The Pharmaceutical and Chemical Journal, 2019, 6(6):56-64

Available online www.tpcj.org

Research Article

ISSN: 2349-7092
CODEN(USA): PCJHBA

Nutritional and Phytochemical Assessment of *Musa sapientum var. velutina*

Oyeyemi, S. Dele*, Otoide, J. Eremosele, Obembe, M. Olusola, Ogunleye, B. Jumoke

Department of Plant Science and Biotechnology, Ekiti State University, P.M.B. 5363, Ado-Ekiti, Ekiti State, Nigeria
*Corresponding author: sundaydeleoyeyemi@gmail.com

Abstract The leaves and peels (epicarp) of *Musa sapientum var. velutina* are generally considered agricultural waste after the fruits have been harvested. Little or no significance is there by attached to their medicinal relevance and nutritional values. This study was carried out to determine the proximate, mineral and phytochemical constituents of banana (*M. sapientum*) leaves and peels using standard method. The qualitative phytochemical analysis of the plant leaf and peel extracts revealed the presence of saponins, alkaloids, steroids, cardiac glycosides and reducing sugars in the leaves while tannins, saponins, alkaloids, flavonoids, phenols and reducing sugars were found in the peels. The proximate composition results for the leaves and peels showed moisture content (13.57 and 13.68%), ash (6.51 and 10.50%), crude fiber (14.50 and 10.78%), crude fat (3.28 and 3.36%), crude protein (24.16 and 20.39%) and carbohydrate (38.43 and 41.30%) respectively. Mineral analysis revealed that sodium had the highest concentration of 235.60% in the leaves and 198.90% in the peels followed by calcium 110.20% (leaves) and 113.19% (peels). Copper had the least concentration of 0.39% and 0.07% in the leaves and peels respectively. The results of the phytochemical, proximate and mineral composition justify the fact that the leaves and the peels of the banana investigated, possess valuable nutritive and medicinal values which can be used in animal feeds fortification.

Keywords *Musa sapientum*, animal feed, banana, proximate, medicinal value

Introduction

Musa sapientum (Wandland & Drude) is a herbaceous plant of the family Musaceae and commonly called velvet pink banana. It has a tree-like pseudostem, green to purple, grows up to a height of 1.5 m. The plant has a crown of large elongated leaves (up to1 m long and 30 cm wide), usually oblong, dark green colour above and pale with red mid-ribbelow. The inflorescence is erect, pink/red bracts with pale yellow flowers. The fruits grow in hanging clusters and are usually red/purple and velvet. It is often grown as ornamental but has soft, sweet flesh that can be eaten.

Banana is a familiar tropical fruits. It was reported to be possibly the world's oldest cultivated crop [1]. Banana is among the major food crop grown and consumed in more than 100 countries throughout the tropics and sub- tropics [2] and constitute the fourth most important food crop after stable food like rice, wheat and maize in developing countries with annual production of 88 million tones [3] and provides more than 25% of the carbohydrate intake for over 70 million people in Africa [4]. In Nigeria, banana is produced in the forest region and transported to urban cities like Lagos and Abuja. The economic significance of banana makes it an important tree crop in Nigeria considering the health, nutrition and dietary benefits. Apart from being a stable food for rural and urban dwellers, it is a means of livelihood particularly for small holder farmers. In addition, a number of medicinal properties are attributed to the leaves, corms, flowers, trunks and fruits of banana. The banana fruits can be eaten raw when ripe.

The unripe fruits are peeled, sliced, dried are made into flour and sliced and fried into chips. Most parts of banana particularly the fruits, leaves as well as peels are used to feed livestock [5]. These plant parts have equally been documented by some authors to have been severally used to treat fevers, burns, diarrhea, inflammation, pains and snake bites in traditional medicine [6]. The leaf juice is used in the treatment of fresh wounds, cuts and insect bites while the leaves act as an arbortifacient [7]. Banana peels have been reported to have antibacterial properties [8].

The use of fruits and vegetative plant parts as sources of drugs and food cannot be underestimated [9,10] as plants have been regarded as valuable sources of natural products used in traditional medicine to treat different diseases in different areas of the world [11].

About 80% of the people in the developing countries use traditional medicine plants [12] and medicinal plants are useful in healing and curing of human diseases. The medicinal value of these plants lies in the bioactive phytochemical constituents that produce definite biological and physiological actions on the human body [13,14]. The explorations of biologically active natural products have played an important role in finding new chemical entities [15]. These bioactive substances which are found virtually in all parts (leaf, stem, back, root, flower, peel and fruit) include saponins, tannins, flavonoids, alkaloids, steroids and phenols [16]. Fruits and vegetables are described by Wargovich [17] as a treasure house of variety of nutrients and bioactive phytochemicals which form the important component of human daily diet.

