**ABSTRACT**

*Dialium guineense* (Velvet tamarind, family: Fabaceae) is reported for its food and nutritional value throughout Africa. The medicinal properties of *D. guineense* leaves and other parts of the plant are also well known in traditional systems of medicine. The plant has been studied by various scientists and researchers for its pharmacological activities and therapeutic approaches such as antibacterial, anti-ulcer, antioxidant, analgesic, anti-hepatotoxic, antimicrobial, anti-plasmodial, anti-hemorrhoidal, anti-vibrio, anti-diarrheal, molluscicidal, oral care and vitamin supplement. We reviewed the folk medicinal value of *D. guineense* with the correlated research findings on its uses. The plant was described with habitat, the local uses, including the uses of its parts mentioned, the ethno medicinal uses, the biological activities, the nutritional value and phytochemistry.

**Keywords:** *Dialium guineense*; ethno medicinal uses; biological activity; nutritional value; phytochemistry

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Received: December 2016; Accepted: June 2016*

**Abstracted by:**
Bioline International, African Journals online (AJOL), Index Copernicus, African Index Medicus (WHO), Excerpta medica (EMBASE), CAB Abstracts, SCOPUS, Global Health Abstracts, Asian Science Index, Index Veterinarius

**INTRODUCTION**

The use of plants in the maintenance of good health is well documented (Burkil, 1995; Moerman, 1996; Edeoga and Eriata, 2001). It has also been reported that the bases of many modern pharmaceuticals used today for the treatment of various ailments are plants and plant-based products (Kamba and Hassan, 2010). About 80% of world population depends on plants-based medicine for their health care (WHO, 2001). Medicinal plants are plants which contain substances that could be used for therapeutic purposes or which are precursors for the synthesis of useful drugs (Abolaji et al., 2007). A plant becomes a medicinal plant only when its biological activity has been ethno botanically reported or scientifically established (Elujoba, 1997).

Medicinal plants, since time immemorial have been used virtually in all cultures as a source of medicine. The use of medicinal plants is increasing worldwide, in view of the tremendous expansion of medicine and a growing interest in herbal treatments. Plants are used in medicine to maintain and augment health physically, mentally and spiritually as well as to treat specific conditions and ailments. Medicinal plants are divine gifts to us from Mother Nature who has kept those remedies in her plant kingdom for mankind to use to fight death from diseases and cure themselves from ailments. It is up to us to seek, to explore, search, and reap the benefits of these treasures.

Over 500 plants are known to be useful for medicinal purposes in Africa, but only a few have been described or studied (Taylor et al., 2001). Natural products from plants can be another potent source for the discovery of excellent activities such as blood booster, antioxidant, anti-ulcer, anti-cancer, antimicrobial etc. The World Health Organization (WHO) emphasized the importance of scientific research into herbal medicine. Many developing countries of the world look upon native medicinal plants as possible addition to the WHO’s list of “essential drugs” once their value have been clinically proven. Our survival and continued existence in turn depends on the efficiency with which man, with all the resources and technology available to him, harnesses, develops, utilizes plants and plant products (Ayoka et al., 2008). One of the emerging plants of interest is *Dialium guineense*. It is a medicinal plant commonly known as Velvet tamarind (or, black velvet), a genus of a legume belonging to the family of Fabaceae and sub-family of Caesalpinioideae. This review is aimed at highlighting the medicinal and economic importance of *Dialium guineense*.

**The Plant: *Dialium guineense***

**Botanical description:** Velvet tamarind also known as black velvet is a common name for *Dialium guineense*, a genus of a legume belonging to the family of Fabaceae and sub-family of Caesalpinioideae. The genus *Dialium* comprises five (5) species in West Africa but *D. guineense*, *D. dinklagel*, *D.
packyphylum are represented in Nigeria (Omotayo, 1999). It is a tree of an average height of 30m with a densely leafy crown, but often shrubby. Bole without buttresses, bark smooth, grey, slash reddish, yielding a little red gum (Hutchinson and Daniel, 1958).

