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Review Article

Evaluation of Nutrient and Anti-nutrient Potentials of Leaves of Selected Tree Species

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Abstract *- This study was carried out to evaluate the nutritional composition of leaves of Mallotus oppositifolius, Sterculia trangacantha, Chrysophyllum delevoyi, Dialium guineense. Leaves were collected from their natural habitat in Ado Ekiti. The result obtained from the study revealed that the samples contained a considerable amount of proximate constituents (Moisture, Fat, Crude fibre, Ash, Protein and Carbohydrate), anti-nutrient (phytates, oxalates saponins, tannins), minerals (Na, Ca, Mg, Zn, Fe), vitamins (A, and C) in varying proportion. The result on proximate composition showed that Chrysophyllum delevoyi had the highest values of protein (22.35%), fat (5.63%) and moisture content (10.38%). Mallotus oppositifolius recorded the highest value of fibre (6.28%), while Dialium guineese had the highest values of carbohydrate (60.44%) and Ash (10.10%). Chrysophyllum delevoyi had the highest value of Mg (122.80). Mallotus oppositifolius had the highest values of Fe (35.08) and Ca (2011.00) mg/100g. Sterculia trangacantha had the highest values of Na (72.27 mg) and Zn (20.28 mg). Mallotus oppositifolius had the highest value of vitamin A (0.69), while Chrysophyllum delevoyi had the highest value of vitamin C (18.35) µg/g. Mallotus oppositifolius had the highest values of oxalates (87.22 mg), tannins (1221.00 mg) and saponins (22.35 mg), while Chrysophyllum delevoyi had the highest values of phytates (64.33mg). From this study, it can be concluded that consumption of these tree species in several forms, either as food or as condiments to supplement minerals, vitamins, protein in the human diet, especially among the rural dwellers with low income, might help to reduce malnutrition rates in our society.*

Keywords *- Evaluate, Nutrients, Potentials, Proximate composition and Tree species.*

I. INTRODUCTION

Forest trees contribute in many ways to global food security by maintaining household nutrition and providing a lifeline to rural populations. The roots, trunk, bark, leaves, flowers, fruits and seeds of a tree are known to have medicinal values in treating diseases such as anaemia, hypertension, malaria, fever and asthma. Medicinal plants have nutritional functions such as carbohydrates, proteins, fats, mineral elements, vitamins and even dietary fibre, which are essential for the physiological activities of the human body. Undernutrition is a result of poverty insufficient energy intake due to poor nutrition education. Animal and animal products are expensive sources of nutrients in developing countries; they serve as valuable sources of nutrients, especially in rural areas where they contribute to protein, minerals, fibre, vitamins and other nutrients which are usually not readily available in regular diets (Mohammed and sharif, 2011).

Dialium guineense belongs to the family Fabaceae, and it is a leguminous tree grown in tropical African countries; the velvet tamarind is a tall tropical, fruit-bearing tree. it is identified as various names in Nigeria Awin or Igbaru (Yoruba), Icheku (Igbo) and Tsamiyarkurm (Hausa) (Nwosu, 2000; Akinpelu *et al*, 2011). *Dialium guineense* are found in lowland, evergreen, humid or dry forests, occasionally in savannah vegetation, dense savannah forest. The leaves are finely hairy, and the fruits are in abundance. The bark is used for stomach ache treatment (Idu *et al*., 2009). The leaves are used to cure fever, prenatal pains and edema. The fruits are used in the treatment of diarrhoea (Arbonnier *et al.*, 2004).

Mallotus oppositifolius belongs to the family Euphorbiaceae; it is identified as various names in Nigeria Oju eja in (Yoruba), okpokirinya (Igbo), and kafarmutuwaa (Hausa). *Mallotus oppositifolius* are mostly found in Africa, and they are widely distributed from Senegal to Ethiopia, south to Angola, Zambia, Zimbabwe, Mozambique and Madagascar.