Materials and Methods

Sample Collection

Unriped mature banana fruits and green leaves were harvested from cocoa plantation at Iyin-Ekiti, Ekiti-State, Nigeria. The banana was botanically authenticated as *Musa sapientum* in the Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti. The unripe fruits were washed with distilled water and peeled using sharp clean kitchen knife. Both the leaves and the peels were thoroughly washed with distilled water to remove dirt and other contaminants. The plant materials were air dried at room temperature, pulverized using Optimal Mixer Grinder (2053) and stored in air-tight containers for further analysis. All analyses were done in triplicate and results were presented as mean ± standard deviation of the determinations.

Phytochemical Tests and Analyses

Qualitative phytochemicals screening was carried out using standard procedures.

Test for tannins: One gm each of the dried sample was added to 10 cm^3 of freshly prepared 10% KOH in a beaker. A dirty precipitate observed indicated the presence of tannins.

Test for saponins: (Froth Test): One gm each of the powdered samples was diluted with distilled water to 20 cm^3 and this was shaken vigorously in a graduated cylinder for 15 minutes. Formation of a persistent froth indicates the presence of saponins. The frothing was mixed with 3 drops of olive oil, shaken vigorously and then observed for the formation of emulsion [18].

Test for phenol: One gm of each of the powdered samples was soaked in 25 cm^3 of 2% of HCl for 1 hour and then filtered through 10 cm Whatman No. 1 Filter paper. 5 cm^3 of the extract was mixed with 1 cm^3 of 0.03% Ammonium thiocyanate solution and few drops of ferric chloride solution. A brownish yellow indicated the presence of phenol.

Test for alkaloids: One gm of each powdered samples was stirred with 5 cm^3 of 1% hydrochloric acid on a steam baths and filtered using 10 cm Whatman filter paper. The filtrate (1cm^3) was treated with a few drops of Dragendorffs reagent (Bismult nitrate + conc. HCl). A change in the colour of the sample from brown to deep brown indicated the presence of alkaloids in the extract.

Test for flavonoids: A portion of the extract was heated with 10 cm^3 of ethyl acetate over a steam bath for 3 minutes, the mixture was filtered and 4 ml of the filtrate was treated with 1 ml of dilute ammonia solution. A yellow colouration indicated the presence of flavonoids [18].

Test for steroids: To 1 g of each of the powdered sample, 2 cm^3 of acetic anhydride was added and the solution was treated with 2 cm^3 of concentrated H_2SO_4. A colour change from violet to blue in the samples, indicated the presence of steroids [18].

Test for phlobatanins: Deposition of red precipitate when an aqueous sample was boiled with 1% aqueous hydrochloric acid was taken as an evidence for the presence of phlobatanins [18].

Cardiac-glycosides (Keller-Killani Test): One gm of the powdered sample was dissolved in 5 cm^3 of water and 2 cm^3 of glacial acetic acid solution containing one drop of ferric chloride solution was added to the solution. This was under laid with 1 cm^3 of concentrated H_2SO_4. A brown ring at the interface indicated the presence of deoxysugar characteristics of cardenolides. A violet ring appeared below the brown ring while in the acetic acid layer a greenish ring formed just above the brown ring and gradually spread throughout this layer [19].

Test for reducing sugar (Fehling's Test): One gm of the extract was dissolved in 5 cm^3 distilled water and filtered. The filtrate was hydrolyzed with dilute HCl, neutralized with alkali (NaOH) and heated with Fehling's A and B solutions. Formation of red precipitate indicated the presence of reducing sugars.

Quantitative Phytochemical Analyses

The quantitative amount of phytochemicals contained in the aqueous extract of the leaves and peels were determined using standard procedures [20-23].

Proximate Analyses

The percentage composition of moisture content, crude protein, crude fat, ash and crude fiber were determined by the standard methods of the Association of Official Analytical Chemist [24]. Moisture content was determined by heating 2.0 g of the powdered sample to a constant weight in a crucible placed inside an oven at a temperature of105 ℃. The dry matter was used in the determination of the other parameters. The crude protein content was calculated by multiplying the total organic nitrogen by 6.25 [24]. Crude fat was obtained by exhaustively extracting 5.0 g of the sample in a Soxhlet apparatus using petroleum ether as the solvent. Ash content was determined by incineration of 10.0 g sample placed in a muffle furnace maintained at 550 ℃ for 5 hours. Crude fiber was obtained by digesting 2.0 g of the sample with H_2SO_4 and NaOH and incinerating the residue in a muffle furnace maintained at 550 ℃ for 5 hours. Carbohydrate content was determined according to Onwuka [25] using calculation equation i.e. available carbohydrates = (100-% moisture + % Ash + % protein + % fiber).