The leaves are finely hairy, with a common stalk of 5 to 13 cm long, with an odd terminal leaflet and usually two pairs of opposite or alternate leaflets, the lower pair being somewhat smaller, mostly 3.5 to 10 x 2.5 to 5 cm, elliptic to broadly elliptic, sometimes slightly obovate, blunt at the apex or abruptly and shortly acuminate, symmetrical and rounded or slightly cuneate at the base; leathery, glabrous above and with the midrib slightly sunken, sometimes finely hairy beneath.

Flowers are usually whitish in large terminal, or occasionally axillary, panicles up to 30 cm long; branches spreading out widely and more or less horizontally (Szolnok, 1985). The whole inflorescence at first covered with very short, brownish hairs. Individual flowers with short stout stalks, the buds about 2 cm.

Fruits are usually abundant, more or less circular and flattened, but sometimes almost globose, up to 2.5 cm in diameter, densely velvety, black; each fruit with a stalk about 6 cm long with a little collar near the apex, with a brittle shell enclosing one seed or exceptionally two, embedded in a dry brownish, sweetly, acidic, edible pulp (Hong et al., 1996).

Figure 1: The plant of Dialium guineense (Orwa et al., 2009)

Origin of Dialium guineense: The origin of the generic name is not known; J.E Smith, a noted 18th century English botanist sought it and could not discover it, nor have modern botanists. The specific name means “of Guinea” suggesting that it probably originated in Guinea; subsequently it was introduced as a plantation crop in tropical and subtropical regions.

Ecology: Velvet tamarind grows in dense savannah forests, shadowy canyons and gallery forests. It is found from Senegal to Sudan along the southern border of the Sahel. It is naturally found on moist, sometimes brackish soils with mean annual rainfall of less than 2100-2600 mm.

Distribution: It is also found in Central and West African countries such as Cameroon, Central African Republic, Chad, Benin, Burkina Fasso, Ivory Coast, Ghana, the Guineas, Liberia, Mali, Senegal, Sierra Leone, and Togo. It is the most common and widespread Dialium in Nigeria. It is commonly known as “ichekku” among the Igbo in the eastern part of Nigeria, as “awin” among the Yoruba in the western part of Nigeria and as “tsamiyar kurm” among the Hausa in the northern part of Nigeria (Nwosu, 2000; Akinpelu et al., 2011). It is also known as “yoyi” in Ghana, “Sierra Leone tamarind” in Sierra Leone and “tamarinier noir” in French.

In Nigeria the trees flowers from September to October and fruits from October to January (Keay, 1998). The wild fruits are dietary supplement for rural dwellers in Nigeria during dry season when fruits are scarce (George, 2011). The ripe fruits are available from January till May; but the peak period for harvest is between March and April according to Okafor, (1975). Animals which like to eat the pulp in which the seeds are embedded help disperse the fruits, however, the fruit can also be transported by water since it floats; transport by sea currents may lead to long-distance dispersal.

Table 1:
Local uses of Dialium guineense

<table>
<thead>
<tr>
<th>S/N</th>
<th>Morphological part</th>
<th>Non-medicinal uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wood</td>
<td>In Africa, it is used as fuel: firewood and charcoal. It is also used for construction materials for making vehicles, tools, weapons, furniture, packing cases, houses and flooring. Also used in making “fufu” pestle.</td>
</tr>
<tr>
<td>2</td>
<td>Bark</td>
<td>It is used in artwork in carving figures like amulet, statuettes and various ornamental objects. It is also used in making chewing sticks commonly used in eastern Nigeria.</td>
</tr>
<tr>
<td>3</td>
<td>Gum</td>
<td>It is obtained from seed and is added to many kinds of foods to improve their viscosity in Japan.</td>
</tr>
<tr>
<td>4</td>
<td>Seed</td>
<td>Tamarind seed powder is used as coffee substitute by village people in India. Dehulled seeds are soaked overnight in water and eaten in addition with sugar or salt in India.</td>
</tr>
<tr>
<td>5</td>
<td>Leaves</td>
<td>The young leaves are chewed for its tangy taste. It is used as paste or whole in various cuisines or as tempering in India. It is also cooked as vegetables in India or “domoda” a dish in Ghana.</td>
</tr>
<tr>
<td>6</td>
<td>Fruits</td>
<td>Edible-can be soaked in water and drunk as beverage. It is also used to provide jam and jellies. When peeled, pulp can be eaten raw in Nigeria or as flavor in snacks.</td>
</tr>
<tr>
<td>7</td>
<td>Flowers</td>
<td>They are used for decoration.</td>
</tr>
</tbody>
</table>