Mallotus oppositifolius is a dioecious shrub about 6–13 meters in height; the leaves are opposite and simple. The leaves possess ingredients of common anti-dysentery, anti-malaria, and anti-inflammatory remedies (Kabran *et al.*, 2012). The leaves are used in the treatment of headache, epilepsy or mental illness (Anuforo (2017).

Sterculia trangacantha belongs to the family Sterculiaceae, found mostly in tropical and warm areas of the world. It is identified as various names in Nigeria as

Alawefun (Yoruba), Okwe (Igbo), Waawankurmii (Hausa). *Sterculia tragacantha* is about 3 to 24 meters in height. *Sterculia tragacantha* is used in the treatment of boils, diarrhoea, fever, gonorrhoea, syphilis, and snakebite in Burkina Faso, Cameroon, Ghana, Guinea, Ivory Coast, Nigeria and Sierra Leone (Dennis *et al.*, 2002. Orisakeye, 2014).

Chrysophyllum delevoyi belongs to the family Sapotaceae, and the tree is evergreen, about 22 m tall. In Nigeria, *Chrysophyllum delevoyi* is commonly called Osandan (Yoruba), Agwaluwa (Hausa) and Ibibios (Igbo). The bark is used as sedatives, stomach troubles. The fruit is used to treat diarrhoea, dysentery and vomiting. (Burkill, 2000). The seed oil is edible, and the seeds are also used to make soap. (Edem et al., 2002).

The consequences of malnutrition in underdeveloped or developing countries cannot be overemphasized; this tragedy is mostly found in rural areas. This can be attributed to mere ignorance of the food trees around them. Intake of protein, minerals, vitamins enriched food among rural dwellers is grossly insufficient, and this is due to its unavailability or too costly for them to get. In the rural communities in Nigeria, most traditional diets often consist of main staple foods, which mostly contain carbohydrates, thereby contributing to the low nutrition security of the rural dwellers. Forest foods contain proteins, fats, carbohydrates, vitamins and minerals (Balogun and Oyeyiola, 2011). More knowledge is needed on the nutritional values of forest foods; awareness of nutrition can play a significant role in empowering rural dwellers. There are some forest tree species that are high in nutrients and can be consumed as food which could possibly enrich the diets of people in the developing countries if given adequate sensitization and research attention. Underutilized forest tree species could be used to sustain world food security demands when appropriately processed for consumption; the trees species-rich in nutrients (such as minerals and vitamins) could effectively reduce the level of malnutrition if fully integrated into human and animal nutrition (Ukoha, 2003). This research is therefore aimed at evaluating the proximate, mineral, vitamin and anti-nutritional properties of leaves of *Dialium guineense, Mallotus oppositifolius, Sterculia tragacantha* and *Chrysophyllum delevoyi*.

II. MATERIALS AND METHOD

A. Sample Collection and Authentication

Fresh leaves of four tree species (*Dialium guineense, Mallotus oppositifolius, Chrysophyllum delevogi* and *Sterculia tragacantha*) were collected from their natural habitat in Ado Ekiti. The samples were taken to the Herbarium of Plant Science Department, Ekiti State University, Ado Ekiti, for identification.

B. Preparation of Samples

The samples were transported to the laboratory; the leaves were rinsed in water to remove dirt. Samples were air-dried in the laboratory by arranging them on a shelf for three weeks. Dried leaves were grounded to a fine powder using a mortar and pestle, sieved by passing it through a 0.25mm mesh sieve to obtain a fine powder. Samples were stored in polythene bags, labelled and kept until when needed for the laboratory analysis.

C. Determination of Nutrients, Anti-nutrients, Minerals and Vitamins Compositions

Proximate values (moisture, crude protein, fat, crude fibre, carbohydrate and ash content) of the samples were analysed using standard methods AOAC (2004). Anti-nutrients (tannin, oxalate, phytate and saponin) were determined according to methods described by AOAC (2004). Vitamins A and C were determined by the filtration method described by Pearson (1976) using Whatman filter paper. Mineral contents of samples such as Sodium (Na), Magnesium (Mg), calcium (Ca), Zinc (Zn) and Iron (Fe) were determined using Atomic Absorption Spectrophotometer, according to the procedure described by (AOAC, 1990 and AOAC, 2005).