Determination of the Mineral Compositions

The minerals in the powdered samples were analyzed from solution obtained when 0.5g of the sample was digested with concentration nitric acid, concentrated hydrofluoric acid and Hydrogen peroxide in the ratio 3:2:1, the mixture were placed on a water bath for 45minutes at 90℃. The resultant solution was cooled and made to mark up to 25mls with distilled water [26]. The mineral elements were analyzed using atomic absorption Spectrophotometer (Buck Scientific Model 200AAS) Spectophotometer while sodium were determined using a flame photometer (Gallenkamp flame analyser, U.K).

Results

The results obtained from these assessments have been summarized in Tables 1-4. Both the leaves and the peels of *M. sapientum* lacked phlobatanins, whereas, they contained saponins, alkaloids and reducing sugar. In the same vein, the leaves lacked tannins, alkaloids and phenols which were available in the peels (Table 1). The quantitative amounts of saponins, flavonoids, steroids, cardiac glycosides and reducing sugar present in the leaves were 31.5, 33.64, 13.21, 13.99 and 15.77 mg/100g respectively, while the amounts found for the same phytochemicals for the peel were 153 25.25, 29.25, 29.25, 41.98 and 23.76 mg/100g, respectively. However, tannins, flavonoids and phenols were not present in the leaves but were present in the peels in the amounts of 25.25, 22.50 and 19.38 mg/100g respectively. Steroids and cardiac glycosides were however absent in the peels. On the other hands, proximate analysis of the leaves revealed 13.57, 6.51, 14.05, 3.28, 24.16 and 38.43% of moisture, ash, crude fiber, crude fat, crude protein and carbohydrate contents, respectively. Whereas, that of the peels were 13.68, 10.50, 10.78, 3.36, 20.39 and 41.30% for moisture, ash, crude fiber, crude fat, crude protein and carbohydrate contents respectively. The mineral compositions of the leaves were 235.60, 110.20, 9.47, 20.42, 18.40, 0.39 and 2.45% for

Sodium, Calcium, Iron, Zinc, Magnesium, Copper and Manganese contents, respectively while that of the peels were 198.90, 113.19, 11.44, 22.40, 16.88, 0.07 and 1.23% for Sodium, Calcium, Iron, Zinc, Magnesium, Copper and Manganese, respectively (Table 4).

Discussion

The medicinal properties of phytochemicals such as tannins, saponins, alkaloids, flavonoids, phenols and steroids have been documented by several authors [27-30]. These phytochemicals have been reported to have multiple biological and pharmacological effects [31]. The phytochemical profile in this study was similar to what was reported by Enechi [32] for the ethanol extract of *Musa paradisiaca* leaves but differs from their reports by the presence of flavonoids and tannins in their works. Tannins are the monomeric precursors of alkaloids and in most cases are usually associated with flavonoids.

Also, the qualitative phytochemical results of the peels of *M. sapientum* in this work were in agreement with the reports of Ighodaro [33]. He reported all these phytochemicals in the unripe peels of *M. paradisiaca* but this study lack phlobatanins and cardiac glycosides.

Environmental factors play an important role in the biochemical constituent of plant. The variation in the phytochemical in these studies might be as a result of area and season of collection, age and varieties of the banana. Tannins have been reported to possess antioxidant and antibacterial, as well as anti-inflammatory properties [34]. Saponins concentration in the leaves of *M. sapientum* (31.50%) was relatively high compared to the previous reports of 1.3% obtained in banana leaf [35]. Saponins act as an immune booster, lower blood cholesterol and act as anti-intestinal cancer agent [36]. The two samples investigated were rich in alkaloids. Reports from other researchers indicated the presence of alkaloids in the leaves [32] and peels of banana [33]. Alkaloids are considered to be very important in medicine and act as a constituent of most of the valuable drugs.

Table 1: Qualitative phytochemical compositions of the leaves and peels of *M. sapientum*

Phytochemical /part used	**Tan.**	**Sap.**	**Alk.**	**Flav.**	**Ster.**	**Phen.**	**Phlo.**	**Car. Glyc.**	**Red. Sug.**
Leaves	-	+	+	-	+	-	-	+	+
Peels	+	+	+	-	-	+	-	-	+

Key: Tan. = Tannins, Sap.=Saponins, Alk.= Alkaloids, Flav.= Flavonoids, Ster.= Steroids, Phen.= Phenols, Phlob. =Phlobatanin, Card. Glyc.= Cardiac Glycosides, Red. Sug.= Reducing sugar, + indicates presence, – indicates absence

Table 2: Quantitative phytochemical compositions (mg/100g) of the leaves and peels of *M. sapientum*

Phytochemical /part used	**Tan.**	**Sap.**	**Alk.**	**Flav.**	**Ster.**	**Phen.**	**Phlo.**	**Car. Glyc.**	**Red. Sug.**
Leaves	-	31.50±0.11	33.64±0.16	-	13.21±0.06	-	-	13.99±0.21	15.77±0.09
Peels	25.25±0.26	29.25±0.11	41.98±0.13	-	22.50±0.03	19.38±0.18	-	-	23.76±0.13

Flavonoids have been reported by Edeoga and Eriata [37] to have marked physiological effects on animals. Alkaloids also have analgesic, antispasmodic and bactericidal properties [38]. Several authors had reported that flavonoids and phenolics have several biological functions such as anti-oxidation, antitumor, anticancer, platelet aggregation, protection against allergies and virus [39-42].

