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RESEARCH PAPER

AFRICAN GRAPES (*LANNEA MICROCARPA*) FRUITS: THE NUTRITIONAL COMPOSITIONS

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ABSTRACT

Studies on nutritional composition of African grapes (*Lannea microcarpa*) fruits pulp was carried out using standard analytical methods. The result of proximate composition in mg/100g revealed the following: moisture (70.55 ± 2.56), ash (3.48 ± 0.81mg), crude fiber (5.21 ± 1.67), crude protein (8.71 ± 1.98), crude lipid (1.87 ± 0.34) and carbohydrate (80.73 ± 6.81) as well as calorific value (374.59 ± 4.32KJ/100g). The fruits pulp also contain reasonable amount of both macro and micro minerals element needed in diet with potassium concentration of (450 ± 3.87mg/100g), phosphorus (6.14 ± 0.89mg/100g), sodium (15.10 ± 1.70mg/100g), calcium (35.00 ± 1.90mg/100g), magnesium (58.00 ± 3.23mg/100g), iron (38.21 ± 2.67 mg/100g),manganese (3.10 ± 0.45mg/100g) as well as zinc (14.14 ± 2.98mg/100g). The anti-nutrients factors (in mg/100g) indicate the presence of tannins (4.17 ± 0.61), oxalates (12.14 ± 2.32), phytates (40.50 ± 1.54), and saponins (2.16 ± 0.87). However, the calculated anti-nutrients to nutrients molar ratios are generally below the critical level known to inhibit the availability of some important minerals elements which suggest the potential safety of using the fruits pulp as nutrients supplement.

Keywords: *Lannea microcarpa*, fruits, pulp, proximate, minerals, anti-nutrients.

INTRODUCTION

In tropical Africa, micronutrient deficiency also called hidden hunger is a major cause of health problems, high mortality and low economic productivity (Ehile *et al.*, 2018). In several African countries, natural tree products constitute an important part of human diets and are also an important source of income (Thiombiano *et al.*, 2014). They constitute the most affordable and dietary sources of vitamins, trace elements and other bioactive compounds and thus constituting common ingredients in a variety of traditional native dishes for the rural population in developing countries (Humphrey *et al.*, 1993)

African grapes (*Lannea microcarpa*) *or* Wild grapes commonly known as "*Faaru*'' in Hausa speaking language belongs to the family *Anacardiacea*. It is found in the savanna and the drier forest re-growth zone of West Africa. In Nigeria it is commonly found in Northern states of Sokoto, Kebbi, Zamfara, Kaduna, Katsina, Kano, and Jigawa. The unripe fruits are green in color while ripe ones are purplish black. The fruits are often sold in both city street markets and along roadsides in West Africa. In Nigeria, the tree is cultivated commercially on a small scale and can be seen in and around villages. The fruit can be eaten fresh or dried like raisins for longer-term storage. The fruit makes an excellent jam, can be made into wine, and the pulp fermented into a potent alcoholic drink (Yunus *et al*., 2013).

Patrice *et al*. (2014) reported that its leaves, bark, roots and fruits are used to treat mouth blisters, rheumatism, sore throats, dysentery, conjunctivitis, stomatitis, skin eruptions, and ulcers. Reports available on the proximate compositions of its seed and physicochemical properties of the seed oil indicated that, if properly utilized the seed could be an important source of protein (21.14%) and oil supplement (64.90%) (Patrice *et al*. 2014; Yunus *et al*., 2013). However, the oil can be used as a feed stock for biodiesel industry and an alternative source of fuel (Yunus *et al*., 2013).

The nutritional compositions of the fruits are not properly documented particularly from this region of Nigeria (North West), and therefore their nutritional contributions to local diets is less understood and quantified. Therefore, the study was carried out to determine the proximate composition, minerals, and anti-nutrients content with the aim of providing clear view of its potential as nutrient supplement.

Plate 1: Riped fruits of *Lannea microcarpa*

MATERIALS AND METHODS

Sample Collection and treatment: Fresh fruits of *Lannea microcarpa* were collected from Chimola district of Gwadabawa Local government Area, Sokoto State, Nigeria. The site was chosen because of the abundance of this plant. The fruits were collected from different branches of the selected trees, as described in the method of Ayaz *et al*. (2002). The sample was collected in black polythene bags and transported to laboratory. Prior to analyses, the sample was authenticated at the Herbarium section, Botany Unit, Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria. Representative sample was taken using alternate shovel method (Alan, 1996). The sample was thoroughly washed with distilled water and then air dried. The peels and the pulp were separated manually using a sharp blade, and the pulp then pulverized to fine powder using pestle and mortar and used for the analyses except for moisture contents in which fresh sample was used (Nordeide *et al*., 1996).

