbonate were from Merck Chemicals. Solvents and all other compounds were of analytical grade.^[19] The plant was collected in Oyo State and authenticated at the Nigerian Forestry Research Institution. The iron reduction potential of the extract was further determined by the Oyaizu method. The phenolic, flavonoid and proanthocyanidin concentrations of the extracts were most medicinal plants and showed a good correlation with its antioxidant activity^[19].

3.2 ANTIDIARRHOEAL PROPERTY

Diarrhoea is defined as loose or watery stools at least 3 times a day or more often than usual. Diarrhoea is a major cause of mortality and morbidity, particularly among children in developing countries, due to significant dehydration leading to death or other outcomes. *Shigella* is the most common dysenteric organism in developing countries, where it causes 10% of acute diarrhoea in children under 5 years of age.^[20] Atrocin, atromyxaxia-methoxazole, nalidixin, fluoroquinolone and ciprofloxacin are the main agents used to treat diarrhoea. Pathogens have developed resistance to antibiotics, which opened the door to the study of medicinal plants for antimicrobial activity. Several African medicinal plants have been reported to be useful in the treatment, control, and management of infectious diseases, including root extracts used in the treatment of African diarrhoea. *Hea. P. pinnata* has been intensively studied for its pharmacological effects, few studies have shown its properties in infectious diarrhoea.^[20]

This study examines the subacute toxicity and in vivo antidiarrheal activity of *P. pinnata*'s ethanol extract in Wistar rats. The anti-diarrheal activities of medicinal plants are related to phytochemical constituents

including flavonoids, tannins, saponins, sugars, sterols, and/or terpenes. The leaves of *B. Abyssinia* contain most of the listed phytochemicals that contribute to its anti-diarrheal activities observed in this study.^[20] The antidiarrheal activity of medicinal herbs is related to phytochemical constituents, including flavonoids, tannins, saponins, sugars, sterols, and terpenes. *B. Abyssinia* leaves contain most of the listed phytochemicals that contribute to its antidiarrheal effects observed in this study. The ethanolic extract of *P. pinnata* had lower weight gain when compared with that of the control groups. For the investigation, *S. flexneri*, a cause of diarrheal illness, was used. This clinical isolation was obtained from the bacterial strain.^[21]

3.3 ANTITYPHOID ACTIVITY

Typhoid, often known as typhoid fever, is a sickness caused by *Salmonella* of the serotype Typhi. Six to thirty days after exposure, mild to severe symptoms may start to manifest. Frequently, a high fever comes on gradually over a few days. This is commonly accompanied by weakness, stomach pain, constipation, headaches, and mild vomiting. Pink patches on the skin are present in some people's rashes. In severe cases, people may experience confusion. If unattended, symptoms could last for several weeks or even months.^[22] Diarrhoea may be severe but is uncommon. Those who carry the infection can still spread the disease to others even if they are unaffected by it themselves. Typhoid fever is an example of an enteric fever, along with paratyphoid fever. *S. enterica* Typhi is believed to only infect and reproduce in humans. Antityphoid is used to prevent fever an infectious disease spread by dirty water and food. *Salmonella* is one of the genera of the family Enterobacteriaceae.^[22] Medically important salmonellosis includes *Salmonella typhi*, *Salmonella Para typhi A*, *Salmonella Para typhi B*, which cause typhoid fever, A and B fever. *Salmonella typhimurium* is the species that causes typhoid in animal experiments. There are an estimated 16 million episodes of typhus worldwide, resulting in 600,000 deaths each year. Most infections and deaths in developing countries where typhus is endemic are associated with peritonitis with perforation of small intestinal Peyer's ulcer patches. These intestinal complications are caused only by *Salmonella enterica* serotype Typhi. Traditional antimicrobials are increasingly available to the common people in Africa due to rising costs. In addition, resistance to all three first-line antimicrobials (i.e., Chloramphenicol, ampicillin, and co-trimoxazole) is increasing. In addition, chloramphenicol, which had long been the drug of choice for typhoid fever, was withdrawn from the market due to its marrow toxicity.^[23]