Other phytochemicals found in the samples were cardiac glycosides and reducing sugars. Cardiac glycosides were reported to act on the heart by regulating its contractions without increasing the amount of oxygen in the heart muscle [43]. The presence of these phytochemicals constituents in the leaves and the peels of *M. sapientum* support their protective, preventive and therapeutic properties.

The moisture contents of the leaves and peels (13.57 and 13.68 %) were high when compared with 7.47% reported for unripe peels of *M. paradisiaca* [33] but comparatively lower than 44.51% reported by Enechi *et al*., [32] for the leaves of *M. paradisiaca*. These disparities could be as a result of differences in treatment during drying of the samples. The ash content of the leaves was 6.51% while that of unripe peels was estimated to be 10.50%. These values were compared favourably with those reported by Arowosegbe *et al*. [44] for some vegetables in Ekiti State,

Nigeria. Ash content is a reflection of richness in mineral elements in the plant samples. The values showed that the leaves and the peels were rich in mineral elements. The crude fiber contents in the leaves and peels of *M. sapientum* (14.05% and 10.78%, respectively) were comparatively higher than the reported values of *Fruticosum triagulare* (6.20%) and *Piper guineensis* (6.40%) by Akindahunsi and Salawu [45] but lower than *Gnetum africana* (25.50%) reported by Mensah *et al*. [46]. High fiber content in diet has been reported to lower serum cholesterol level, risk of coronary heart diseases, Diabetes mellitus, constipation and hypertension [47,48], hence these crude fiber quantities in *M. sapientum* leaves and peels is highly desirable and will provide health promoting benefits for the ruminants and non-ruminants [49].

Table 3: Proximate composition (%) of the leaves and peels of *M. sapientum*

Phytochemical/ Part used	Moisture content	Ash content	Crude Fiber	Crude Fat	Crude Protein	Carbohydrate
Leaves	15.58±0.13	6.51±0.03	14.05±0.47	3.28±0.04	24.16±0.74	38.43±0.21
Peels	13.68±0.11	10.50±0.04	10.78±0.02	3.36±0.02	20.39±0.37	41.30±0.32

Table 4: Mineral compositions (%) of the leaves and peels of the leaves and peels of *M. sapientum*

Phytochemical/ Part used	Sodium	Calcium	Iron	Zinc	Magnesium	Copper	Manganese
Leaves	235.60	110.20	9.47	20.42	18.40	0.39	2.45
Peels	198.90	113.19	11.44	22.40	16.88	0.07	1.23

The crude fat contents were found to be 3.28% in the leaves and 3.36% in the unripe peels. These values were similar to the results of the other banana species [33]. The crude fat estimated for the samples in this study were found to be moderate. Crude fats are major sources of energy but should be consumed moderately (not more than 30 calories) to avoid obesity and other related diseases.

The crude protein composition of the leaves and the peels investigated (24.16% and 20.39%, respectively) were high when compared to leafy vegetables such as *Afzelia Africana* (16.52%) as reported by Ogunlade *et al* [50] but lower than *Anchomanes difformis* leaves [51] and unripe peels of *Musa paradisiaca* (6.89%) by Ighodaro [33]. However, the values compared favourably with *Moringa oleifera*, (20.80%), *Ocimum gratissimum* (20.15%) and *Venonia amygdalina* (24.90%) by Arowosegbe *et al* [44].

Protein is an essential component of diet needed for survival of animals and human being. High amount of protein is essential for animal growth and increased milk production [52]. The protein concentration of the leaves and peels of *M. sapientum* will go a long way in meeting the protein requirement of ruminants and non-ruminants.

The carbohydrate contents of the leaves (38.43%) and peels (41.30%) were higher than *Annona muricata* (16.62%), Usonobun *et al*. [53] but lower than 82.8% in *Cochorus tridens* leaves [54] and 48.18% in unripe peels of *M. paradisiaca* [33]. Carbohydrate contents contribute to the energy value in *M. sapientum* leaves and peels. Ebun-Oluwa and Alade [55] reported that carbohydrate is essential in themaintenance of life in animals. Carbohydrate also provides energy to the body cells, particularly the brain [56]. Several researchers have evaluated the nutritional value of banana peel and reported the peel as a very good potential source of carbohydrate [33,57]. When we consider the nutritional potential as well as availability of this agricultural waste, the peel can be used as ruminant feeds. However, green banana peels contain tannins hence, there is needs for steam or fermentation treatment before given to the ruminants as feed [58].

