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Phytochemical screening and proximate analysis of eight ethnobotanicals used as antimalaria remedies in Ibadan, Nigeria

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ABSTRACT

Objective: To screen eight plants for phytochemical compounds and proximate constituents that may account for their use in malaria treatment. The plants were Morinda *lucida, Adansonia digitata, Khaya senegalensis, Garcinia kola, Alstonia boonei, Piper guineense, Eugenia caryophyllus* and *Aframomum melegueta.*

Methodology and results: The powdered plant samples were analyzed for their phytochemical compounds and proximate constituents using standard laboratory methods. The habit of the test plants were 75% trees, 12.5% herbs and 12.5% climbers. The use-value of plant parts was 67% roots, 22% seeds and 11% floral buds. *M. lucida, G. kola* and *K. senegalensis* contained anthraquinones, while all the test plants contained cardiac glycosides in varying concentrations. *P. guineense* and *A. melegueta* tested negative for saponins. *P. guineense* showed substantially high content of crude protein (8.75%) whereas *A. digitata* contained substantially high crude fibre (37.00%).

Conclusion and application of results: This study has contributed to conservation of indigenous ethnomedicinal knowledge. Further search for antimalarial plants should include plants from the reported families in this study: Clusiaceae, Bombacaceae, Meliaceae, Apocynaceae, Rubiaceae, Zingiberaceae, Piperaceae and Myrtaceae. However the indigenous people need to be enlightened on the implication of over exploitation of wild plants and the need for conservation of plant genetic resources. The presence of nutrients in the test plants could serve as supplements in their therapeutic activity. *P. guineense* and *A. digitata* could be used as food supplements in weaning food owing to their protein and fibre constituents respectively. Toxicity tests, isolation and identification of active compounds of the test plants could lead to confirmation of their safety in administration and the discovery of novel plant drugs.

Key words: Malaria, ethnobotanicals, phytochemical screening, proximate analysis

INTRODUCTION

Malaria is an infectious disease caused by a parasite, *Plasmodium* which infects red blood cells. It is characterized by cycles of chills, fever, pain and swelling. It is the most significant public health problem in Nigeria. Of the few species of malaria parasite, the most serious type is *Plasmodium falciparum* as it can be life threatening. The other three species of malaria parasites, *P. vivax, P. ovale* and *P. malariae* are generally less serious and are not life threatening (WHO, 2000).

Malaria is a particularly major problem in parts of Asia, Africa, South America and Central America. In Sub-Saharan Africa, about 90% of all malaria deaths occur among children under 5 years old. It is estimated that a child dies of malaria every 30 seconds in Africa. In Nigeria, the disease is a

major health problem with stable transmission throughout the country. It accounts for about 50% of out-patient consultation, 15% of hospital admission and is the prime amongst the top three causes of death in the country. More importantly, it is a social and economic problem which consumes about US $5 million in various control attempts (WHO, 2004).

Around the world, malaria is becoming more resistant to a number of drugs currently in use and is on the increase because of the global warming process. Thus, many communities who live in endemic areas have started to look for malaria remedies in plants in their local environments. The diversity of resistance types will require that public health measures to control malaria be region specific (Willcox and Bodeker, 2005).

Owing to increased resistance of malaria to orthodox antimalarial drugs and the renewed interest in plant drugs, this study, analyzed *Morinda lucida, Alstonia boonei, Adansonia digitata, Khaya senegalensis, Garcinia kola, Piper guineense, Aframomum melegueta* and *Eugenia caryophyllus* for their phytochemical and proximate constituents to establish the scientific basis for their use in treating malaria.

In addition to their antimalarial activity, the selected plants are used for the treatment of various diseases. *Garcinia kola* (Heckel) stem bark is used as a purgative and its powdered bark for the treatment of malignant tumours. The sap is used for parasitic skin diseases (Iwu, 1993). Fibres lining the inner surface of the husk of *Adansonia digitata* (Linn.) are given in decoction to treat dysmenorrheal (painful menstruation) and it is a well known febrifuge in West Africa. It is also used as tonic (Burkill, 1985). *Khaya senegalensis* (Desr.) A. Juss. is used as a vermifuge, taeniacide and as an antimicrobial agent for the treatment of venereal diseases. The crushed bark and seeds have been employed as an emmenagogue. Its gum has been evaluated for tablet binding properties (Iwu, 1993; Mahmud *et al*, 2010). The decoction of the stem bark of *Alstonia boonei* (De Wild) is used after childbirth to accelerate expulsion of the afterbirth (Burkill, 1985). The root bark is used to treat hypertension, cataract and cough. It is also used in treating wounds and the leaves are used to treat measles (Mshana *et al.*, 2000). The extract of the leaves and stem bark of *Morinda lucida* (Benth) has been recommended for the prevention and treatment of hypertension and its cerebral complications (Iwu, 1993). The root decoction of *Aframomum melegueta* (K. Schum) is used as an ingredient for the preparation of remedy for infertility to promote conception and the fruit as a tonic (Burkill, 1985). *Piper guineense* (Schum.et Thonn) leaves are used to regulate the menstrual cycle and also used as ingredient in infertility remedies. The roots are also used in the treatment of gonorrhoea, bronchitis, syphilis and other male reproductive problems (Iwu, 1993; Mbongue *et al,* 2004). *Eugenia caryophyllus* (Sprengel.) cloves and clove oil are used in the preparation of certain types of cigarette in Indonesia. Oils of clove are a common ingredient of mouthwashes and toothpastes (Iwu, 1993).