This infection causes acute inflammation, which causes lymph tissue to detach from the surrounding mucosa. In addition, salmonella entering the body causes the production of superoxide and nitric oxide, which react together to form peroxynitrite as a strong biological oxidant. Oxidative stress occurs when organisms are

exposed to high levels of reactive oxygen species such as superoxide anions, hydrogen peroxide, and hydroxyl radicals. Most cells, including prokaryotic cells, create reactive oxygen intermediates during aerobic respiration at modest rates.^[23] Reactive oxygen species can cause serious health problems, including sickle cell anaemia, atherosclerosis, Parkinson's disease, heart failure, myocardial infarction, Alzheimer's disease, schizophrenia, and chronic fatigue syndrome. On the other hand, antioxidant compounds such as polyphenols, phenolic acids, flavonoids, and carotenoids prevent the development of chronic complications partly through their interaction with reactive oxygen species and their ability to scavenge free radicals. Treatment of bacterial infections such as typhoid, syphilis, gonorrhea, diarrhoea, and symptoms such as abdominal and backpain. The World Health Organisation were available typhoid vaccines preferred in all age groups due to its improved immunological characteristics, suitability for younger children, and expected longer duration of protection. There are two typhoid vaccines. One is an inactivated vaccine and the other is an attenuated live vaccine. Your doctor can help you decide which type of typhoid vaccine is best for you. The inactivated typhoid vaccine is given by injection. People who receive the typhoid vaccine need one dose at least 2 weeks before travel and a booster shot every 2 years. People who receive the oral typhoid vaccine need 4 doses every other day for a week, the last one at least a week before travel, and a booster every five years.^[22]

3.4 ANTIMALARIAL ACTIVITY

A condition brought on by the Plasmodium parasite and transmitted by mosquito bites. Depending on the Plasmodium species, the severity of malaria varies. Symptoms include chills, fever, and sweating, which usually appear a few weeks after the bite. People who travel to areas where malaria is common usually use protective medications before, during and after travel.^[12] Treatment includes antimalarial drugs. Four different malaria parasites infect humans: Plasmodium falciparum, P. vivax, P. ovale and P. malariae. Antimalarial drugs, or simply antimalarial drugs, are often natural antiparasitic chemical agents that can be used to treat or prevent malaria, the latter most often in two vulnerable target groups, young children, and pregnant women.^[23] Malaria is a major cause of death and illness among children and adults in tropical countries. The death rate, now estimated at more than a million people a year, has risen in recent years, likely due to increased resistance to antimalarial drugs. This has led scientists to look for other avenues, one of which is the study of medicinal plants. The acquisition of artemisinin from Artemisia annua further encouraged malaria phytotherapists to revisit herbs commonly used in the traditional treatment of the disease.^[23]

Paullinia pinnata is a stiff and strong woody vine that tunnels into forest openings and climbs rocks and trees with forced tentacles to reach full sunlight. It can be

extension or more stem diameter. The plant is easily recognized by its leaves, which have five serrated leaflets with visible veins and a winged stipule and petiole.^[24] Swiss albino mice weighing was used in the experiment and obtained from the animal house of the Department of Pharmacology and Clinical Pharmacy, Ahmadu Bello University, Zaria. Paullinia pinnata leaves were collected from Dumbi Village. Plasmodium berghei was obtained from the National Institute of Medical Research, Yaba, Lagos, Nigeria. The plant is easily recognized by its leaves, which have five serrated leaflets with visible veins and a winged stipule and petiole. The fruits are red or dark red when ripe Acevedo-Rodriguez. The plant comes from Cuba, Central America, South America, and tropical Africa.

3.5 ANALGESIC AND ACUTE INFLAMMATION

Any medication intended to relieve pain is referred to as an analgesic drug, sometimes known as a painkiller, pain reliever, or analgesic. Although analgesia and anaesthesia are neurophysiologically similar and consequently several medicines have both analgesic and anaesthetic effects, anaesthetics conceptually differ from those that temporarily diminish, and in some cases eradicate, feeling.^[24] The type of pain influences the analgesic of choice as well: Traditional analgesics are less effective at treating neuropathic pain, while non-traditional analgesic drug classes, like tricyclic antidepressants and anticonvulsants, frequently provide relief. A defence mechanism of the body includes inflammation. It is the procedure through which the immune system identifies, rejects, and starts to repair foreign and damaging stimuli. Inflammation can be either acute or chronic. A pain-inducing signal to protect the body against tissue damage. Inflammation is a pathophysiological response plasma fluid and blood cells. Areas of pain and inflammation associated with several diseases that can be improved with pain relievers and anti-inflammatory drugs. However, it is known that most of these drugs cause many unwanted effects, especially in the gastrointestinal tract, in addition to their excessive prices. recruitment, moist and semi-deciduous forests, gallery forests, along streams and savannas. In South Africa, Madagascar, Brazil, and Jamaica, it naturally grows.^[24]