The results of mineral component showed the concentration of Sodium to be highest in the leaves (235.60%) and peels (198.90%). The samples were also high in calcium, iron, zinc, and magnesium but low in copper and manganese. The results obtained in this study were higher compared to the reports of Anhwange *et al*. [59] for *M. sapientum* peel. The result of the leaves and the peels of this banana are rich in essential mineral element such as calcium, sodium, magnesium, iron and zinc which make them to be nutritionally and medicinally important for proper body function.

Calcium is an important factor in the formation of strong bones and teeth, muscle contraction and relaxation, blood clotting, heart functioning and cell metabolism [60-62]. Both the leaves andthe peels of *M. sapientum* investigated contained moderate quantity of sodium. The RDA for sodium is 500mg [63]. Iron in the diet play an important role in synthesis of collagen and proper functioning of the immune system [59]. The RDA value for iron is 10-15 mg [64]. This implies that the leaves, as well as the peels of *M. sapientum* can contribute to the daily iron intake hence recommended for anaemic convalescence. Zinc is an essential element in the nutrition of man. Zinc is important trace element for protein and nucleic acid synthesis and normal body development [65]. The leaves and peels could be said to be fairly good source of zinc.

Magnesium is an activator of co-enzymes in carbohydrates and protein metabolism. Lack of magnesium may lead to severe diarrhea and malnutrition [66] as well as persistent migraine [67]. Copper plays a vital role in haemoglobin formation and also contributes to iron and energy metabolism [68]. Manganese in the plant samples was found to be low. Manganese is known to aid formation of skeletal and cartilage. Consumption of foods that contain manganese is believe to support the immune system, regulates blood sugar level and cell reproduction [59]. The nutritional profile obtained in this study lends credence to the reports of some authors on the importance of banana leaves and peels as supplementary feeds for cattle and small ruminants. Dormond *et al.* [69] reported that dairy cows fed up to 21 kg of fresh ripe banana peels increase milk production. A 3:1 mixture of dried and ground banana and yam peels supported a good performance in weaning rabbits and was cost effective when it was replaced with 50% of maize grain [70].

Conclusion

The results of the study revealed the rich phytochemical contents of the leaves and the peels of *M. sapientum* which provide evidence of efficacy of the unexplored medicinal potential of the plant. Moreover, the leaves and peels are generally regarded as agricultural waste but have high protein, fiber, carbohydrate as well as minerals and could be considered as cheap and nutritionally rich feeds for animals especially now that there is increase in cost and demand of animal feeds.

References

[1]. Mohammed, Z. I. & Saleha, A. (2011). *Musa paradisiaca* L. and *Musa sapientum* L: A Phytochemical and Pharmacological Review. *Journal of Applied Pharmaceutical Science*, 1(5): 14-20.

[2]. Inibap, R.E. (2003). Conservation through utilization of bananas and plantains in the great lakes region of East Africa. Final report. INIBAP, Montpellier, France.

[3]. Frison, E. & Sharrock, F. (1999). The economic, social and nutritional importance of banana in the world. In: Picq, C., Foure, E., Frison, A.E. (Eds). Banana and Food Security International Symposium, Douala, Cameroon, 10-14. November, 1998.

[4]. IITA, (1998). Plantation and Banana improvement program-Annual reports for 1997.International Institute of Tropical Agriculture, Onne, Nigeria.

[5]. Babatunde, G.M. (1992). Availability of bananas and plantains productions for animal feeding. In: Roots, tubers, plantains and bananas in animal feeding. FAO Animal Production and Health Paper No. 95. FAO. Rome. pp. 231-276.

[6]. Coe, F.G. & Anderson, G.J. (1999). Ethnobotany of the sumu (ulwa) of southeastern Nicaragua and comparisons with Mikitu plants lore. *Economic Botany*.53: 363-386.

[7]. Paul, C.O., Omoaruemike, E.O. & Sikiru, O.O. (2013). Phytochemical screening and effect of *Current Research Journal of Biological Sciences*. 5(1): 26-29.

[8]. Nelson, S.C., Ploetz, R.C. & Kepler, A.K. (2006). *Musa species* (bananas and plantains). In: Elevitch C.R. (Ed.). Species Profiles for Pacific Island Agroforestry. Permanent Agricultural Resources, Holualoa, Hawai's. pp.33.

[9]. Hammer, K.A., Carson, C.F. & Rile, T.U. (1999). Antibacterial activity of essential oils and other plant extracts. *Journal of Applied Microbiology*, 86: 985-990.