Non-Medicinal Uses of Dialium guineense: It is commonly used for food; the pulp is red, with a sweet-sour astringent flavor similar to baobab, but sweeter. It can be eaten raw when dry by man and animal (Matsuda, 2006). The pulp when peeled is also eaten raw in south-east Nigeria because of its refreshing properties and pleasant scorching taste (Ubbaonu et al., 2003). The thirst quenching, refreshing pulp can also be soaked in water and drunk as a beverage and also provides jam and jellies (FAO, 2004). It could also be used as flavor in...
snacks and non alcoholic beverages (Adame, 2002; Efiong et al., 2009).

The young leaves are sometimes chewed for its tangy taste. They are also used as paste or whole in various cuisines or as tempering in India. The leaves are bitter and are used to cook “domoda” a Ghanaian dish that tastes both sweet and bitter.

The seed are roasted, seed coats are removed mechanically, and dehulled tamarind seeds are soaked overnight in water and eaten with the addition of salt or sugar by the rural people of certain ethnic groups such as kurumba, irulas, malayali and Dravidian tribes in India (Siddhuraju et al., 1995). Nonetheless, hot water extract of dry heated tamarind seed powder is used as a coffee substitute by village people.

The flowers and leaves are eaten as vegetables and the gum obtained from the seed is added to many kinds of food in Japan to improve their viscosity (Siddhuraju, 2007), and the low cost tamarindus kernel powder could be used as a good substitute for costly pectin for making jelly (Bhattacharya et al., 1994).

The tree is used for fuel; it is used to make firewood and charcoal. It is also used for timber; sapwood is white with distinct ripple marks; the heartwood is red brown. Because of the high silicate content of the timber, axes and saws get blunt. The wood is hard, durable, heavy, light brown with a fine texture and is traded internationally. It is used for vehicles, for construction material, for making houses and flooring, tools, weapons, furniture, packing cases and fufu pestle. The bark is used as indigenious tooth brush among Nigerian populace (Akinpelu et al., 2011). It is also used in artwork in carving figures like amulet, statuettes and various ornamental objects.

**Ethnomedicinal Uses of Dialium guineense:** Different parts of the tree have been used in folkloric medicine for treatment of different diseases: the bark in cancer, headache, and pains. Idu et al., (2009) reported the usefulness of the bark for oral hygiene and stomach ache among the Esan tribe of Edo state; the leaves are used as a remedy in fever, prenatal pains and edema; the fruits in diarrhea (Arbonnier et al., 2004). The pulp of the fruit is edible and sweet, fairly low levels of ascorbic acid and tannin are present. It is a good source of proteins and minerals (Arogba et al., 2006). The fruits of the plant are chewed among some women in south-east Nigeria to improve lactation and check genital infection (Nwosu, 2000). The leaves and stem bark are used as folkloric remedies for the treatment of infections such as diarrhea, severe cough, bronchitis, wound, stomach ache, malaria fever, jaundice, anti-ulcer and hemorrhoids (Bero et al., 2009). The leaves can also be squeezed and applied on wounds as practiced by Wolof of Senegal (Devendra, 1988). *D. guineense* fruits and leaves are used in the prevention of cancer. The extracts of leaves and seed coat have been reported to be very rich in vitamin C (Maduaka, 1988). Presence of antioxidant and vitamin C makes it an ideal food additive to boost the body’s immunity level. Okegbile et al. (1990) found high content of vitamin c and other micronutrients in wild fruits when compared with nutrition supplied by other fruits such as oranges, avocado pear, pineapple, paw-paw and commercially produced fruits.