It is also found in Zimbabwe and Zambia, Senegal, Cameroon, and Mali. Medicines use the whole plant, leaves, stem and root. For these reasons, the World Health Organization. Otherwise, leaves are used against snake bite, gonorrhea, wound, to encourage the research of medicinal plants and traditional medicine in developing countries, freeing them from the obligation to buy expensive medicines from abroad. In this way, it was decided to evaluate the analgesic and anti-inflammatory effects malaria and intestinal worms. Ivory Coast, its base the plant is used to treat rheumatism. In Ghana I used this plant as an aphrodisiac and to treat dysentery. Machated root is used to treat lung diseases and is used in hay fever, fractures, and abscesses. The leaves of this

plant are used for stomach and abdominal pain. The aim of this study was to investigate the effects of aqueous extract of the dried leaves of *Paullinia pinnata* on acute plant extract-induced nociception induced by acid acetic acid, formalin, and hot plate, followed by carrageenan, dextran, histamine, and serotonin.^[25] Prepared according to the protocol established by the Institute of Medical Research. Molecules of acetic acid, formaldehyde, Freund's complete adjuvant, carrageenan, dextran, histamine, serotonin, paracetamol, tramadol, dexamethasone, naloxone, and indomethacin are used. botanical information on the region's analgesic herbs and their uses. For this, herbal antioxidants and pain-relieving herbs were prescribed. For this, a questionnaire was used to obtain indigenous knowledge about herbal pain management from traditional practitioners in Shahrekord.^[7] This ethnobotanical study was conducted in 2018 and involved 29 traditional healers from the region. Finally, the data obtained from the questionnaires were analysed using Excel software. A frequency of plant use calculation was also made. As one area of research, examining medicinal plants with purported analgesic and anti-inflammatory effects may provide the opportunity to discover new, safer, and more effective compounds. Traditionally, different practices are used to relieve pain and inflammation in different countries.^[25]

Herbal medicines are widely used in developing countries to relieve pain and inflammation due to their cost, availability, and environmental benefits. Until now, the use of *Leonotis ocymifolia* for its analgesic and anti-inflammatory effects has not been studied, although traditional healers in Ethiopia are said to have used the plant for this purpose. Therefore, the aim of this study was to investigate the recognized analgesic and anti-inflammatory effects of *Leonotis ocymifolia* leaf extract in different rodent models. Plants with analgesic and anti-inflammatory effects contain mainly alkaloids, flavonoids, saponins, phenolic compounds of tannins, glycosides, coumarins and triterpenoids. The analgesic and anti-inflammatory properties of these compounds have been proven. It follows that sitosterol and friedelin must be present for the methanol extract of *P. pinnata* to have analgesic and anti-inflammatory actions. Daily oral administration of *P. pinnata* extracts significantly reduced monosodium urate-induced inflammation at both ankle and foot levels. The focus of this manuscript is the search for new natural drugs with anti-gout activity that combine anti-inflammatory, analgesic, and antioxidant properties. *Paullinia pinnata* Linn is a climbing plant that is widespread in western and central Cameroon. It is used empirically to treat infections and painful and inflammatory diseases. In East Africa, a decoction of the leaves is used to treat snake bites. From *P. pinnata*, substances such p-sitosterol and friedelin have been identified.^[26]

3.6 ANTHELMINTIC ACTIVITY

A class of antiparasitic drugs known as anthelmintics eliminate parasites and other internal parasites from the

body by either killing or stunning them without seriously harming the host. They can also be called vermifuges or vermicides. Anthelmintic drugs are used to treat people infected with helminths helminthiasis. These drugs are also used to treat infected animals. Medical tablets are used in mass deworming campaigns for school children in many developing countries.^[27] Mebendazole and albendazole are the most widely used medications to treat soil helminths; praziquantel is the drug of choice for treating tapeworm and schistosomiasis. Anthelmintics are a class of antiparasitic medications that eliminate parasites and other internal parasites from the body by either rendering them unconscious or killing them without seriously harming the host developing nations. Mebendazole and albendazole are the most widely used medications to treat soil helminths; praziquantel is the drug of choice for treating tapeworm and schistosomiasis.^[24] The anthelmintic activity of the ethanolic leaf extract of *P. pinnata* was evaluated by determining *Ascaris* sum motility test and mortality index. It is used to treat bovine helminthiasis in some areas of Uganda where human and veterinary services are still very poor; In addition, many people live in rural areas a few kilometres from health centres. Saponins, alkaloids, flavonoids, tannins, and triterpenoids were found in the alcoholic extract of *P. pinnata*. The plant had significant anthelmintic activity and mortality was higher than that of albendazole. Medicinal plants used in folk medicine can be a source of affordable and effective anthelmintics.^[27]