Proximate composition: Proximate analysis of sample was conducted using the conventional procedures described by the Association of Official Analytical Chemists (AOAC, 2005): Moisture content by drying at 105°C overnight, ash by incineration at 550°C for 24 hrs, crude protein (N × 6.25) by the Kjeldahl method and crude lipid content by Soxhlet extraction using n-hexane. The available carbohydrate (CHO) was calculated by difference. Energy value (kcal/100 g) was calculated by multiplying the grams of protein, fat, and carbohydrate by the factors of 4, 9, and 4 kcal/g, respectively.

Minerals Composition: Mineral elements of the samples were determined according to procedures described by Walinga et al. (1989). The sample (1g) was digested with 4 ml of a mixture (ratio 7:1) of perchloric acid (HClO4, 60%) concentrated sulfuric acid and 15 ml of concentrated nitric acid. After complete digestion, the product was cooled, filtered and the volume adjusted to 50 ml. For determination of calcium, 0.2 ml of the filtered solution was diluted with 4.8 ml of lanthane (La_2O_3,1%). For the other minerals, the dilutions were made with distilled water. Potassium was measured using a flame photometer (Corning 400, Essex, England); phosphorus was determined with a Skalar auto analyzer (Skalar, Breda, The Netherlands) and all other minerals with an atomic absorption spectrophotometer (Perkin Elmer Analyst 100).

Anti-nutrients Composition: For determination of total oxalate, 75ml of 15N H_2SO_4 was added to 1g of the sample. The solution was carefully stirred intermittently with a magnetic stirrer for 1hr and filtered using what-man No1 filter paper. 25ml of the filtrate was then collected and titrated against 0.1N $KMnO_4$ solution until a faint pink color appeared that persisted for 30sec (Umar *et al*., 2007).

Phytate was determined using the method of Reddy and Love (1999). Four gram (4g) of the sample was soaked in 100ml of 2% HCl for 5hours and filtered. To 25ml of the filtrate, 5ml of 0.3% ammonium thiocyanate solution was added. The mixture was then titrated with iron (III) chloride solution until a brownish-yellow color that persisted for 5minutes was obtained.

The tannin content was determined using Folin Denis reagent as reported by Abdel *et al*. (2007) in which a standard calibration curve was prepared and the Absorbance (A) against concentration of tannins at specific wave length was estimated as follows: Suitable aliquots of the tannin-containing extract (initially: 0.05, 0.2 and 0.5ml) were pipetted in test tubes, the volume was made up to 1.00ml with distilled water, then 2.5ml of sodium carbonate reagent were added. The tubes were shaken and the absorbance was recorded at 725nm after 40 min. The amount of tannin was calculated as tannic acid equivalent from the standard curve.

For Hydrocyanic acid (HCN), ten grams (10g) sample was placed in a separate 500ml macro Kjeldahl flasks, 200ml distilled water and 10ml chloroform were added to the content. The mixture was then steam distilled into a 100ml conical flasks containing 5ml of 2% potassium hydroxide solution, to about 40ml and then transferred to 250ml beaker. A few crystals of potassium iodide were added to the distillate and titrated with standard 0.02M silver nitrate solution to the end point recognized by the appearance of permanent faint turbidity. The amount of cyanide in the juice was calculated using equation below (AOAC, 1990).

$$1\text{ml of } 0.02\text{MAgNO} = 0.108\text{mgHCN}.$$

Data Analysis: The Data obtained were statistically analyzed using one way analysis of variance (ANOVA) with SPSS version 16.0 statistical package and the results were expressed as mean ± standard deviation of three replicates.

RESULTS

The results of proximate composition, minerals content, and anti-nutrients composition are presented in Table 1, 2, and 3 respectively, while that of anti – nutrients to nutrients molar ratio is presented in Table 4.

Table 1: Proximate Composition of *Lannea microcarpa* fruits pulp (g/100g dry weight)

Parameter	Composition
Moisture*	70.55 ± 2.56
Ash	3.48 ± 0.81
Crude protein	8.71 ± 1.98
Crude lipid	1.87 ± 0.34
Crude fiber	5.21 ± 1.67
Available carbohydrate	80.73 ± 6.81
Calorific value (kcal/100g)	374.59 ± 4.32

The data are mean ± standard deviation of three replicates * = Percentage wet weight

Table 2: Minerals content of *Lannea microcarpa* fruits pulp (mg/100g dry weight)