*D. guineense* is used as chewing stick among Nigeria populace (Akinpelu et al., 2011). Previous studies have shown that the plant contains saponins which are presumed to add to the cleaning effect of teeth and at the same time prevent carries and plaque (Okwu and Okeke, 2003). Lawal et al. (2010) reported in their findings that *D. guineense* is used as antiulcer and as vitamins supplements among some tribes in the southern part of Nigeria. Traditionally, it is used for the treatment of heart disease, Lawrence et al. (1997) reported that the tannins component possess excellent cardio protective qualities in addition to the antioxidant action. It precipitates lipoprotein which carries cholesterol and thus reduces the level of in-take cholesterol. Mensah et al. (2009) also reported the usefulness of tannins in the management of hypertension among the Esan people of Edo state. The fruit pulp contains over 13% of dietary fiber which increases its bulk and augments bowel movement, thereby help prevent constipation. The fiber also bind to toxins in the food thereby help protect the colon mucus membrane from cancer causing chemicals. In addition, it binds to bile salt and decrease their re-absorption in the colon thereby help in expulsion of bad cholesterol.

**Table 2:**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Morphological part</th>
<th>Medicinal uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bark</td>
<td>It is chewed for oral hygiene and stomach ache among the Esan people of Edo state. It is also used as a remedy for cancer, pains, headache and infections such as diarrhea, severe cough, bronchitis, wound, malaria fever, jaundice, ulcer and hemorrhoids. Also used in the prevention of dental carries and plaque formation (mouth wash) in south east Nigeria.</td>
</tr>
<tr>
<td>2</td>
<td>Leaves</td>
<td>Remedy for fever, prenatal pains, edema and infections such as diarrhea, severe cough, bronchitis, wound, malaria fever, jaundice, ulcer and hemorrhoids. It is also used as vitamin supplement among some tribes in southern Nigeria.</td>
</tr>
<tr>
<td>3</td>
<td>Fruits</td>
<td>Remedy for diarrhea. It also is used to improve lactation and check genital infection in South East Nigeria.</td>
</tr>
</tbody>
</table>

**Biological Activities of Dialium guineense:** Different parts of the plant possess remarkable therapeutic actions that can support the traditional usage of this plant in the treatment of some ailments. There are several reports on the therapeutic properties and pharmacological actions of *D. guineense* based on modern scientific investigations:

**Anti-ulcer activity:** Aqueous extract of *D. guineense* was evaluated for its anti-ulcer activity using ethanol/HCL and indomethacin as ulcerogens. The effect of the extract on gastric mucous secretion was also investigated. The extract
was administered orally at the doses of 100 and 200 mg for the experimental groups while the control and reference groups received distilled water (5 ml/kg, p.o) and cimetidine (32 mg/kg, p.o) respectively. The extent of healing was determined via reduction in ulcer index. The results showed that the extract significantly (p<0.05) reduce the ulcer index from 4.75±0.17 to 0.20±0.12 and from 3.95±0.19 to 0.14±0.09 in the ethanol/HCL and indomethacin induced ulceration respectively. The extract also significantly (p<0.05) increased the gastric mucus secretion. This study showed that aqueous extract of *D. guineense* has anti-ulcer effects which might be due to its ability to increase gastric mucus secretion. The findings from this study also justify the folkloric use of *D. guineense* for the treatment of gastric ulcer (Balogun et al., 2013). Hence, further studies are needed to elucidate the gastro protective mechanism(s) of *D. guineense* plant.