[10]. Sofowora, E.A. (2008). Medicinal plant and traditional medicine in Africa. John Wiley and Sons Ltd. pp. 1-10.
[11]. Palombo, E.A. (2005). Phytochemicals from traditional medicinal plants used in the treatment of diarrhea: modes of actions and effects on intestinal function, *Phytotherapy Resources*. 20:717-724.
[12]. Karadi, R.V., Shah, A., Parekh, P. & Azmi, P. (2011). Antimicrobial activities of *Musa paradisiacal* and *Cocosnucifera*. *International Journal of Research, Pharmaceutical and Biomedical Science*, 2(1): 264-267.
[13]. Akinmoladun, A.C., Ibunkun, E.O., Obuofor, E.M. & Farombi, E.O. (2007). Phytochemical constituent and antioxiodant activity of extract from leaves of *Ocimum gratissimum*. *Science Research Essay***.** 2: 163-166.
[14]. Edeoga, H.O., Okwu, D.E. & Mbaebe, B.O. (2005). Phytochemical constituents of some Nigerian Medicinal Plants. *African Journal of Biotechnology*, 4: 685-688.
[15]. Newman, D.J., Cragg, G., Snader, M. & Ukaz, K.M. (2003). Natural products as sources of newdrugs over the period 1981-2002. *Journal of Natural Products*. 66(7): 1022-1037.
[16]. Sofowora, E.A. (1993). Medicinal Plants and Traditional Medicine in Africa. Spectrum Books Ltd, Ibadan, Nigeria. pp. 191-289.
[17]. Wargovich, M.I. (2000). Anticancer properties of fruits and vegetables. *Hortscience*, 35: 573- 575.
[18]. Harbone, J.B. (1993). Introduction to Ecological Biochemistry. 4th Academic Press London. U.K.
[19]. Ayoola, G.A., Coker, H.B., Adesegun, S.A., Adepoju, B., Obaweya, K., Ezennia, E.C. & Atangbayila, T.O. (2008). Phytochemical Screening and antioxidant activities of some selectedmedicinal plant used for malaria therapy in South western Nigeria. *Tropical Journal of Pharmacological Resources.* 1019-1024.
[20]. Singleton, M J., Mattes R.D. & Heiser, C. (1999). Analysis of total phenol and other oxidation substrate and antioxidants by means of Folin-Ciocalteu's phenol reagent. Methods *Enzymoli*. 299: 152-178.
[21]. Obadoni, B.O. & Ochuko, P.O. (2001). Phytochemical Studies and Comparative efficacy of the crude extract of some homeostatic plants in Edo and Delta States of Nigeria. *Global Journal of Pure and Applied Science*, 8: 203-208.
[22]. Trease, G.E. & Evans, W.C. (2002). Pharmacognosy. 15th 449 ed. Saunders, London, pp. 53-336.
[23]. Amakura, Y., Kondo, K., Akiyama, H., Ito, H., Hatano, T., Yoshida, T. & T. Manitani, T. (2009). Maker constituents of the natural antioxidant *Eucalyptus* leaf extract for the extract for the evaluation of food additives. *Chemical Pharmaceutical Bulletin*. 54: 1213-1215.
[24]. AOAC. (1990). Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington D.C.
[25]. Asaolu, S.S. (1995). Lead content of vegetables and tomatoes at Erekesan market, Ado-Ekiti. *Pak. Journal of Industrial Resources*, 38: 399-400.
[26]. Onwuka G.I. (2005). Food analysis and instrumentation, theory and practical. 1st edition Naphtha Prints Lagos, Nigeria, 89-98.
[27]. Gill, L.S. (1992). Ethnobotanical uses of plants in Nigeria. University of Benin Press, Benin City, Edo State, Nigeria, pp, 65-75.
[28]. Banso, A. & Adeyemo, S.O. (2007). Evaluation of antibacterial properties of tannins isolated from *Dichrostachys cinerea*. *African Journal of Biotechnology***,** 6(15): 1785- 1787.
[29]. Igbinosa O.O., Ighinosa E.O. and Aiyegoro O.A. (2009). Antimicrobial activity and phytochemical screening of stem bark extracts from *Jatropha curcas* (Linn). *African Journal of Pharmacy and Pharmacology*. **3**(2): 58-62.
[30]. Ighodaro O.M. Mairiga J.P. and Adeyi A.O. (2009). Reducing and Anti-oxidant profile of flavonoids in *Ocimum gratissimum. International Journal of Chemical Sciences*, 2(1): 85-89.
[31]. Abdurahaman, F.I., Tijani, M.A. & Osuyi, U.O. (2012). Proximate content and chemical composition of *Ocimum gratissimum* leaf. *International Research Journal of Pharmacy*, 2(3): 347-354.
[32]. Enechi, O.C., Oddo, C.E. & Agosi, P.O. (2014). Anti-oxidant vitamins, phytochemicals and proximate composition of the ethanol extracts of the leaves of *M. paradisiaca*. African *Journal of Pharmacy and Pharmacology*, 8(18): 464-468. DOI: 5897/AJPP2014 4037.