Mineral element	Composition
Na	15.10 ± 1.70
K	450 ± 3.87
P	6.14 ± 0.89
Ca	35.00 ± 1.90
Mg	58.00 ± 3.23
Fe	38.21 ± 2.67
Mn	3.10 ± 0.45
Zn	14.14 ± 2.98

The data are mean ± standard deviation of three replicates

Table 3: Anti-nutrients composition of *Lannea microcarpa* fruits pulp (mg/100g dry weight)

Antinutients	Composition
Phytates	40.50 ± 1.54
Oxalates	12.14 ± 2.32
Tannins	4.17 ± 0.61
Saponins	2.16 ± 0.87

The data are mean ± standard deviation of three replicates

Table 4: Anti-nutrients to Nutrients Molar ratio of *Lannea microcarpa* fruits pulp

Anti-nutrients to Nutrients	Molar ratio	Critical level
[Oxalate]/[Ca]	0.16	2.5
[Oxalate]/[Ca+Mg]	0.04	2.5
[Phytate]/[Ca]	0.07	0.2
[Phytate]/[Fe]	0.09	0.4
[Phytate]/[Zn]	0.27	10

DISCUSSION

The results of proximate compositions as presented in Table 1, indicate that the moisture content (70.55 %W/W) is lower than the value reported by Thiombiano *et al.* (2014) in the *Detarium microcarpum* pulp (95.07%W/W) but higher than 23.70%WW recorded in the pulp of *Gardenia erubescens*. Higher moisture content is associated with a rise in microbial activities during storage (Hassan and Umar, 2004). Therefore, the fruits should be properly dried before storing.

The ash content of the shoot was 3.48% dry weight (DW), which is an indication that it contains nutritionally important mineral elements. The value obtained is comparable to that of *Detarium microcarpum* pulp (3.26%DW) but higher than 2.54%DW reported for *Gardenia erubescens* pulp (Thiombiano *et al.*, 2014).

The analyzed sample contains low amount of crude protein (8.71%DW) which is higher than 4.65%DW in the pulp of *Detarium microcarpum* and also higher compared to 1.10%DW recorded for *Gardenia erubescens* pulp (Thiombiano *et al.*, 2014). According to Watt and Merrill (1963), plant foods that provide more than 12% of its calorific value from protein are considered good source of protein and this indicates that *Lannea microcarpa* fruit is a potential source of protein.

The *Lannea microcarpa* fruit has low level of crude lipid (1.87%DW) which is comparable with 1.79%DW for *Detarium microcarpum* pulp but higher than 1.19%DW reported in the pulp of *Gardenia erubescens* (Thiombiano *et al.*, 2014). Low lipid content makes the *Lannea microcarpa* fruit pulp good source for weight control.

The fruits pulp contains 5.120%DW crude fiber which is relatively appreciable compared to that of other wild fruits. The fiber obtained support bowel regularity, help maintain normal cholesterol levels and blood sugar levels, reduce constipation and also prevention of heart diseases (Wasagu *et al*., 2013).

The function of carbohydrate is for energy supply. Carbohydrates also contribute to the sweetness, appearance and textural characteristics of many foods (Ummi and Mirfat, 2014). The fruits pulp have 80.73% DW carbohydrates which is higher than 74.65%DW for *Detarium microcarpum* pulp and 6.70%DW for *Gardenia erubescens* pulp (Thiombiano *et al.*, 2014), which indicates that carbohydrate is the major macro nutrient in the fruit pulp of *Lannea microcarpa*.

The calorific value of the *Lannea microcarpa* fruit is 374.59kcal/100g which is higher than 335.50kcal/100g reported in the pulp of *Detarium microcarpum* and 41.90kcal/100g for *Gardenia erubescens* pulp (Thiombiano *et al.*, 2014). The energy value is within the range of recommended daily intake of 300kcal of energy per 65kg body weight adult human (Muller, 1988). The fruits therefore if consumed in good quantity could be a good source of energy.

The result of minerals composition as presented in Table 2 showed that the fruit is rich in both macro and micro mineral elements. Among the macro elements, potassium is the most abundant (450.59mg/100 mg) followed by magnesium (58.0 mg/100 g), calcium (35.0mg/100g), sodium (15.10mg/100g), and then phosphorus (6.14mg/100g). On the other hand, iron is the most abundant micro element present (38.21mg/100g), followed by zinc (14.14mg/100g) and manganese is the lowest (3.10mg/100g). The values obtained are higher compared to that of *Lannea microcarpa* fruits pulp reported by Thiombiano *et al.* (2014), which may be due to genetic variations as well as the climatic conditions on which the plant grows. However, the results recorded are generally lower than that of *Detarium microcarpum* fruits pulp (Florence *et al*., 2014).