A member of the Asteraceae family, *Artemisia* herbal has been used as an antiparasitic medicine and other common applications in folk medicine. *Punica granatum* of the Lythraceae family is used against gastrointestinal nematodes. *P. granata* has been used in natural and holistic medicine to repel tapeworms and treat various ailments. The aim of this study was therefore to evaluate the in vitro anthelmintic activity of these plant extracts against *H. contortus*.^[27] As a result, a large part of the population has relied on traditional treatments using plant extracts, which are said to provide beneficial responses. Natural remedies are not only more readily available and accepted but can also be cheaper if they are scientifically proven to be effective yield. The ethanol extract was subjected to phytochemical analysis using several chemical reactions to detect the presence of secondary metabolites, mainly based on colour change or precipitate formations. In addition to the above, in tropical developing countries such as Uganda, with large populations and poor public health strategies, the low income of people living in rural areas complicates the availability of current conventional anthelmintics, leading to a high prevalence of helminth infections.^[27]

3.7 ANTIBACTERIAL AND LEISHMANICIDAL ACTIVITY

They kill bacteria or prevent them from multiplying and spreading. Antibiotics are not effective against viral infections. It is the most important type of antibacterial

against bacterial infections, and antibiotics are widely used in the treatment and prevention of such infections. Either they can eradicate bacteria or stop them from multiplying. A limited number of antibiotics also have activity against protozoa. Leishmaniasis is a disease caused by *Leishmania* protozoa, most transmitted by infected sandflies.^[17] It has historically been widespread in tropical climates on several continents, including Europe, Africa, Asia, and the Americas. The biochemistry and cell biology of *Leishmania* are like other kinetoplastids. They share the same main morphological characteristics: a single arch with an intussusception at the base - a flagellum pocket; kinetoplast, found in one mitochondrion; and the subpolar microtubular, which forms most of the cytoskeleton. *Leishmania* has a lipophosphoglycan layer outside the cell. Lipophosphoglycan activates toll-like receptor, a signalling receptor involved in triggering the innate immune response in mammals.^[25] This study aimed to investigate the antileishmanial, antibacterial and cytotoxic activities of *P. pinnata* leaves using various in vitro bioassays that may lead to further research. The results of this study would further add to the existing knowledge of *P. pinnata* and provide observations that can be further investigated. Nitrate, acetate, and iodide nanoparticles have counterions' actions and are equally effective at preventing bacterial growth. This behaviour can be explained by the fact that the antibacterial activity of the particles depends on the hydrophobic chain and positive charge of the derivative, and not on the counterion.^[18] Thus, all tested materials inhibited the growth of bacteria in the same way. Another explanation for this behaviour is that the counterion can influence the antibacterial properties if it changes the solubility of the biocides while the nanoparticles crosslink. Thus, the counterions showed little effect on the antibacterial activity of the nanoparticles.^[13]

Based on the above information, due to the simplicity of the synthesis, it was decided to focus on the iodide formed with quaternary ammonium polyethylene imine and to further investigate the physical, chemical, and biological properties of restorative composite resins containing particles compared to the corresponding commercial material, although only one percent of the particles were added.^[15] Water contact angles increased after the addition of nanoparticles, which increased the surface hydrophobicity of the material. The presence of active antibacterial components on the surface of restorative composite materials may also provide further explanation for the long-term antibacterial properties of the materials after incorporation. These findings add another aspect to the belief that the effective antibacterial effect of these components is lethal direct contact with bacteria.^[22] The antibacterial activity of nitrofurans results from poorly characterized reduction products resulting from drug degradation by bacterial nitro reductase enzymes. One mechanism by which these reduction products kill bacteria is by disrupting the codon-anticodon interaction that prevents mRNA

translation. The mechanism of action against sensitive protozoa has not been established. Antimicrobial spectrum, clinical applications, and clinical pharmacology. Nitrofurantoin has broad antibacterial activity, but its use in small animals is limited to the treatment of lower urinary tract infections. Nitrofurans have moderate activity against anaerobic bacteria and are most active under anaerobic conditions. When tested in anaerobic conditions, some aerobic bacteria that are resistant under aerobic conditions become susceptible.^[20]