D. Statistical Analysis

Data obtained from this study were subjected to analysis of variance (ANOVA) using SPSS version 25.0. Each of the measurements was carried out in triplicate; means were separated and compared to find the levels of significance at $P < 0.05$. Results were expressed as Mean ± Standard deviations.

Table 1. Scientific and Local Names of Tree Species

Family	Scientific Name	Yoruba	Hausa	Igbo
Fabaceae	*Dialium guineense*	Awin /igbaru	Tsamiyarkurm	Icheku
Euphorbiaceae	*Mallotus oppositifolius*	Ojueja	Kafar	Okpokirinya
Sapotaceae	*Chrysophyllum deleloyi*	Osandan	Agwaluwa	Ibibios
Sterculiaceae	*Sterculia tragacantha*	Alawefun	Waamankurmii	Okwe

III. RESULTS

The proximate composition of *Dialium guineese, Mallotus oppositifolius, Chrysophyllum delevoyi, Sterculia trangacantha* was presented in Table 2. The table showed that *Chrysophyllum delevoyi* had the highest value (10.38%) of Moisture content while *Mallotus oppositifolius* had the lowest value (8.94%), *Steculia trangacantha* and *Dialium guineese* were not significantly different. The result on fat showed that *Chrysophyllum*

delevoyi had the highest value (5.62%) while *Dialium guineese* had the lowest value (4.10%). *Sterculia trangacantha* and *Dialium guineese* were not significantly different. The result on Ash showed that *Dialium guineese* had the highest value (10.1%) while *Chrysophyllum delevoyi* had the lowest value (6.09%). The result on protein revealed that *Chrysophyllum delevoyi* had the highest value (22.35%) while *Dialium guineese* had the lowest value (10.36%). The result on Crude fibre showed that *Mallotus oppositifolius* had the highest value (6.28%) while *Chrysophyllum delevoyi* had the lowest value (4.20%). *Dialium guineese* had the highest value of carbohydrates (60.44%), while *Chrysophyllum delevoyi* had the lowest value (51.34%). Table 3 showed that a significant difference occurred in the mineral content across the sampled leaves. The highest concentration of sodium was found in *Sterculia trangacantha* (72.27mg), while *Dialium guineese* had the lowest concentration (35.22mg), *Chrysophyllum delevoyi* had the highest concentration of Magnesium (122.80mg), while *Sterculia trangacantha* had the lowest (69.30mg). *Mallotus oppositifolius* had the highest concentration of Iron (35.08mg) while *Sterculia trangacantha* had the lowest value (12.85mg), *Mallotus oppositifolius* had the highest concentration of Calcium (2011.00mg), while *Chrysophyllum delevoyi* had the lowest value (443.6m0g). *Sterculia trangacantha* had the highest concentration of Zinc (20.28mg), while *Dialium guineese* had the lowest value (6.45mg). Table 4 showed that a significant difference occurred in the vitamin content across the sampled leaves. *Chrysophyllum delevoyi* had the highest concentration of Vitamin C (18.35µg), followed by *Mallotus oppositifolius, Sterculia trangacantha*, and *Dialium guineese* had the lowest value (5.60µg). *Mallotus oppositifolius* had the highest concentration of Vitamin A (0.69µg) followed by *Chrysophyllum delevoyi*, and the result revealed that *Sterculia trangacantha* and *Dialium guineese* were not significantly different. Table 5 showed that the anti-nutritional properties of the sampled leaves differed significantly. The highest concentration of phytate (64.83mg) was found in *Dialium guineese,* while *Chrysophyllum delevoyi* had the lowest value (12.55mg). The highest concentration of oxalate was recorded in *Mallotus oppositifolius* (87.22mg), while *Chrysophyllum delevoyi* had the lowest value (12.55mg). The highest concentration of tannin was found in *Mallotus oppositifolius* (1221.00mg), while *Chrysophylum delevoyi* had the lowest value (622.85mg). *Mallotus oppositifolius* had the highest concentration of saponin (22.35mg), while *Chrysophyllum delevoyi* had the lowest value (6.74mg).