The results also showed that *Lannea microcarpa* fruits could be a potential source of both macro and micro minerals elements which are important for normal body functioning. For example Potassium is a systemic electrolyte and is essential for coregulating ATP with sodium. It is also a major intracellular cation that maintains intracellular osmotic pressure. Sodium is an electrolyte present in extracellular fluid and is essential for coregulating ATP with potassium. Phosphorus and calcium are important component of bones and teeth. As phosphate ion, phosphorus is required for formation of teeth and bones, as well as production of high energy compounds such as ATP, creatine phosphate (Florence *et al*., 2014).

Magnesium activates enzymatic systems responsible for calcium metabolism in bones and in the nerves electrical potential (Ishida *et al*., 2000). Zinc is known to play an important role in gene expression, regulation of cellular growth and participates as a co-factor of enzymes responsible for carbohydrate, proteins and nucleic acid metabolism (Camara and Amaro, 2003). Iron is utilized in the body for transportation of oxygen to the tissue and melanin formation (Linder, 1991). It is also an important element in the diet of pregnant women, nursing mothers, infant, convulsive patients and elderly to prevent anaemia and other related diseases, but prolong consumption can result in liver failure (Linder, 1991). Manganese helps in supporting the immune system, regulating the sugar level in blood and contributes in the energy production during cell division. More so, deficiency in manganese could result to birth defects in pregnant women (Bello *et al*., 2008).

Anti-nutrients composition

The result of antinutrients composition of *Lannea microcarpa* fruit pulp is presented in Table 3. The phytates content of the fruits was 40.50mg/100g, and is higher than 0.41mg/100g recorded for *Detarium microcarpum* fruit pulp (Florence *et al*., 2014). Phytate is a strong chelating agent that binds dietary essential minerals such as zinc, calcium and iron to form complexes thereby decreasing the bioavailability of these minerals (Fergusin *et al*., 1993).

The fruits pulp has oxalates content of 12.14mg/100g. The recorded value is higher than 1.06mg/100g for *Detarium microcarpum* fruit pulp reported by Florence *et al*. (2014). Presence of oxalates in food cause irritation in the mouth and interfere with absorption of divalent minerals particularly calcium by forming insoluble salt with them (Hassan and Umar, 2004). Consumption of oxalate may results in kidney disease (Onibon *et al*., 2007).

The tannins concentration of the fruits was 4.17mg/100g. The value recorded is higher compared to 0.17mg/100g obtained in *Detarium microcarpum* fruit pulp (Florence *et al*., 2014). Tannins in the biological system have the ability to chelate protein making it impossible or difficult to digest (Alerto, 1993).

The value recorded for saponoins was 2.16mg/100g. The value is lower than 2.73mg/100g for *Detarium microcarpum* fruit pulp (Florence *et al*., 2014). High saponin contents has been associated with gastro-enterities manifested by diarrhea and dysentery (Awe and Sodipo, 2001). However, it was reported that saponin reduces body cholesterol by preventing its reabsorption and suppresses rumen protozoan cell membrane thereby causing it to lyse (Umaru *et al*., 2007).

To predict the bioavailability of some divalents mineral elements specifically calcium, magnesium, zinc and iron, anti-nutrients to nutrients molar ratios were calculated and the results presented in Table 4. From the results, it was observed that, [oxalate] / [Ca], [oxalate] / [Ca + Mg] ratio are below the critical level known to impair calcium bioavailability (Umar, 2005). Similarly, [phytate] / [Ca], [phytate]/[Fe], and [phytate]/[Zn] ratio ratios were low compared to the critical value known to cause calcium, iron, and zinc deficiency respectively by the phytate (Mitchikpe *et al*. (2008). The result suggests that the nutrients analyzed have no adverse effect on the bioavailability of the minerals elements, however, if at higher concentration the anti-nutrients can be minimized to tolerable limit by proper processing methods such as cooking, frying and soaking (Elijah *et a*l., 2017).

CONCLUSION

The results obtained suggest that African grapes (*Lannea microcarpa*) fruit pulp is potentially an important supplement of carbohydrate and protein, in addition to some essential mineral elements of nutritional benefit such as potassium, magnesium, iron, zinc, and manganese. The anti-nutrient to nutrients molar ratios are below the critical level known to impair minerals bioavailability indicating that the fruit pulp is relatively safe for consumption subject to toxicological studies.

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AUTHOR’S CONTRIBUTIONS

Professor L.G. Hassan, Dr. K.J. Umar and N. A. Sani were involved in several stages of this research, including the literature search, experiments, manuscript drafting and draft revisions.

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