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The Analysis of Bambara Nut (*Voandzeia subterranea* (L.) *thouars*) for Sustainability in Africa

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Abstract: The ash, moisture, protein and carbohydrate contents of Bamabara nut *Voandzeia substerranea* (L.) *thouars*) a traditional African food stuff were determined by standard methods. The oil content was determined by soxhlet extraction with petroleum ether (60-80°C). The saponification, acid, peroxide and iodine values were determined by chemical analysis and the fatty acid composition was determined by gas chromatography. The results obtained from the research show that bambara nut contains 4.8% ash, 7.2% moisture, 19.0% protein, 47.0% carbohydrate, 7.0% oil and 1.0% free fatty acid. The results also show the presence of oleic acid (18.0%), caprylic acid (17.0%), capric acid (8.0%), lauric acid (9.0%), palmitic acid (10.0%), palmitoleic acid (21.0%) and linoleic acid (12.0%). The saponification, acid, peroxide and iodine values obtained for the seed oil were found to be 170.7, 90.0, 4.0 and 50.3 mg g^{-1}, respectively. These results show that Bambara nut has a remarkable nutritional value and since the plant grows well under harsh climatic conditions thus ensuring its regular availability, it can serve as a food supplement for both Africans and the inhabitants of other part of the world.

Key words: Bambara nut (*Voandzeia subterranean* (L.) *thouars*), sustainability, fatty acids, nutrition, palmitic acid, Nigeria

INTRODUCTION

Bambara nut (*Vorandzeia subterranean* (L.) *thouars*) is a seed of Africa origin used locally as a vegetable. It was first found in west Africa (http://wapedia.mobi/en/bambara). The plant is leguminous and has numerous nitrogen fixing nodules on the root. Evidence has shown that based on the root nodules, the plant supports land care provision in Africa (National Research Council, 2006). The quest for plant with nutritional properties continues to receive attention. Bambara nut which constitutes complete food stuff is reported to contain protein, carbohydrate and lipid and can be consumed at different stages of maturation (National Research Council, 2006). The plant has a potential to improve malnutrition and boost food availability.

The botanical name of Bambara nut is *Voandzeia subterranean* (L.) *thouars*, synonyms of *Vigna subterranean* and belongs to the plantea of the family of fabaceae and sub family of Faboidea. The common names of Bambara nut are okpa (Nigeria Igbo), Gurujia (Nigeria, Hausa), congo groundnut (Cong), Njugo, bean (South Africa) Nzama (Malawi) Ntoyo (Ci Bemba) or Katoyo (K, Kanod) (Zambia) (http://wapedia.mobi/en/bambara). The plant is distributed in Africa and grows best under bright sunshine, high temperature and at least 4 months free frost and frequent rain. However, it is highly adaptable and tolerates harsh weather conditions better than most crops. Bambara nuts are used locally as food stuff for preparing moi-moi (Nigeria, Igbo). It can be boiled and eaten as nut and can also be grounded into flour for preparing fufu maize for (Nigeria, Middle Belt). Bambara is used to fortify maize for pap (Nigeria, Anambra state). The dry seeds can last for very long time and serves as famine food boosting food availability (National Research Council, 2006).

Bambara plant is also used to sustain the plant habitat as it increases the fertility of the soil and brings about the high yields of other crops cultivated around it without the application of fertilizer (http://wapedia,mobi/en/bambara). The plant also serves as a natural For Florida garden. The nut can be eaten raw when immature because it is soft and pleasant. The extract from the nut of *Voandzeia subterranean* particularly the protein extracts can be used directly in cosmetic formulations and provides specific properties and notable particular effects. The nut can be used quite freely to replace the high-prized lumps of meat without sacrificing adequate nutrition. The fatty acid present in the nut oil is

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among the essential fatty acids needed in the body. These fatty acids are primarily used to produce hormone like substance that regulates the wide range of functions. The nut also contain tannin which is one of the anti nutritional factors (Obizoba and Egbuna, 1992). The unique properties and composition of Bambara nut make it serve as a balanced food which contains almost all the vital nutrients that promotes good health for people living in Africa.

Sustainability involves a set of structure and process that build the civil common (Summer, 2008). Civil common is based on values that promote life first and foremost. The quality of one's life is more directly connected to the one's environment. Bambara nut can serve as one of the vital ingredient in accelerating the rate of realization of the Millennium Development Goals (MDGS) form the basis for the much desired sustainability development. In this communication, the result of the proximate analysis of bambara nut, extraction of the oil, characterization of the oil and determination of the fatty acids composition of the oil is reported. The suitability of bambara nut for food consumption for human sustainable development is also discussed.

MATERIALS AND METHODS

A sufficient quality of the fresh nut of bambara (*Voandzeia subterranean* (L.) *thouars*) grown in Enugu state, Nigeria was obtained from Ose Market, Onitsha of Anambra state, Nigeria. The dry nuts were stored in a container and preserved in a cool area (until needed). The moisture, crude protein and oil contents of the bambara nut were determined using the methods described by Pearson and the ash content was determined using the method of (Porneranz and Meloan, 1994) while the total carbohydrate content was determined by difference. All determinations were done in triplicate and mean values recorded.

A sufficient quantity of the dried bambara nuts was ground in a moulinex, model seB PREP LINE 850 (moulm Cafe) and 50 g of the ground sample was placed into a cellulose paper cone and extracted using light petroleum ether (60-80°C) in a soxhlet extractor for 8 h. The oil content was recovered by evaporation of the solvent with rotary evaporator (model N-1 manufactured by Tokyo Rikakikal Co. Ltd, Japan) and residual solvent was removed by drying in an oven at 60°C for 1 h and flushing with 99.9% nitrogen. All experiments were done in triplicates and the means and standard deviations (mean±SD) calculated. The peroxide, iodine, saponification and acid values and percentages of free fatty acid contents were determined by the standard analytical procedures described by Pena *et al*. (1992). The fatty acid composition was determined by conversion of the oil to fatty acid methyl esters by mixing together 95 μL of n-hexane, 50 mg of oil and 50 μL of what unit is that? Sodium methoxide as described by Cocks and van Rede (1966).