**Antimicrobial activity:** In a study, determination of antimicrobial activity of *D. guineense* leaf extract was carried out against clinical isolates of 6 bacterial species (*Staphylococcus aureus, Streptococcus mutans, Escherichia coli, Bacillus cereus, Pseudomonas aeruginosa, Klebsiella pneumonia*), and 4 fungal species (*Candida albicans, Microsporum gypseum, Trichophyton mentagrophytes and Trichophyton rubrum*) using agar well diffusion method of Rath et al. (2002). Inhibition zones formed by the extract were compared with the standards: ciprofloxacin and griseofulvin. The leaf extract at a concentration of 250, 125, 62.5 µg/ml was effective against *S. mutans* (25.9 mm), and *P. mirabilis* (10.2 mm) being the most and lowest sensitive isolates. The results also revealed that significant (p<0.05) diameter zones of inhibitions were obtained with 125 and 250 µg/ml against bacterial isolates when compared with the reference drug. Generally, the Gram positive bacteria were found to be the most sensitive organisms, followed by the fungi, and the Gram negative bacteria. The results of the leaf extract of *D. guineense* demonstrated antimicrobial activity against the organisms tested. This study substantiates its popular and wide traditional applications in diverse ailments (Gideon et al., 2013). While in another study, stem bark extract of *D. guineense* was examined in rats. The results showed that the extract produced a dose dependent significant reduction (31.3%) in the length of intestinum from 45.54% at 0.8g/ml was recorded for cold water leaf extract against *Staphylococcus aureus* and ethanol extract inhibited the growth of the bacterial isolates in a concentration dependent manner with minimum inhibitory concentration (MIC) at 0.2g/ml. (Orji et al., 2012).

**Antibacterial activity:** Effects of ethanolic leaf and bark extract of *D. guineense* using agar well diffusion technique against clinical isolates of *Klebsiella pneumonia* and *Staphylococcus aureus* were carried out. Results showed that the extract at varying concentration exerted antibacterial activity on the test organism. The highest inhibition diameter (18mm) at 0.8g/ml was recorded for cold water leaf extract against *Staphylococcus aureus* and ethanol extract inhibited the growth of the bacterial isolates in a concentration dependent manner with minimum inhibitory concentration with minimum inhibitory concentration (MIC) at 0.2g/ml. (Orji et al., 2012).

**Analgesic activity:** The analgesic activity of the methanolic stem bark extract of *D. guineense* using 3 anti-nociceptive models; acetic-induced abdominal constriction or writhing, tail immersion and hot plate analgesic models in rats was evaluated. Tests of analgesic drugs commonly measure nociception and involve the reaction of animals to painful stimuli (Rang et al., 2003) the stimuli may be thermal (tail immersion or hot plate tests), chemical (acetic acid-induced writhing or formalin tests or mechanical (tail or paw pressure tests) (George et al., 2009). Three test doses (250, 500, 1000mg/kg) of extract were administered orally via gastric gavage. The activity was compared *D. guineense* produced a significant analgesic activity in a dose dependent manner in the acetic acid-induced writhing model. All the doses (250,500,1000mg/kg) had shown a good analgesic activity. In the tail immersion model, the extract at the dose of 1000mg/kg significantly increased the pain reaction time while in hot plate model the extract and drug also significantly increased the mean pain reaction time at the doses of 500 and 1000mg/kg (Ezeja et al., 2011).

**Anti-diarrheal activity:** In this study, the effect of *D. guineense* stem bark extract on diarrheal-induced rats was investigated. The effect of the extract at oral doses of 50-200mg/kg body weight on the castor oil-induced diarrhea, gastrointestinal motility (charcoal meal) and castor oil-induced intestinal fluid accumulation (enterpooling) was examined in rats. The results showed that the extract produced a dose dependent significant reduction (31.3-80.8%). In the watery nature and frequency of fecal droppings over 4hrs, while lope amide gave 85.8% reduction on gastrointestinal motility and enterpooling, the extract also dose dependently reduced the small intestine transit time of charcoal meal (28.90%-45.54%) and intestinal fluid volume (46.27%-73.88%) in a manner comparable to 5mg/kg each of atropine (58.20%) motility time inhibition and lope amide (76.12%) enterpooling inhibition. This finding justifies its use as folklore remedies for the treatment of infection such as diarrhea (Gideon et al., 2012).