Table 2. Proximate composition of sampled leaves (%)

Species	Moisture	Fat	Ash	Protein	Fibre	CHO
MO	8.94 ±0.04^{d}	4.7 ±0.02^{c}	9.3 ±0.02^{b}	14.09 ±0.03^{c}	6.28 ±0.02^{a}	56.69 ±0.05^{b}
ST	9.28 ±0.06^{c}	5.25 ±0.02^{b}	8.82 ±0.06^{c}	16.9 ±0.02^{b}	5.84 ±0.04^{b}	53.76 ±0.10^{c}
CD	10.38 ±0.04^{a}	5.63 ±0.04^{a}	6.10 ±0.03^{d}	22.36 ±0.05^{a}	4.2 ±0.02^{d}	51.35 ±0.02^{d}
DG	9.63 ±0,05^{b}	4.11 ±0.02^{d}	10.1 ±0.04^{a}	10.36 ±0.04^{d}	5.36 ±0.04^{c}	60.45 ±0.03^{a}
SEM	0.0407	0.0187	0.0322	0.0287	0.0258	0.0472

Data are presented as mean ± standard deviation of three replicates. Values in the same column followed by different letters are significantly different at $P < 0.05$.

MO- *Mallotus oppositifolius,* ST- *Sterculia tragancatha,* CD– *Chrysophyllum delevoyi,* DG – *Dialium guineense.*

Table 3. Mineral content of sampled leaves (mg/100g)

Species	Na	Mg	Fe	Ca	Zn
MO	63.08 ±0.53^{b}	117.3 ±1.30^{b}	35.09 ±0.04^{a}	2011 ±5.00^{a}	9.13 ±0.03^{b}
ST	72.28 ±0.18^{a}	69.3 ±0.30^{d}	12.85 ±0.02^{d}	11344 ±4.00^{b}	20.29 ±0.09^{a}
CD	54.49 ±0.19^{c}	122.8 ±0.80^{a}	34.26 ±0.06^{b}	443.6 ±2.80^{d}	6.79 ±0.01^{c}
DG	35.22 ±0.34^{d}	104.35 ±0.35^{c}	17.89 ±0.04^{c}	1081.5 ±1.50^{c}	6.45 ±0.05^{d}
SEM	0.2763	0.6510	0.0314	2.9180	0.0418

Data are presented as mean ± standard deviation of three replicates. Values in the same column followed by different letters are significantly different at $P<0.05$

MO- *Mallotus oppositifolius,* ST- *Sterculia tragancatha,* CD – *Chrysophyllum delevoyi,* DG – *Dialium guineense.*

Table 4. Vitamin content of the sampled leaves (µg/g)

Species	Vitamin A	Vitamin C
MO	0.69±0.03[a]	11.65±0.15[b]
ST	0.13±0.01[c]	10.18±0.08[c]
CD	0.44±0.02[b]	18.35±0.15[a]
DG	0.087±0.01[c]	5.60±0.00[d]
SEM	0.0155	0.0919

Data are presented as mean ± standard deviation of three replicates. Values in the same column followed by different letters are significantly different at P<0.05.

MO- *Mallotus oppositifolius,* ST- *Sterculia tragancatha,* CD – *Chrysophyllum delevoyi,* DG – *Dialium guineense.*

Table 5. Anti-nutritional properties of sampled leaves (mg/100g)

Species	Phytate	Oxalate	Tannin	Saponin
MO	26.26 ±0.14[a]	87.22 ±0.92[a]	1221 ±0.20[a]	22.35 ±0.25[a]
ST	18.70 ±0.05[c]	15.63 ±0.18[c]	875.85 ±14.95[c]	8.14 ±0.02[c]
CD	22.5 ±0.30[b]	64.83 ±0.63[b]	1105.30 ±3.10[b]	14.68 ±0.13[b]
DG	14.9 ±0.70[d]	12.55 ±0.15[d]	622.85 ±2.55[d]	6.74 ±0.04[d]
SEM	0.31666	0.46484	6.32001	0.11557

Data are presented as mean ± standard deviation of three replicates. Values in the same column followed by different letters are significantly different at P<0.05.