3.8 ANTIHYPERTENSIVE ACTIVITY

The antihypertension is known as the prolonged blood pressure that is greater than the commonly accepted normal maximum level for a specific age group is a sign of hypertension, a threat to the cardiovascular system. Due to the related problems, which include coronary heart disease, stroke, sudden cardiac arrest, congestive heart disease, renal insufficiency, and aneurysm, among others, it is regarded as a leading cause of death in people around the world. Because it is a silent killer and has no early warning signs, hypertension and other related cardiovascular disorders have recently become serious public health problems in both industrialized and developing nations.^[12] According to statistics for developed countries, the incidence of the disease and symptoms associated to it are increasing in developing countries. Drugs in the antihypertensive class are used to treat hypertension. Antihypertensive therapy aims to avoid high blood pressure-related consequences like myocardial infarction, stroke, heart failure, and kidney failure. Antihypertensives come in a variety of classes and work in various ways to reduce blood pressure.^[14] Thiazide diuretics, calcium channel blockers, acetyl choline inhibitors, angiotensin receptor antagonists, and beta blockers are a few of the most significant and frequently prescribed drugs. Several sizable studies and the resulting national guidelines have focused on the kind of drug to use initially for hypertension. The primary objective of treatment should be to avert the worst consequences of hypertension, including heart attack, stroke, and heart failure.^[23]

The type of drug used, and its dosage depend on the patient's age, any accompanying clinical problems, and any end-organ damage. The cost, side effect profiles, and endpoints that can be prevented by the various classes of antihypertensives vary. The national healthcare budgets may suffer if more expensive agents are chosen when less expensive ones would be just as effective. The first-line treatment of choice for high blood pressure when medication is required, according to the best available research as of 2018, is low-dose thiazide diuretic.^[19] Primary and secondary hypertension are the two main classifications of hypertension, respectively. Although the fundamental cause of hypertension is frequently unclear, it is typically a side effect of a medical disease or medicine that has been previously identified. High blood pressure is typically caused by an underlying illness called chronic renal disease. Under these

circumstances, the kidneys are unable to absorb body fluids, causing an excess of fluid to build up. The blood pressure then increases. The dangers of hypertension are significantly increased using alcohol and tobacco.^[19] Smoking and drinking heavily both tend to make people's blood pressure rise. Age is one more danger element. People over 60 are observed to have high blood pressure on average. The blood vessels' flexibility declines and gets steeper with age. In both adults and children, high blood pressure is a mechanism brought on by hereditary or environmental causes. Systolic blood pressure is the amount of force the heart uses to pump oxygen-rich blood throughout the body, whereas diastolic blood pressure is the amount of force used during the heart's normal filling cycle. The biological system regulates the effects of rising or falling blood pressure to return it too normal.^[26]

Numerous variables, including increased vascular resistance and initial volume rise, might contribute to elevated blood pressure. Increased cardiac output, tissue blood flow, and vascular resistance are all caused by neurogenic and humoral stimuli, which also promote retention of renal capacity. Blood pressure is subsequently raised as a result. Increasing blood volume also reduces vascular resistance and blood pressure. When lifestyle changes have failed and blood pressure is higher than 140/90mmHg, patients often begin drug therapy.^[26] It is also administered if stage 1 of hypertension is more severe than it is or if the physician determines that treatment should begin right away after diagnosis. Globally, the use of traditional medicine in therapy is expanding quickly. In many underdeveloped nations, a sizable portion of the population relies on traditional healers and their treatments. Traditional medicine has frequently maintained its popularity for historical and cultural reasons, even though modern medicine coexists alongside such traditional practice.^[6] It is possible that the widespread usage of these traditional remedies is a result of their accessibility and affordability. They include the use of medical herbs, animal parts, minerals, and alternative therapies, such as religious practices. This comprises the understanding and practical application of health behaviours passed down through generations and exposed to various cultures.^[15] Alkaloid phytochemicals fall into numerous subgroups, each of which has unique qualities. By interfering with norepinephrine vesicular concentration, an indole alkaloid that resembles reserpine is used to treat hypertension. Reserpine's ability to deplete catecholamines from sympathetic nerve terminals in the periphery is thought to be the cause of its antihypertensive effects. These medications control peripheral resistance, heart contraction force, and heart rate. Malignant hypertension is a type of hypertension that depends on systolic and diastolic pressure.^[6] Given that it only affects 1 percentage of people with hypertension, this form of hypertension is abnormal. Young adults, African American males, and pregnant ladies all like it. When diastolic pressure exceeds 130

