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A Review of *Piper guineense* (African Black Pepper)

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ABSTRACT

Piper guineense (African black pepper) is a West African spice plant with medicinal property and widely used traditionally in the treatment of various ailments. The phytochemical studies of the plant revealed the presence of proteins, carbohydrates, alkaloids, steroids, glycosides, saponins, flavonoids, tannins and phenolic compounds. It also contains vitamins, minerals and fat. Various studies have been done on the plant to determine its pharmacological and therapeutic properties such as antibacterial, antioxidant, anti-inflammatory, hepatoprotective, fertility, aphrodisiac, anticonvulsant and larvicidal properties. This review provides detailed information on the phytochemical, nutritional and pharmacological properties of the *Piper guineense*.

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INTRODUCTION

Over the years, plant extracts and plant-derived medicines have made an immense contribution to the overall health and wellbeing of man [1]. In 1978, World Health Organization emphasized the importance of scientific research into herbal medicine. Herbs are generally valued for their virtues as food as well as medicine [2]. Many developing countries of the world look upon native medicinal plants as a possible addition to WHO's list of "essential drugs" once their value has been clinically proven. Medicinal plants have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions and to defend against attack from predators such as microbes. Of the 265,000 species of flowering plants that have been identified on planet Earth, only 0.5% of them have been studied in detail for chemical composition and medicinal value. In fact, modern scientists only know the chemical composition of less than 5% of the flora in the rainforest [3]. At least 12,000 such compounds have been isolated and this number is estimated to be less than 10% of the total [4,5]. Chemical compounds in plants mediate their effect in the human body through processes identical to those already well understood for the chemical compounds in conventional drugs thus herbal medicines do not differ greatly from conventional drugs in terms of how they work. This enables herbal medicines to be as effective as conventional medicines but also gives them the same potential to cause harmful side effects[5]. The study of traditional uses of plants is recognized as an effective way to discover future medicines. The use of these plants in medicine is due to the presence of bioactive constituents such as phenols, flavonoids, tannins and alkaloids, present either in the seeds, leaves, stems or roots[5]. This review aims at highlighting the phytochemical, nutritional, medicinal and pharmacological properties of *P.guineense*.

The plant: *P.guineense*

Scientific classification:

Kingdom – Plantae
Division – Magnoliophyta
Class – Magnoliopsida
Order – Piperales

Family – Piperaceae
Genus – Piper
Species – *Piper guineense*

Morphology and Description

P.guineense is a spice plant from the family Piperaceae and from genus piper. It is a West African spice plant commonly called Ashanti pepper [6]. It is known as Uziza in Igbo and Iyere in Yoruba. Other common names are Benin pepper, Guinea pepper and false cubeb [6]. Spices generally are parts of various plants cultivated for their aromatic pungent or otherwise desirable substances. They consist of rhizomes, bulbs, flower bud, fruit, seed, and leaves. They usually are categorized into tiny wild fruits, nuts, herbs, and leafy vegetables.

The plants that provide Ashanti pepper are vines that grow up to 20m tall climbing up bole of trees by means of adventitious roots. It is a perennial plant that is characterized by heart-shaped leaves and oval, petiole, alternate, 12cm long. The leaves which have a peppery taste, are pale greenish color when fresh and darker green when frozen or dried. The inflorescence is a pedicel flower spike between 3 and 6cm long and the peduncle 5mm long. Flowers are greenish yellow and arranged in a spiral along the spine [7]. The fruits of *P.guineense* occur in clusters, small, reddish or reddish brown when ripe and black when dry [8]. The fruit is a drupe mesocarp or fleshy, oval, 5mm in diameter.

Origin, habitat and distribution of *P. guineense*

The plant is native to tropical regions of central & Western Africa and is semi-cultivated in countries like Nigeria where it is found commonly in the southern part [9]. It grows in evergreen rainforest, forest edges, usually in wet places, gallery forest along rocky rivers of an elevation of 750-1,650m. There are more than 700 species of this plant throughout tropical and subtropical regions of the world [1]. This plant has so many uses including culinary, medicinal, cosmetic and insecticidal uses [10,9].



A

B



C



D

Adapted from Wikipedia, July 2015.