MO- *Mallotus oppositifolius,* ST- *Sterculia tragancatha,* CD – *Chrysophyllum delevoyi,* DG – *Dialium guineense.*

IV. DISCUSSION

Crude protein content in all sampled leaves was relatively high, and they ranged between (10.36% - 22.35%). The value of 14.09% obtained for *Mallotus oppositifolius* was similar to the value (14.17%) obtained by Olujobi (2015) for B*ombax buonopozense.* The protein value in all the leaves investigated except for *Dialium guineese* were moderately high, with their values higher than 12 %, which is the acceptable value for any food to be considered as a good source of protein (Onwordi *et al.*, 2009, Asaolu *et al.*, 2012). Protein helps in bodybuilding and the repair of tissue. Therefore, they could be a good source of diet for individuals with deficiency disease.

Carbohydrate contents were significantly high in all the samples, and they varied between (51.34% - 60.44%) for the sampled tree leaves. The value of carbohydrate obtained in *Dialium guineese* (60.44%) in this study was similar to the value (60.61%) obtained by Princewill-Ogbonna, (2019) reported for *Mangifera indica.* The high value of carbohydrates recorded in the analysed samples suggested that they could be a good source of body fuel for daily activities; carbohydrate helps to produce the energy required for smooth functioning of the body (Akubugwo *et al.*, 2007). The crude fibre was appreciably high, ranging from (4.20% - 6.28%) for the sampled leaves. The highest content of crude fibre was found in the leaves of *Mallotus oppositifolius,* which may be attributed to its ability to synthesize these proximate substances more than *Dialium guineese and Chrysophyllum delevoyi.* The fibre content obtained for *Dialium guineese* in this present study (5.36%) was higher than 1.05% reported by Nicholas et al. (2014) for the same leaf sample. Ash content ranged between (6.09% - 10.10%) for the sampled tree leaves. The ash content reported in the present study for *Dialium guineese* (10.10%) was found lower than the value (12.50%) reported by Nicholas *et al.* (2014) for the same leaf sample. The relatively high value of the ash content reported was an indication that *Dialium guineese*, *Chrysophyllum delevoyi*, *Mallotus oppositifolius*, *Sterculia trangacantha* could be a good source of minerals for human nutrition. The fat content varied from (4.11% -to 5.63%) for the sampled tree leaves. The value (5.63%) obtained for *Chrysophyllum delevoyi* was in agreement with the value (5.34%) obtained by Nicholas *et al.* (2014) for *Dialium guineese*. The result showed that the sampled leaves were poor sources of lipids; they could be a good diet for people suffering from obesity (Ejoh *et al.*, 1996). Fat helps in reducing blood sugar and also acts as a general body cleanser (Emebu and Anyika, 2011). The mineral content of the four sampled leaves in this study proved that they could be a good source of the dietary mineral requirement for man and hence a good way for expensive cultivated varieties of leaves with lower mineral content value. Minerals are very important in normal body functions. Mineral content in this study was in abundance in all the samples. The sodium content of the investigated leaves ranged from (35.22mg-72.27mg).The value (35.22%) obtained for *Dialium guineese* was higher than the value (16.75%) for *Terminalia cattapa.* Sodium has been said to be very important in the maintenance of acid-base balance in the body (Adeyeye, 2002). The magnesium content of the investigated leaves ranged from (69.30 mg-