**Anti-hepatotoxic activity:** In this study, the ability of *D. guineense* pulp phenolic extract to protect against aflatoxin B1-induced hepatotoxicity and oxidative stress was investigated in rats. Results showed that aflatoxin B1 mediated elevation in the concentration of oxidative stress biomarkers; malondialdehyde, conjugated diene, lipids hydroperoxides,
protein carbonyl, and percentage DNA fragmentation were significantly lowered by *D. guineense* phenolic extract (p<0.05). Likewise aflatoxin B1 mediated decrease in the activities of reactive oxygen species detoxifying enzymes (super oxide dismutase, catalase, glutathione peroxidase, glutathione reductase and glucose 6 phosphate dehydrogenase) was significantly attenuated. Overall the in vivo effects suggest that *D. guineense* phenolic extract elicited reactive oxygen scavenging and detoxification potential as well the capability to prevent lipid per oxidation, protein oxidation and DNA fragmentation (Abdulwasiu et al., 2014).

**Anti-vibrio activity:** The determination of anti-vibrio activity of the leaf extract of *D. guineense* on 18 strains of vibrio was carried out by Akinpelu et al., (2011). It was found to possess bioactivity against 14 out of 18 environmental strains of vibrio species tested at a final concentration of 20mg/ml. On the other hand, the standard antibiotics used ampicillin inhibited the growth of fifteen out of the eighteen tested strains of the vibrio species. The zones of inhibitions exhibited by the extract against the tested isolates ranged between 12 and 20mm. Zones of inhibition exhibited by ampicillin against the tested isolates ranged between 7 and 40mm. *D. guineense* leaf extract exhibited minimum inhibitory concentration ranging between 0.313 to 5.0mg/ml against vibrio isolates while the minimum bactericidal concentration exhibited ranged between 0.625 and 10mg/ml by the leaf extract.

**Anti-plasmodial activity:** Twenty volunteers adults infected with malaria parasites were selected for this study. The antimalarial drug (artesunate) and the plant extract (leaves) (5mg two times daily) were administered separately in some, and then co-administered in others for 3 days. The studies of the anti-plasmodial effects alone showed only moderate clearance of malaria parasites after 3 days. Likewise *D. guineense* extract alone showed a moderate anti-plasmodial effect after 3 days of treatment while co-administration of *D. guineense* and artesunate showed that the combination cleared the malaria parasites after 3 days suggesting that *D. guineense* has a synergistic anti-plasmodial effect (Adumanya et al., 2013). In another study, 85 medicinal plants including *Dialium guineense* were investigated for their potancy as antimalarial. *D. guineense* was found to inhibit the growth of plasmodium falciparum, the malaria parasite responsible for the illness (Bero et al., 2009).

**Molluscicidal activity:** The molluscicidal effect of the fruit and leaves of *D. guineense* have been reported. It was found to be due to glycosides of the triterpenoid oleic acid. Three glycosides were isolated from the fruit and a fourth the leaves. The amount of total saponins present in *D. guineense* makes it a good candidate for readily available molluscicide in Nigeria villages (Odukoya et al., 1996).

**Oral care:** In southern Nigeria, the twigs are used as chewed sticks and the presence of bioactive compounds comprised of saponins, tannins, flavonoids, alkaloids is responsible for their effectiveness. Chewing sticks when used without toothpaste are very efficient, effective, and reliable for cleaning teeth. The teeth of chewing stick users are usually strong, clean, fresh, and devoid of dental plaque carries (Okwu and Okeke, 2003).

**Anti-hemorrhoidal activity:** *D. guineense* extract was found to possess an astringent effect which helps heal mucous membranes and exposed tissue and bring about contraction and firm up tissue. The herbal treatment in hemorrhoid therapy involves use of astringents. This astringent effect is caused by tannins, which reduce lubrication by precipitating proteins. It is proposed that this astringent herb accomplish anti-hemorrhoid activity by causing coagulation of proteins in the cells of the perianal skin or the lining of the anal canal. They plug up minute leaks and holes in the veins and capillaries, promote vein elasticity and act as vasoconstrictors in the perianal area. Thus promote dryness of the skin, which in turn helps relieve burning, itching and pain associated with hemorrhoids (Odukoya et al., 2009).