A – *P. guineense* ripe seeds, B – *P. guineense* leaves, C - *P. guineense* leaves and unripe seeds
D - *P. guineense* dry seeds

PHYTOCHEMISTRY

The different parts of the plant have been characterized and their chemical composition determined. They are used as therapeutic agents in minor ailments [11]. Phytochemicals are not vitamins or minerals but are bioactive compound found in plant foods that work with nutrient and dietary fibers to protect against disease [12]. The presence of phytochemicals like alkaloids in both the leaves and seed extracts of *P. guineense* signified the possession of medicinal properties within the plant. The flavonoids possess antioxidant, anti-inflammatory, anti-tumor, anti-allergic and antiplatelet properties[13]. They are also found to have cholesterol lowering ability [14]. Alkaloids which are natural products present in *P.guineense* are made up of heterocyclic nitrogen that has anti-malarial, antihypertensive, antiarrhythmic and anticancer

properties [15]. Alkaloids are being used as CNS stimulant, powerful pain relievers, topical anesthetic in ophthalmology among others [16]. Tannins are compounds with proline-rich proteins that help to inhibit the absorption of iron when present in the gastrointestinal lumen thus reducing the bioavailability of iron due to the presence of compounds that help in the treatment of diseases like enteritis, gastritis, and esophagitis. Plants that contain tannins as their primary component are astringent, thus very beneficial for the management of diarrhea, dysentery, inflammation of the mucous membrane [17]. Saponins have anti-carcinogenic properties [18] and may also play an important role in antimalarial activity of plants [19]. *P.guineense* also contains cardiac glycosides in a significant amount and cardiac glycosides are useful in the management of diseases associated with the heart [20]. *P.guineense* also contains dillapiol, 5-8% of piperine, elemicine, 10% of myristicine and safrole and these chemicals exhibit bactericidal and antimicrobial effects on some micro-organisms [21]. *P. guineense* like other members of the piper family contains 5-8% of the chemical “piperine” which gives them their “heat”. They also contain large amounts of beta-carophyllene which is being investigated as an anti-inflammatory agent [22].

TABLE 1: PHYTOCHEMICAL COMPOSITION OF VARIOUS PARTS OF *P. GUINEENSE*.

Parts	Composition	References
Leaves	Alkaloids include piperine, wisamine, dihydrowisamine, dihydropiperine.	[23]
	Flavonoids Saponins Tannins Resins Essential oils include dillapiol, elemicin, myristicine, and safrole	[14] [21]
Seeds	Alkaloids Flavonoids Saponins Tannins Terpenes Resins Steroids Essential oil includes dillapiol, elemicin, myristicine, and safrole Cardiac glycosides	[18] [21]

NUTRITIONAL VALUE

P.guineense have nutritional and non-nutritional factors which are responsible for its aroma, flavor, and preservative properties [24]. The proximate analysis reveals that the plant contains crude protein, fat, carbohydrate, vitamins and minerals [24]. The essential oil content is high in the range of 0.1 to 5% [18] while the peroxide value and free fatty acid contents are generally low[18]. Nwankwoet *al.*[25] also studied UzizaLeaf and found that in addition to the above mentioned, it also contains a high amount of ash. This implies high mineral content such as calcium, zinc, magnesium, copper and potassium in the vegetable [26]. The crude fiber content of Uziza leaf was also found to be high, so consumption of this leaf could aid digestion, absorption of water from the body, bulky stool and prevent constipation [27]. The fat content of Uziza Leaf was found to be low so could be employed as part of the weight loss regimen. Also, the protein content of this plant makes it a good source of plant protein. The study also showed that *P.guineense* has a high carbohydrate content, so its consumption could provide the body with the energy needed for daily activities [28]. Okonkwo and Ogu [29] also reported that *P.guineense* contains vitamin C in considerable amount and this aids the good health of teeth and gums and also promotes healing. He reported that *P.guineense* contains vitamin A and traces of vitamin B₁ and B₂ which all are important for general good health. It also contains vitamin E which plays a significant role as an antioxidant[30].