[33]. Ighodaro, O.M. (2012). Evaluation study on Nigeria species of *M. paradisiacal* peels. Phytochemical screening, Proximate analysis, Mineral composition and Antimicrobial Activities. *Researcher*, 4(8): 17-20.

[34]. Mensah, J.K., Ihenyen, J.O. & Okhiure, M.O. (2013). Nutritional, phytochemical and antimicrobial properties of two wild aromatic vegetables from Edo State. *Journal of Natural Products and Plants Resources*, 3(1): 8-14.

[35]. Ngamsaeng, A., Wanapa, M. & Khampa, S. (2006). Evaluation of local tropical plants by in vitro Rumen fermentation and their effects on fermentation end-products. *Pakistan Journal of Nutrition*, 5: 414-418.

[36]. Sodipo, O.A., Akinniyi, J.A. & Ogunbanwo, J.A. (2000). Studies on certain characteristic of extract from bark of *Palmsinystalia macruceras* K. Schum. Pierre Esbeile. *Global Journal of Pure and Applied Science*. 6:82-87.

[37]. Edeoga, H.O. & Eriata, D.O. (2001). Alkaloid, tannin and saponin contents of some Nigerian medicinal plants. *Journal of Medicinal and Aromatic Plant Science*, 23: 344-349.

[38]. Stray, F. (1998). The Natural Guide to Medicinal Herbs and plants. Tiger Books International London. pp. 12-16.

[39]. Farquar, J.N. (1996). Plant sterols, their biological effects in human. Handbook of Lipids in Nutrition BOCA Rotan HL CRC Press. pp: 101-105.

[40]. Okwu, D.E. (2004). Phytochemicals and vitamins content of indigenous species of South Eastern Nigeria. *Journal of Sustainable Agriculture and Environment*.6: 30-34.

[41]. Omale, J. & Okafor, P.N. (2008). Comparative antioxidant capacity, membrane stabilization, polyphenol composition and cytotoxicity of the leaf and stem of *Cissus multistriata*. *African Journal of Biotechnology*, **7**(17): 3129-3133.

[42]. Ugwu, O.P.C., Nwado, O.F.C., Joshua, P.E., Bawa, A., Ossai, E.C. & Odo, C.E. (2013). Phytochemical and Acute Toxicity Studies of *Moringa oleifera* Ethanol Leaf Extract. *International Journal of Life Sciences Biotechnology and Pharmaceutical Research*, 2(2): 66-71.

[43]. Ayoola, P.B. & Adeyeye, E.I. (2012). Phytochemical and Nutrient Evaluation of *Carica papaya* (pawpaw) leaves. *International Journal of Research and Review in Applied Sciences*, 5(3): 325-328.

[44]. Arowosegbe, S., Oyeyemi, S.D. & Alo, O. (2015). Investigation on the medicinal and nutritional potentials of some vegetables consumed in Ekiti State, Nigeria. *International Research Journal of Natural Sciences*, 3(1):16-30.

[45]. Akindahunsi, A.A. & Salawu, S.O. (2005). Phytochemical screening and nutrient-antinutrient composition of selected tropical green leafy vegetables. *African Journal of Biotechnology,* 4: 497-501.

[46]. Mensah, J.K., Okoli, R.I., Ohaju-Obodo, J.O. & Eifeduji, K. (2008). Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. *African Journal of Biotechnology*, **7**(14): 2304-2309.

[47]. Ganong, W.F. (2003). Circulating Body Fluids. Review of Medical Physiology. 21st Edu. Typo Press, Lebanon.

[48]. Ishida, H., Suzuno, H., Sugiyama, N., Innami, S., Todokoro, T. & Maekawa A. (2000). Nutritional evaluation of chemical component of leaves and stems of sweet potatoes (*Ipomoea batata*). *Food Chemistry*, 68: 359-367.

[49]. Ayoola, P.B. & Adeyeye, E.I. (2009). Proximate Analysis and Nutritional Evaluation of some Nigerian pawpaw seeds varieties. *Science Focus*, 14(4): 554-558.

[50]. Ogunlade, I., Ilugbiyin, A. & Osasona, I. (2011). Comparative study of proximate composition, antinutrient composition and functional properties of *Parchira glabra* and *Africana* seed flours. *African Journal of Food Science*, 5:32-35.