<table>
<thead>
<tr>
<th>S/N</th>
<th>Activity</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anti-ulcer</td>
<td>Balogun et al., 2013</td>
</tr>
<tr>
<td>2</td>
<td>Anti-microbial</td>
<td>Gideon et al., 2013; Olajubu et al., 2012</td>
</tr>
<tr>
<td>3</td>
<td>Anti-bacterial</td>
<td>Orji et al., 2012</td>
</tr>
<tr>
<td>4</td>
<td>Analgesic</td>
<td>Ezeja et al., 2011</td>
</tr>
<tr>
<td>5</td>
<td>Molluscicidal</td>
<td>Odukoya et al., 1996</td>
</tr>
<tr>
<td>6</td>
<td>Anti-oxidant</td>
<td>Gideon et al., 2013</td>
</tr>
<tr>
<td>7</td>
<td>Anti-hepatotoxic</td>
<td>Abdulwasiu et al., 2014</td>
</tr>
<tr>
<td>8</td>
<td>Anti-plasmodial</td>
<td>Adumanya et al., 2013; Bero et al., 2009</td>
</tr>
<tr>
<td>9</td>
<td>Anti-vibrio</td>
<td>Akinpelu et al., 2011</td>
</tr>
<tr>
<td>10</td>
<td>Anti-diarrheal</td>
<td>Gideon et al., 2012</td>
</tr>
<tr>
<td>11</td>
<td>Vitamin C substitute</td>
<td>Maduaka, 1988</td>
</tr>
<tr>
<td>12</td>
<td>Oral care</td>
<td>Okwu and Okeke, 2003</td>
</tr>
<tr>
<td>13</td>
<td>Anti-hemorrhoidal</td>
<td>Odukoya et al., 2009</td>
</tr>
</tbody>
</table>

**Mineral Composition of *Dialium guineense***

**Fruit:** According to Nicholas et al. (2014), the high performance liquid chromatography (HPLC) analysis of *D. guineense* fruits revealed the followings: high glucose and fructose content (90.8% of total soluble sugar), total quantity of proteins (5.3%) containing all the essential amino acids, lipids (3.1%) and essential vitamins such as ascorbic acid, B-carotene and tocopherol in trace were found to be relatively low by comparison. The mineral composition includes phosphorus, potassium, zinc, calcium, manganese. It is also a potential source of iron (4.8-8.4mg/100g), magnesium (0.1g/100g) and copper (0.7mg/100g) and would contribute towards meeting the recommended daily allowances of these micronutrients in combating malnutrition especially in sub-Saharan Africa (Nicholas et al., 2014).
Seed and pulp: This was done according to the method described by Association of Official Analytical Chemist (AOAC) and carried out in duplicate. Values obtained for the proximate analysis of whole seed and pulp were: moisture (10.13% and 10.53%), dry matter (90.15% and 88.40%), ash (2.55% and 12.50%), organic matter (12.60% and 41.55%), crude fat (35.33% and 35.34%), crude fiber (13.52% and 1.05%), carbohydrate 943.90% and 58.65%, protein (17.44% and 3.94%), and total nitrogen free extract (2.79% and 0.65%) respectively. The proximate mineral composition was: magnesium (0.16mg/l and 0.40mg/l), sodium (2.42md/l and 2.88mg/l), iron (0.91mg/l and 1.43mg/l), calcium (0.54mg/l and 0.35mg/l) and potassium (0.34mg/l and 1.21mg/l) (Folake et al., 2013).