Table 2: PROXIMATE COMPOSITION OF *P. GUINEENSE* SEEDS [31]

Moisture content	12.35+0.01%
Dry matter	87.65+0.01%
Ash	6.33+0.02%
Crude fibre	8.79+0.01%
Crude fat	9.89+0.07%
Crude protein	5.86+0.04%
Carbohydrate	57.32+0.78%

TABLE: 3. VITAMIN CONTENT OF *P. GUINEENSE* SEEDS [31]

Vitamin A	7.08+0.0(µg/g)
Vitamin B ₁	0.029+0.0(µg/g)
Vitamin B ₂	0.16+0.0(µg/g)
Vitamin C	292.62+0.24(µg/g)

TABLE 4: MINERAL CONTENT OF *P. GUINEENSE* SEEDS [31]

Calcium	179.52+0.11 mg/100g
Magnesium	35.54+0.36 mg/100g
Potassium	98.52+0.10 mg/100g
Sodium	20.87+0.04 mg/100g
Phosphorus	217.70+0.41 mg/100g
Iron	2.52+0.10mg/100g

Table 5: PROXIMATE COMPOSITION OF *P. GUINEENSE* LEAVES [25].

Moisture	11.70+0.03%
Ash	7.73+0.04%
Crude fibre	9.26+0.03%
Fat	2.24+0.02%
Crude protein	16.67+0.02%
Carbohydrate	48.21+0.00%

TABLE: 6. VITAMIN CONTENT OF *P. GUINEENSE* LEAVES [25]

Vitamin C	248.37+0.04 mg/100
Vitamin E	32.26+0.06 mg/100

MEDICINAL AND PHARMACOLOGICAL PROPERTIES OF *P. GUINEENSE*

Traditionally *P. guineense* is believed to have medicinal properties and this has led modern-day researchers to study its extracts. This review gives the evidence-based information regarding the

medicinal and pharmacological activity of the plant. *P. guineense* is consumed in some parts of West Africa especially Nigeria and Ghana on account of its nutritional and medicinal properties [32].

Non-medicinal uses of *P. guineense*

It is used in Western African cuisine where it imparts "heat" (piquantness) and a spicy pungent aroma to West African soup(stew) [6]. A spice is a substance used to flavoring, seasoning, and imparting aroma to food. A spice may be derived from any part of the plant like the leaves, fruits and roots of such plants [33]. The leaves are used as a spice to flavor meat preparation and fresh pepper soup. They are also processed and consumed as vegetables in meals [34]. The fruits are used as a spice to flavor soup, rice, and stew. The oil distilled from *P. guineense* is used in perfumery and in soup making. Sometimes, it is also grown as an ornamental often indoors in cooler climates.

Ethnomedicinal uses of *P. guineense*

The leaves are considered aperitif, carminative and eupeptic [18]. The leaves are used to treat respiratory infections, rheumatism, and syphilis [35]. In Nigeria, the leaves have been shown to have antibacterial activity [36]. *P. guineense* leaves are aseptic in nature and have the ability to relieve flatulence [37]. The leaves are also used for treating female infertility and low sperm count in male[38] while the Fruits are used as an aphrodisiac [18]. In China, *P. guineense* fruit extract is used in the treatment of epilepsy [39]. In traditional herbal medicine, seeds are put into a variety of uses. In some part of Nigeria, seeds are consumed by women after childbirth to enhance uterine contraction for expulsion of a placenta and other remains from the womb [40]. It is added to food of lactating mothers during postpartum period, as it is claimed that it encourages or stimulates uterine contractions, therefore, aiding in the fast return of uterine muscle to the original shape [41]. It is also used in Eastern part of Nigeria as abortifacient. It is also used as an adjuvant in the treatment of rheumatic pains and as an anti-asthmatic [42] and also for the control of weight [43] and as an aphrodisiac [44,45],BEP [46] reported that the seeds of *P. guineense* are used to relieve discomfort in the stomach caused by excess gas. Echo et al reported that methanolic extract has molluscicidal properties and may be useful in the treatment of bilharzia. It is also used for the preparation of non-toxic insecticides and perfumes [47,48]. The seed and leaf

extract are capable of exhibiting a depolarizing neuromuscular activity in a concentration-related manner [40]. The roots are chewed and juice swallowed as an aphrodisiac. They are also used as chewing sticks for cleaning the teeth. Ash from the burnt plant is used as a salt substitute for medicinal preparations. Research shows that *P. guineense* also has preservative and antioxidant properties [6]. In a comparative study of three native West African peppers on the preservation of catfish, Ashanti peppers were discovered to be the most effective [22].