MATERIALS AND METHODS

Collection and identification of medicinal plants: *Morinda lucida, Alstonia boonei, Adansonia digitata, Khaya senegalensis and Garcinia kola* were obtained from the nursery and botanical garden of the University of Ibadan. *Piper guineense, Aframomum melegueta* and *Eugenia caryophyllus* (cloves) were purchased from local herbal market (Bode) in Ibadan, Nigeria. All test plants were identified at species level at the University of Ibadan Herbarium (UIH).

Preparation of plant materials: The plant parts (Table 1) were washed thoroughly, cut into small parts and then air-dried for 2 weeks. They were then milled to a coarse powder. The powered samples were stored in glass containers for further use.

Phytochemical screening of powdered plant samples: The powdered plant materials were screened for the presence of natural products using standard procedures in the laboratory of the Department of Pharmacognosy, University of Ibadan.

Proximate analysis of powdered plant samples: The proximate analysis of powdered plant materials was carried out using the AOAC methods (1990) in the laboratory of the Department of Animal Science, Faculty of Agriculture & Forestry, University of Ibadan.

Statistical analysis: Analysis of variance and comparison of means were carried out on all data of proximate analysis of plant samples using statistical analysis system (SAS). Differences between means were assessed for significance at p= 0.05 by Duncan's Multiple range test (DMRT).

RESULTS AND DISCUSSION

The medicinal plants tested are from the families Clusiaceae, Bombacaceae, Meliaceae, Apocynaceae, Rubiaceae, Zingiberaceae, Piperaceae and Myrtaceae. They comprised of 75% trees, 12.5% herbs and 12.5% climbers. The use-value of plant parts was 67% roots, 22% seeds and 11% flora buds (Table 1).

Table 1: Profile of plants used for the treatment of malaria in Ibadan, Nigeria.

Botanical name	Common name	Family name	Parts used	Habit
Garcinia kola	Bitter kola	Clusiaceae	Root	Tree
Adansonia digitata	African Baobab	Bombacaceae	Root	Tree
Khaya senegalensis	Dry Mahogany	Meliaceae	Root	Tree
Alstonia boonei	Stoolwood	Apocynaceae	Root	Tree
Morinda lucida	Brimstone tree	Rubiaceae	Root	Tree
Aframomum melegueta	Alligator pepper	Zingiberaceae	Seeds	Herb
Piper guineense	Guinea pepper	*Piper*aceae	Seeds	Climber
Eugenia caryophyllus	Clove pepper	Myrtaceae	Clove (flora buds	Tree

The results of the phytochemical screening of the plant samples are shown in Table 2. Phytochemically, the plant samples are quite rich, containing alkaloids, saponins, tannins, anthraquinones and cardiac glycosides in substantial quantities. *M. lucida, G. kola* and *K. senegalensis* had high concentration of anthraquinones. Many well known purgative plant drugs such as aleos and senna contain anthraquinone. Seventy-five percent of the test plants contained alkaloids. The presence of alkaloid in high quantity in *P. guineense* confirms the findings of Ajaiyeoba *et al* (2006) that the traditional use of the plants for the treatment of malaria was due to the presence of alkaloids. The medicinal plants that are moderately rich in alkaloids and tannins have potential health promoting effects (Ikewuchi and Ikewuchi, 2008; Jigam *et al*, 2010).

Saponins were absent in *P. guineense* and *A. melegueta* but present in high concentration in the other plants. Saponins have anti carcinogenic properties and other health benefits. They may also play a significant role in antimalarial activity of plants (Adesokan and Akanji, 2010). The concentration of tannins was high in *E. caryophyllus*, *G. kola* and *K. senegalensis*. Alshawsh *et al* (2007) reported that tannins may have antiplasmodial activity. All the test plants contain varying quantity of cardiac glycosides. The cardiac glycosides are used for treating heart problems that may result from severe malaria attack (Fatoba *et al*, 2003).

Table 2: Results of phytochemical screening of powdered plant samples.

Plant samples	Anthraquines	Alkaloids	Saponins	Tannins	Cardiac glycosides
Piper guineensis	_	+++	_	++	+
Aframomum melegueta	_	++	_	_	+
Eugenia caryophyllus	_	_	+++	+++	++
Alstonia boonei	_	++	+++	_	++
Morinda lucida	+++	++	+++	+	++
Garcinia kola	+++	+++	+++	+++	+
Adansonia digitata	±	++	+++	_	+
Khaya senegalensis	+++	_	+++	+++	+

Legend: +++ = High, ++ = Moderate; + = Low; ± = Inconclusive.