and blood pressure increases quickly, malignant hypertension develops. Vision blurring, nausea, chest pain, and confusion are symptoms of malignant hypertension in humans. When a person takes three separate antihypertensive medications, yet their blood pressure remains high, this is another type of hypertension. This typically happens in documented hypertensive situations. According to research, overweight African Americans with underlying conditions including diabetes and chronic disease are more likely to have resistant hypertension.^[26]

Hypertension frequently has an unknown underlying cause, but it is typically a side effect of a medical disease or medicine that has been previously identified. Most often, high blood pressure is brought on by chronic renal disease. Additional concentrations of ethanolic and aqueous extracts of *P. pinnata* leaves showed a positive inotropic effect in the anesthetized normotensive cat, and this is dose-dependent and may involve any adrenergic receptor-mediated effect. There are too many fluids in the body because the kidneys are unable to absorb them in these circumstances.^[15] The blood pressure is then elevated. An important component in the development of hypertension is the use of alcohol and tobacco. Blood pressure frequently increases in those who consume large amounts of alcohol and smoke cigarettes. Age is one of the other risk factors. People above the age of 60 are reported to have high blood pressure frequently. Glucocorticoids and minerals raise blood pressure.^[6] This impact is mediated by enhanced vascular reactivity or salt and water retention. Therefore, by boosting the receptors for pressure hormones like angiotensin I, glucocorticoids and mineralocorticoids increase vascular tone. Most patients receive care with the intention of bringing their systolic blood pressure below normal ranges. A combination of pharmacological therapy and lifestyle adjustments are used to manage high blood pressure.^[26]

3.9 ANTIMICROBIAL ACTIVITY

A substance that either eliminates bacteria or prevents their growth is an antimicrobial. Antimicrobial drugs can be categorized based on the microorganisms they are most effective. Antibiotics are used to treat bacteria, whereas antifungals are used to treat fungi. They can also be categorized based on how they are used. The words used to describe the use of antimicrobial drugs to treat and prevent infections are antimicrobial prophylaxis and antimicrobial chemotherapy, respectively.^[2] Antiseptics, which are applied to living tissue and help prevent infection during surgery, disinfectants, and antibiotics are the three main categories of antimicrobial agents. Disinfectants kill a wide variety of microbes on non-living surfaces to stop the spread of disease. The term "antibiotic" used to refer exclusively to preparations made from living microbes, but it is now widely used to denote synthetic substances like sulphonamides or fluoroquinolones. Although the term was once only used to refer to antibacterials, its usage has since expanded to

refer to all antimicrobials.^[23] Bactericidal agents, which kill bacteria, and bacteriostatic agents, which prevent bacteria from multiplying, are two other categories of antibacterial agents. Second- and third-line treatments for antibiotic-resistant infections can harm patients by resulting in severe adverse effects, such as organ failure, and delaying treatment and recovery for weeks or even months.^[14]

The side effects of antibiotics include diarrhoea, nausea, vomiting, rash, dizziness, and yeast functions. Serious side effects which are less common, include allergic reactions, some of which may be severe or life-threatening. Learn about potential side effects as well as allergic response symptoms.^[2] If you have adverse effects or have any questions or concerns, speak with your healthcare professional. Antimicrobial medications are used to treat diseases caused by bacteria. In this context, the word "resistance" describes a lack of sensitivity to such therapies. For the treatment to be effective, an antimicrobial must be overcome. This may result in more serious infections, protracted healing times, rising medical costs, the need for more expensive medications or riskier operations, and even death. Microbes, which are tiny living things, can enter your body.^[23] Microbes include things like bacteria, viruses, fungi, and parasites. The most prevalent and adaptable type of life on earth, microbes have been present for 3.5 billion years in a variety of habitats. Antimicrobials are drugs used to treat illnesses brought on by bacteria. The drugs which are used in the treatment of Penicillin, Cephalosporins, Valacyclovir, Fluconazole, Praziquantel. Plant secondary metabolites are mostly responsible for their antimicrobial activity. The main groups of phytochemicals with antimicrobial properties are phenols and polyphenols, terpenoids, alkaloids, lectins, and polypeptides.^[2] The antimicrobial activity of plant-derived compounds is based on several mechanisms. Phytochemicals may work by disrupting microbial membranes or impairing cell metabolism. It is estimated that there are around 250-500 thousand plant species. However, only a small number of them have been studied for antimicrobial activity. People have used plant materials to treat infectious diseases since ancient times, although their causes were unknown.^[23] Today medicinal plants are used in traditional medicine to treat various infectious diseases in many countries, including Armenia. Very few biological studies have been carried out on the chemical constituents of the nominal species *P. pinnata*. Due to our interest in the chemical and biological study of this plant, methylinositol, steroid terpenoids and oleanantriterpenoids were isolated from the methanolic extracts of its leaves and stem. Our previous studies evaluated the anti-typhoidal and antioxidant properties of these compounds.^[14]