[51]. Oyeyemi, S.D. & Tedela, P.O. (2014). Nutritional quality and phytochemical properties of *Anchomanes difformis* leaves (Blumes.) Engl. *Indian Journal of Scientific Resources and Technology*, 2(4): 66-70.

[52]. Tangka, J.K. (2003). Analysis of the thermal energy requirements for the extraction of leaf protein concentrate from some green plants. *Biosystems Eng*., 86(4): 473-479.

[53]. Usunobun, N., Okolie, N.P., Anyanwu, O.J., Adegbegi, A.J. & Eghaverba, M.E. (2015). Phytochemical screening and Proximate composition of *Annonamuricata* leaves. *European Journal of Botany Plant Science and Phytology*, 2(1): 18-28.

[54]. Asibey-Berko, E. & Tayei, F.A.K. (1999). Proximate analyses of some underutilized Ghanaian vegetables. *Ghana Journal of Science*, 39: 91-92.

[55]. Ebun-Oluwa, P.O. & Alade, A.S. (2007). Nutritional potential of Belandiern Nettle Spurge *Jatropha cathatica* seed. *Pakistian Journal Nutrition*, 6: 345-348.

[56]. Raimi, M.M., Oyekanmi, A.M. and Farombi, A.G. (2014). Proximate and phytochemical composition of Leaves of *Ceiba pentandra*, *Manihot esculentus* and *Abelmoschus esculentus* in Southwestern, Nigeria. *Scientific Research Journal*. 2(4): 30-34.

[57]. Amir, Y.S., Yelni, G. & Isyaturriyadhah, A. (2012). The result of biotechnology by local microorganisms to banana peel on rumen fluid characteristics as ruminant feed. *Journal of Advanced Agricultural Technologies*, 1(1): 28-31.

[58]. Kurniati, C. (2011). The effect of processing methods stone banana peel (*Musa brachyarpa*) on the content of NDF, ADF, cellulose hemicelluloses, lignin and silica, Skripsi, Andaks University, Padany.

[59]. Anhwange, B.A., Ugye, T.D. & Nyiaatagher, T.D. (2009). Chemical composition of *Musa sapientum* (Banana) peels. *Electronic Journal of Environmental Agricultural and Food Chemistry*, 8(6): 437-444.

[60]. Dosunmu, M.I. (1997). Chemical composition of the fruit of *Tetraptera* and the physico-chemical properties of its oil. *Global Journal of Pure and Applied Science*, 3: 61-67.

[61]. Turan, M., Kordis, S., Zeyin, H., Duran, A. & Sezen, Y. (2003). Macro and micro minerals content in some Wild Edible Leaves consumed in Eastern Anatolia, Acta Agric., Scand. Section B. *Plant Soil Science*, 53: 129-137.

[62]. Rolfes, S.R., Pinna, K. & Whitney, E. (2009). Understanding normal and clinical nutrition. Eighth. Edn. Wadsworth Cengage Learning, pp. 383.

[63]. NRC (1989). Recommended Dietary allowance. National Research Council. National Academy Press. Washington, DC.

[64]. Nieman, D.C., Butterworth, D.E. & Nieman, C.N. (1992). Nutrition.WMC. Brown Publisher, Dubugue, pp. 50. Fresh perspective. *Clinical Cardiology*. 1111-1115.

[65]. Melaku, U., Clive, E.W. & Habtamon, F. (2005). Content of Zinc, Iron, Calcium and their absorption inhibitors in Ethiopia. *Journal of Food Composition Analysis*.18: 803-807.

[66]. Baker, D.B. (2000). Agricultural phosphorus reductions in the Lake Erie basin: A succestory. (Extended abstract). *In proceedings*, Third National Workshop on Constructed Wetlands/BMPs for Nutrient Reduction and Coastal Water Protection, New Orleans, L. pp. 127-128. NCSU, Raleigh, NC.

[67]. Appel, L.J. (1999). Non pharmarcologic Therapies that Reduce Blood Pressure. A

[68]. Adinortey, M.B., Sarfo, J.F., Quayso, E.T., Weremfor, A., Adinortey, C.A., Ekloh, W. & Ocran, J. (2012). Phytochemical screening, Proximate and Mineral composition of *Launaea taraxacifolia* leaves. *Research Journal of Medicinal Plant*, 6(2): 171-179. DOI: 10.3923/rjmp.

[69]. Dormand, H., Boschini, C. & Rojas Bourrilon, A. (1998). Effect of two levels of ripe banana peel on milk production by dairy cattle. *Agronomia Costarricence*, 22(1): 43-49.

[70]. Akinmutimi, A.H., Odoemelam, V.U. & Obasienkong, S.F. (2006). Effect of replacing maize with ripe plantains and yam peels in the diet of weaned rabbits. *Journal of Animal Veterinary Advances*, 5(9): 737-740.