Table 3 shows the proximate constituents of the plant samples. *P. guineense* contained significantly high quantity (8.75 %) of crude protein compared to other plant samples, followed by *E. caryophyllus* (5.60 %) and least (2.28 %) was recorded in *M. lucida*. The presence of protein in *P. guineense* had been reported (Isong and Essien, 1996). Its high protein serves as a supplement for the daily protein requirement of the body and could be responsible for its use in antimalarial remedy (Isong and Essien, 1996). *P. guineense* contains substantial quantity of crude protein and ash, and it is recommended as a source of protein and energy supplement (Effiong *et al*, 2009). *A. digitata* had 37 % crude fibre, followed by *A. boonei* (30 %) and the least (2 %) was in *P. guineense*.

Al Qarawi *et al.* (2010) explained that *A. digitata* has antipyretic and febrifuge activity, its high quantity of crude fibre in this study, may suggest apparent digestibility of nutrients and suitable supplement in food in addition to antimalarial activity. The highest oil (ether extracts) was obtained from *P. guineense* (23 %), followed by *E. caryophyllus* (22 %) and least oil constituent was in *M. lucida* (5 %). According to Mudi and Muhammad (2009), moderate presence of ether extract may have antimalarial activity in ethanolic extract. The ash content of *A. digitata* was the highest (9 %) and the least (3 %) was recorded in 4 out of the 8 plant samples. The high ash (mineral) content in *A. digitata* implies that it is very nourishing and suitable for consumption. This is in line with the findings of Ifon and Bassir (1980) who suggested that botanicals with ash content above 8.8% are healthful.

A. boonei gave the highest dry matter (98.5 %) and *E. caryophyllus* (72 %) the least. High dry matter content implies low moisture content. George (2008) explained that when the percentage of moisture is high in the milled form, the plants while fresh will contain higher amount of moisture. High moisture content helps in maintaining the protoplasmic contents of the cells but make botanicals perishable and susceptible to spoilage by micro organisms during storage.

Other medicinal plants with antimalarial properties have also been reported: Odugbemi *et al* (2007) studied the anti-malarial activities of *Morinda lucida, Enantia chlorantha, Alstonia boonei, Azadirachta indica* and *Khaya senegalensis.* Idowu *et al* (2010) also studied the anti-malaria activities of *Morinda lucida, Lawsonia inermis, Citrus medica, Sarcocephalus latifolius* and *Morinda morindiocles.* Oyewole *et al* (2008) reported the anti-malarial and repellant activities of *Tithonia diversifolia* leaf extracts. Odeku (2008) reported the anti-malarial property of the stem bark of *Alstonia boonei,* which could be formulated in tablet form.

In conclusion, this study provided an insight into the nutritional composition of the tested medicinal plants in addition to their therapeutic potentials. It was concluded that the presence of these nutrients and phytochemically-active components in the plant samples might be responsible for their therapeutic activity as antimalarial plants.

Table 3: Results of proximate analysis of powdered plant samples.

Plant samples	Crude protein (%)	Crude fibre (%)	% Ether extract	% Ash	% Dry matter
Morinda lucida	$2.28^{de}\pm1.00$	$17.00^{bcd}\pm10.00$	$5.00^{b}\pm1.00$	$3.00^{d}\pm1.00$	$97.00^{a}\pm10.00$
Aframomum melegueta	$3.85^{bcd}\pm1.0$	$4.00^{d}\pm1.00$	$11.00^{b}\pm0.00$	$3.00^{d}\pm1.00$	$80.50^{ab}\pm10.00$
Adansonia digitata	$4.55^{bc}\pm1.00$	$37.00^{a}\pm10.00$	$7.00^{b}\pm1.00$	$9.00^{a}\pm1.00$	$96.00^{a}\pm10.00$
Khaya senegalensis	$4.38^{bc}\pm1.00$	$22.00^{abc}\pm10.00$	$8.00^{b}\pm1.00$	$6.00^{bc}\pm1.00$	$94.00^{a}\pm10.00$
Garcinia kola	$1.40^{e}\pm0.95$	$27.00^{abc}\pm10.00$	$6.00^{b}\pm1.00$	$3.00^{d}\pm1.00$	$97.50^{a}\pm10.00$
Alstonia boonei	$3.33^{cd}\pm1.00$	$30.00^{ab}\pm10.00$	$9.00^{b}\pm1.00$	$3.00^{d}\pm1.00$	$98.50^{a}\pm10.00$
Piper guineensis	$8.75^{a}\pm1.00$	$2.00^{d}\pm1.00$	$23.00^{a}\pm10.00$	$7.00^{b}\pm1.00$	$79.00^{ba}\pm10.00$
Eugenia caryophyllus	$5.60^{b}\pm1.00$	$12.00^{cd}10.00$	$22.00^{a}\pm10.00$	$5.00^{c}\pm1.00$	$72.00^{b}\pm10.00$

Values in the same column followed by the same letter are not significantly different ($p>0.05$) from each other.

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