TABLE: 7. ETHNOMEDICINAL USES OF *P. GUINEENSE*

Morphological part of the plant	Medicinal uses
Leaves	Respiratory infections, rheumatism, syphilis [35] To relieve flatulence [37] As aperitif, carminative and eupeptic [18]
Fruits	To treat epilepsy [39] As an aphrodisiac [18]
Seed	The adjuvant in the treatment of rheumatism and as an anti-asthmatic [42]. Control of weight [43]. As an aphrodisiac [44]
Roots	As an aphrodisiac As chewing stick

BIOLOGICAL ACTIVITIES OF *P. GUINEENSE*

Antimicrobial Activity

Anyanwu and Nwosu [1] studied the antimicrobial activity of aqueous and ethanolic extracts of *P. guineense* leaves on some bacteria and fungal organisms namely *Staph. aureus*, *E. coli*, *P. aeruginosa*, *C. albicans* using agar Well diffusion method and minimum inhibitory concentration. The result of this study showed that the leaf extracts of *P. guineense* inhibited the growth of all the microbial isolate tested. This implies that the leaf extract has antimicrobial action. The extracts had a broad spectrum activity as their actions were independent of gram reaction. The higher antimicrobial activity of the extracts was observed against *E. coli* followed by *Staph. aureus*. The antimicrobial effect of this plant can be attributed to the phytochemicals present in it, they are rich in flavonoids, tannins, saponins and alkaloids which have been found

to have antimicrobial properties. The study showed that the aqueous extract of *P.guineense* has less antimicrobial activity than the ethanolic extract against the isolates. This may be due to insolubility of the active compounds in water or the presence of inhibitors of antimicrobial components [49].

Antibacterial effect

In this study aqueous and ethanol extracts of *O.gratissimum* and *P.guineense* leaves were screened for antibacterial activity against *E.coli* and *Staph. aureus*. Both extracts were found to exhibit selective inhibition against the isolates [50]. In another study, the extract of *P.guineense* showed anti-mycobacterial activity [51].

Antioxidant effect

Omodamiro and Ekeleme [52] studied the antioxidant activity of *P.guineense*. The result showed that the leaves of this plant exhibited free radical scavenging effects. This could be attributed to the presence of phenolic compounds in the plant which is a major group of compounds that act as primary antioxidants or free radical scavengers. In another study, the seed extracts of *P.guineense* was found to rapidly scavenge nitric oxide in vitro at different intervals [53].

Antifungal activity

In this study, the antifungal activity of ethanol extract of seed of *P.guineense* was investigated using filamentous fungi and yeasts. The result indicated a significant antifungal effect[54].

Aphrodisiac property

An aphrodisiac is a substance that when consumed, increases sexual behavior [55]. The activity of aqueous extract of *P.guineense* on the sexual behaviour of male rats was studied by Kamtchouing *et al.*[56] using such criteria as penile erection, copulating behaviour and orientation activities towards themselves and the female rats (anogenital sniffing, mounting). The rats received 122.5 mg/kg of the aqueous extract for 8 days and the results showed that this plant extracts stimulated male sexual behaviour, it significantly increased penile erection and frequency of intromission and ejaculation. The plant extract was also found to increase the

orientation of males towards females by increasing mounting and anogenital behaviour. So this study showed that *P.guineense* has aphrodisiac property[56].

Effect on Fertility

Memudu *et al.* [57] studied the effect of crude extracts of dry fruits of *P.guineense* on male fertility parameters using adult Sprague dawley rats. 200mg/kg of the extract was given to 2 groups of rats for four weeks and eight weeks respectively. The result showed that the extract improved male reproductive functions. It improved sperm motility, sperm function, testicular spermatogenesis and weight and this could be attributed to its androgenic and aphrodisiac properties. In essence *P.guineense* should be recommended as a form of treatment for male fertility problems especially those associated with hormonal secretion. In another study, the effect of ethanol extract of *P. guineense* was investigated in mice. Findings revealed that the extract has a negative effect on mice reproduction [58].

Antiparasitic effect

In this study, the effect of methanol extract of the seeds of *P.guineense* on some parasites was investigated and found to be active against goldfish (*Carassius auratusauratus*, *Pisces cyprinidae*) monogenean parasites [59].

Effect on Hematological parameters

Uhegbu *et al.*[24] investigated the effect of aqueous extract of *P.guineense* on some hematological parameters of albino Wistar rats. The result showed that intraperitoneal injection of *P.guineense* seed extracts at a dose of 10mg/kg and 20mg/kg to the 2 groups respectively for 21 days significantly increased the haemoglobin level, white blood cell and red blood cell counts of the animals. The increase in white blood and red blood cell count may be attributed to the protein content of the seed extract[24]. Plant seeds are rich in phytochemicals, vitamins and minerals, hence, may be the cause of increased production of white and red blood cells in the animals[60].