Table 4:
Nutritive value of D. guineense fruit (Nicholas et al., 2014)

<table>
<thead>
<tr>
<th>Constituents</th>
<th>D. guineense fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>58.65%</td>
</tr>
<tr>
<td>Proteins</td>
<td>3.94%</td>
</tr>
<tr>
<td>Crude fat</td>
<td>5.34%</td>
</tr>
<tr>
<td>Iron</td>
<td>14.3mg/100g</td>
</tr>
<tr>
<td>Magnesium</td>
<td>4.0mg/100g</td>
</tr>
<tr>
<td>Sodium</td>
<td>28.8mg/100g</td>
</tr>
<tr>
<td>Calcium</td>
<td>3.5mg/100g</td>
</tr>
<tr>
<td>Potassium</td>
<td>12.1mg/100g</td>
</tr>
<tr>
<td>Moisture</td>
<td>10.53%</td>
</tr>
<tr>
<td>Ash</td>
<td>12.50%</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>1.05%</td>
</tr>
</tbody>
</table>

Phytochemistry of Dialium guineense
According to Gideon and Raphael (2013), crude extract of stem bark revealed the presence of bioactive compounds comprising cardiac glycosides, tannins, phlobatannins, saponins, terpenoids, resins, steroids, triterpenes, alkaloids, flavonoids, reducing sugars and carbohydrates while phytochemicals identified in the leaf extract are tannins, alkaloids, flavonoids, saponins, steroids and cardiac glycosides (Davidi et al., 2011; Ogu and Amiebenemo, 2012). Phytochemical screening was done using standard procedures described by Harbone (1984) and Trease and Evans (1984). Most of the effects observed with extracts of D. guineense may be attributed to the constituent compounds of phenols which play important roles in health in addition to enhancing antimicrobial activity in this plant. The medicinal value of D. guineense lies in these chemical substances that produce a definite physiological action in human body. These phenolic compounds include tannins, flavonoids, saponins, cardiac glycosides among others. These are known to be biologically active and their presence has been reported for several activities like antibacterial (Orji et al., 2012), molluscicidal (Odukoya et al., 1996), anti-plasmodial (Bero et al., 2009; Adumanya et al., 2013), anti-diarrheal (Gideon et al., 2012), anti-vibrio (Akinpelu et al., 2011), analgesic (Ezeja et al., 2011), anti-hepatotoxic (Abdulwasiu et al., 2014), anti-ulcer (Balogun et al., 2013), anti-microbial (Gideon et al., 2013; Olajubu et al., 2012), antioxidant (Gideon et al., 2013), anti-hemorrhoid (Odukoya et al., 2009), oral care (Okwu and Okeke, 2003). Currently, the active ingredients in the plant that could be responsible for these activities are not yet known, however further studies are needed to isolate pure compounds of pharmacological importance from the plant crude extract.

Table 5:
Phytochemical constituents of D. guineense

<table>
<thead>
<tr>
<th>S/N</th>
<th>Compounds</th>
<th>Biological Effect</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tannins</td>
<td>Wound healing</td>
<td>James and Friday, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cardio-protection and antioxidant.</td>
<td>Lawrence et al., 1997</td>
</tr>
<tr>
<td>2</td>
<td>Alkaloids</td>
<td>Antimalaria</td>
<td>Hermans et al., 2010</td>
</tr>
<tr>
<td>3</td>
<td>Flavonoids</td>
<td>Anti-inflammatory antioxidant and Anti-ulcer.</td>
<td>Nijyeldt et al., 2001; Di carlo et al., 1999; Borrelli et al., 2001; Galati et al., 2001.</td>
</tr>
<tr>
<td>4</td>
<td>Cardiac glycosides</td>
<td>Anti-cancer. Inotropic effect</td>
<td>Katarzynek et al., 2006; Shi et al., 2010.</td>
</tr>
<tr>
<td>5</td>
<td>Saponins</td>
<td>Mouth wash</td>
<td>Okwu and Okeke, 2003.</td>
</tr>
</tbody>
</table>

Conclusion
Dialium guineense has been indicated in the treatment of various health ailments in traditional system of medicine. The review carried out so far have shown D. guineense as a medicinal plant with a lot of potentials, valuable, untapped resource of active drugs for combating various diseases. Further research is indispensable to reveal the detailed molecular mechanism(s) behind these biological activities in order to exploit their medicinal potentials.

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Medicinal importance of velvet tamarind