The top layer (1 μL) was injected into gas chromatography (model GC-14A, manufactured by Shimadzu Corporation, Kyoto, Japan) equipped with a flame ionization detector and a polar capillary column 0.28 mm of 0.32 mm internal diameter, 60 m length and 0.25 μm film thickness Moμdel No BP×700 supplied by SGE Inorporated USA) to obtain individual peaks of fatty acid methyl esters. The detector temperature was raised to 240°C and column temperature to 110°C. The column temperature was kept constant at 110°C for 1 min and increased at the rate of 8°C min^{-1} to 220°C and kept constant at this temperature for one another minute. The run time was 32 min. The fatty acid contents were identified by comparing their retention times with those of standards. Percent relative fatty acid was calculated based on the peak area of a fatty acid species to the total peak area of all the fatty acids in the oil sample.

RESULTS AND DISCUSSION

Table 1 shows the proximate analytical result obtained for bambara nut. The low ash content (4.75%) recorded for bambara nut shows that the food stuff contains very small amounts of micro elements. The Table 1 also shows that the protein level of bambara nut (18.50%) significant as it can serve as a proteineous food which enhances growth and cell maintenance. The carbohydrate level of 46.50% is an indication that the nut has very high energy content hence it has the capacity to serve as energy given food the masses of people in Africa.

The low moisture content of the nut (7.19%) is good for its keeping or storage quality. High moisture/water content reduces storage value. The percentage oil content of bambara seed is low compared to Soya beans, groundnuts and bread fruits that are legume. The colour of the obtained was yellow and was found to be a liquid at room temperature.

Table 2 shows the values of the chemical components of bambara nut. The chemical properties of oil are amongst the most important properties that determine the present condition of the oil. For example, free fatty acid and peroxide values are valuable measures of oil quality and iodine value is the measure of the degree of unsaturation of oil. The values in Table 2 are all significant. From this Table 2, it can be shown that the

Table 1: Proximate analytical result of bambara nut (measured in percentage of g/100 g of dry sample)

Parameters	Level (%)
Ash content	4.75±0.25
Moisture content	7.19±0.50
Protein content	18.50±0.26
Carbohydrate[a]	46.50±0.20

[a]Carbohydrate was estimated by difference of value i.e., 100 (sum of percentages of moisture, ash, protein and lipid)

Table 2: Chemical data obtained for bambara nut oil

Parameters	Level
Oil[a] (%)	72.50[a]
Acid value (mg g^{-1})	90.00±0.12
Saponification value (mg g^{-1})	170.66±0.64
Free fatty acid (%)	1.11±1.82
Peroxide value (mg g^{-1})	4.00±10.21
Iodine value (mg g^{-1})	88.60±0.45

[a]Weight of extracted oil×100/weight of nut

Table 3: Relative levels of fatty acids in bambara nut oil

Fatty acids	Level (%)
Oleic acid	18
Caprylic acid	17
Capric acid	8
Lauric acid	9
Palmitic acid	10
Palmitoleic acid	21
Linoleic acid	12

percentage Free Fatty Acid (FFA) is very low (1.11%). This is an indication that the oil is stable and its oxidative rancidity will not be easily attained. The fatty acid components found in bambara nut oil were Caprylic acid (17.0%), Capric (8.0%), Lauric acid (9.0%), Palmitic acid (10.0%). Palmitoleic acid (21.0%), Oleic (18.0%) and Linoleic acid (12.0%) (Table 3). The Linoleic acid, Oleic and Palmitoleic acid are unsaturated acids and are also among the essential fatty acids required by the body. (http://en.wikipedia.or/wiki/fatty acid).

These fatty acids are used to produce hormone like substances that regulate wide range of functions. They regulate blood pressure, blood clothing and blood lipid level and inflammation response to injury infections. Therefore, they are essential in human diet since there are no synthetic mechanisms available for their production in the human body.

Linoleic acid is one of the most important polyunsaturated fatty acids in human food of its ability to prevent distinct heart vascular disease (Boelhouwer, 1983). The result in Table 3 also shows that bambara nut oil is predominantly made of the unsaturated palmitoleic acid, oleic acid, lineleic acid and caprylic acid. This predominance of the unsaturated fatty acids and high iodine value index indicate that oil from bambara nut of Nigeria is of unsaturated type.

The result in Table 3 further shows that bambara nut which is abundant and tolerates drought and poor soil can serve as a reliable food as it can provide these essential fatty acids in the diet, thereby possessing the ability to sustain the people living in Nigeria and Africa.

CONCLUSION

The results obtained in this study show that bambara nut contains many of the essential nutrients that are highly recommended for human consumption. This implies that it can sustain the people living in Nigeria and the continent of Africa and as well helps in requirements of achieving the sustainable development.

It is also known from folklore and literature review that its nitrogen fixing property improves the soil and sustains the environment. Consequently, the consumption and cultivation of bambara nut should be encouraged in Africa for human and environmental sustenance which is one of the millennium development goals.

RECOMMENDATIONS

Further studies on cultivation of the bambara nut on commercial bass should be undertaken since the plant grows well in arid conditions.

Such large scale cultivation in the face of climatic changes will enhance food availability and improve land care.

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