Sedative and anxiolytic effects

The aromatherapeutic potential of *P.guineense* essential oil was investigated in mice via inhalation administration and the result showed significant sedative and potent anxiolytic activities [61].

Insecticidal effect

Investigations with an ethanolic extract from five Nigerian plants showed that extract of *P.guineense* and *C.odorata* show the best potential for development as botanical insecticides [62].

Pharmaco-enhancer effect

P. guineense has been shown to inhibit specific liver cytochrome enzymes [63].

Anti-tumor effect

In this work, *P.guineense* and other plant species were investigated for its anti-tumor effect. Results showed that quite a number of plant parts including *P.guineense* seeds were found to be efficient in the management of cancer [64].

Contractile effect

The effect of ethanolic extraction of West African black pepper (*P. guineense*) on contractility of gastrointestinal smooth muscles of Guinea pig was carried out. The results showed a significant contraction of GIT smooth muscles through the cholinergic and histaminergic receptors [65].

Antihyperlipidemic effect

P. guineense extract was investigated for its hypolipidemic effect. The results showed that it decreased the plasma cholesterol and triglycerides level in treated rats [66].

Anti-atherogenic effect

In a study aimed at evaluating the anti-atherosclerotic activities of *P. guineense* on atherogenic diet fed hamsters. The results suggested that *P.guineense* had significant antioxidant and antiatherogenic effects against atherogenic diet intoxication [67].

Hepatoprotective effect

Nwozoet *al.* [68] studied the hepatoprotective effect of aqueous extract of *P. guineense* on ethanol-induced liver toxicity in male albino rats, in this experiment chronic administration of ethanol to the animals for 21 days enhanced lipid peroxidation with reduced levels of glutathione as well as reduced activity of superoxide dismutase (SOD) and glutathione –S- transferase, serum triglyceride levels, alanine transaminase (ALT), and aspartate transaminase (AST) activities were also elevated but these was attenuated by co-administration of the extract of *P. guineense* at a dose of 100 or 200mg/kg. Administration of this plant during ethanol exposure inhibited hepatic lipid peroxidation and ameliorated SOD and AST activities and also restored GSH levels significantly. This study showed that aqueous extract of *P. guineense* has potent antioxidants which have hepatoprotective properties.

Larvicidal property

A laboratory evaluation of ethanolic extracts of *P. guineense* (seeds and leaves) on mosquito larvae carried out by Ihemanmaetal. [70] showed that the leaf and seed extract of *P. guineense* have Larvicidal effects at high concentration on mosquito larvae. *P. guineense* seeds and leaves have larvicidal effects on mosquitoes with 90% and 80% mortality at 100mg/ml respectively. This could be attributed to the phytochemicals present in the plant extracts. The more concentrated the plant extract is, the more the larvicidal effect. Hence, this plant could be utilized in the production of botanical larvicides which could be used as a substitute for the synthetic ones as they are readily available, affordable, eco-friendly and biodegradable[70].

TABLE: 8. TESTED BIOLOGICAL ACTIVITIES OF *P. GUINEENSE*

Tested activities	Author(s)
Antimicrobial Activity	[1] [49]
Antioxidant Activity	[52] [53]
Aphrodisiac property	[55] [56]
Effect on Fertility	[57] [58]
Effect on Hematological parameters	[20] [60]
Hepatoprotective Activity	[68]
Anti-convulsant property	[69]
Larvicidal property	[70]
Anti-bacterial activity	[50] [51]
Anti-fungal activity	[54]
Anti-parasitic activity	[59]
Sedative activity	[61]
Anxiolytic activity	[61]
Insecticidal	[62]
Pharmaco-enhancer	[63]
Anti-tumor activity	[64]
Contractile activity	[65]
Anti-hyperlipidemic activity	[66]
Anti-atherogenic	[67]

CONCLUSION

P.guineense popularly known as Uziza is an important source of various nutrients and phytochemicals with diverse functions; it is a good medicinal plant that should always be included in our daily diet, so as to ensure the derivation of an adequate amount of the needed vitamins, phytochemicals and other nutrients present in the plant. Much of the traditional uses has been confirmed by scientific research. A lot of work has been done on the plant to determine

its chemical constituents and biological activity, but more work is still needed to exploit their therapeutic utility in the management of diseases.

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