122.8 mg). The values were higher than 43.66% for *Terninalia cattapa.* Magnesium is an important element in the correction of diseases associated with the circulatory system (Vunchi, 2011). Magnesium also plays a role in regulating the acid-alkaline balance in the body. High magnesium levels in drinking water have been linked to resistance to heart disease (Fallon and Enig, 2001). Iron content ranged from (12.85 mg-35.08 mg). The values obtained were found lower (14.3mg) than *Dialium guineese* reported by Nicholas *et al.* (2014). Iron (Fe) is essential for blood formation and the normal functioning of the central nervous system (Mohammed, 2011). Calcium content ranged from (443.60 - 2011.00mg) in the sampled leaves. Calcium is essential for bone and teeth formation (Vunchi *et al.*, 2011). Calcium helps with maintenance and also in blood clothing, muscle contraction and regulation of cell permeability. (Wardlaw, 2004). Zinc content varied between (6.45 - 20.26mg) in the samples investigated. Zinc is very useful in protein synthesis, cellular differentiation and replication, immunity and sexual functions infertility (Pathak and Kapil, 2004). Zinc deficiency may lead to growth failure and poor development of gonadal function (Ihedioha and Okoye, 2011). The results for vitamin A were reported as 0.69, 0.13, 0.08 and 0.44 (µ/g) for *Mallotus oppositifolius, Sterculia trangacantha, Chrysophyllum delevoyi, Dialium guineese, respectively*. The amounts of vitamin A were low for all four samples investigated. The values obtained for vitamin C were reported as 11.65, 10.17, 5.60 and 18.35 (µ/g) for *Mallotus oppositifolius, Sterculia trangacantha, Chrysophyllum delevoyi, Dialium guineese*, respectively. It revealed that *Dialium guineese* (18.35) had the highest vitamin C content. The amounts of vitamin C in the samples were generally higher than the daily recommended nutrient intake. Vitamin A is essential for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell function (Lukaski, 2009). Vitamin C is required for the prevention of curving and maintenance of healthy skin, gums and blood vessels. Deficiency of vitamin C causes bruising, bleeding, dry skin (Olson, 1999). The results revealed that the anti-nutritional properties varied significantly in all the leaves investigated. The presence of these anti-nutritional properties is an indication that the leaves could be used for medicinal purposes. Oxalate content varied from (12.55mg- 64.83mg). Oxalates induce low serum calcium and magnesium levels as well as renal failure due to salt precipitation in the kidneys (kidney stones) (Rahman. 2013). Phytate content ranged from (12.55mg and 64. 83mg). Phytate has been known for some nutritional diseases, such as the availability of mineral elements and inhibitions of some metabolic activities. The Tannin content ranged from (622.85mg and 1221.00mg); the values were found to be significantly high in all four samples. Tannins have cardio-protective, anti-inflammatory, anti-carcinogenic, anti-mutagenic, anti-tumour, anti-bacterial, antiviral and immune modulator activity (Arts *et al.*, 2000). Tannin has been used in the treatment of common pathogenic strains in the body (Kubmarawa *et al.*, 2007). Saponin content ranged from (8.14mg and 22.35mg). Saponin has been reported to suppress cholesterol build up in the body, while tannin has been used in the treatment of common pathogenic strains in the body (Kubmarawa *et al.*, 2007).

V. CONCLUSION

It has been observed that the leaves of the tree species investigated in this study contained a considerable number of proximate constituents (Ash, moisture, fat, crude fibre, protein, carbohydrate), anti-nutrient (Phytate, Oxalate, Saponin, Tannin), minerals (Na, Zn, Ca, Mg and Fe), vitamins (A and C) in varying proportion. The result further revealed that *Chrysophyllum delevoyi* contained a higher value of protein; *Mallotus oppositifolius* is rich in fibre, *Dialium guineese* is rich in carbohydrate. *Sterculia trangacantha* is rich in sodium and zinc, *Chrysophyllum delevoyi* is rich in magnesium, *Mallotus oppositifolius* is rich in iron and calcium. The result also revealed that *Chrysophyllum delevoyi has* the highest proportion of vitamin C.

VI. RECOMMENDATION

The leaves of the tree species investigated in this study contained a considerable amount of important nutrients. It is therefore suggested that they could be consumed as food or added to food as condiments to supplement minerals, vitamins, protein in the human diet, especially among the rural dwellers with low income, including these in daily diets might help reduce malnutrition rates which are rampant in our world today.
Also, the need arises to create more awareness and also promote the consumption of these tree species for increased utilization and better nutrition.

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