3.10 HEPATOTOXICITY

Hepatotoxicity refers to liver damage caused by chemicals. Drug-induced liver injury is a cause of drug-induced acute and chronic liver disease and the most

common reason for post-approval withdrawal of drugs from the market. The liver is highly sensitive to the toxicity of toxins and is involved in their transformation and removal.^[16] Some drugs can cause organ damage if taken in overdose (e.g., Paracetamol) and sometimes even within therapeutic limits (e.g., Halothane). Other chemical agents, such as those used in laboratories and industry, natural chemicals (e.g., Microcystins), and herbal medicines can also cause hepatotoxicity.^[8] Chemicals that cause liver damage are called hepatotoxins. Drugs or toxins with pharmacological hepatotoxicity are those with predictable dose-response curves and well-characterized mechanisms of toxicity, such as directly damaging liver tissue or inhibiting a metabolic process. As with paracetamol overdose, this type of injury occurs shortly after the toxicity threshold is reached.^[27] Animal models frequently use carbon tetrachloride to cause acute type A liver damage. Symptoms of hepatotoxicity may include rash, abdominal pain, nausea and vomiting, fatigue, dark urine, light-coloured stools, jaundice, loss of appetite, and fever. People taking HIV medications that can cause hepatotoxicity should be aware of the possible symptoms of hepatotoxicity. Drug-induced hepatotoxicity is acute or chronic liver damage resulting from drugs or herbal compounds.^[26] It is difficult to diagnose because the presentation is like many diseases of the liver and galloping. Removing the harmful agent and closely monitoring the situation until it is resolved are the main treatments. Herbal medicines play an important role in the treatment of liver diseases. In the absence of reliable hepatoprotective drugs in modern medicine, several herbs and their preparations are used in traditional Indian medicine to treat liver diseases.^[26] Many studies have been conducted in the field of drug discovery and development, but due to the side effects of modern medicine, natural medicines are considered an effective and safe alternative treatment for hepatotoxicity.^[27]

Medicinal plants have been proven to be an effective remedy in the management and treatment of liver diseases without therapeutic adverse effects. As a result, much effort is being made to find plant-based remedies that can offer effective relief, accessibility, and safer therapies. In addition, the search must be centered on a medicinal plant that can scavenge reactive oxygen species and nitric oxide, which are the intermediate products of inflammatory processes and lipid peroxidation during mediated toxicity that eventually progresses to liver injury.^[16] One of these botanicals with hepatoprotective potentials is *Paullinia pinnata*, which has been given several pharmacological significances. In view of all the commendable activities of *P. pinnata* associated with reactive oxygen species scavenging, coupled with its folklore usage in the treatment of liver disorder, with paucity of scientific evidence, hence the current study.^[27]

CONCLUSION

Based on the results of this investigation, it is possible to draw the conclusion that *Paullinia pinnata* still has antibacterial and analgesic properties. The leaf of this plant plays a vital role in the treatment of insanity, rabies, and dysentery. The evaluation of the phytochemicals should be taken into account the tannins, saponins, triterpenes, and ceramides. *Paullinia pinnata*'s ethanolic leaf extract was reported to suppress parasitaemia to some extent. The ethnopharmacological use of this plant in the treatment of typhoid fever holds considerable promise for the creation of novel native antioxidants and antityphoid medications. The leaves may not be cytotoxic and had no effect on leishmania. Several research approaches are involved to find out the several other efficacy of the plant.

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