Effect of Fermentation on the Proximate and Anti - Nutritional Properties of African Bush Mango (*Irvinigia garbonensis)*

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ABSTRACT

This paper studies the effect of fermentation on the proximate and antinutritional properties of African bush mango (*Irvinigia garbonensis).* The sample of African bush mango (*Irvinigia garbonensis)* was divided into two portions of sample A (fermented) and sample B (unfermented). The two samples were subjected to analyses using standard methods. A had moisture content of 10.72% crude fat 41.50%, protein 13.42%, crude fibre 3.70%, ash content of 6.80%, carbohydrate 22.80% and the dry organic matter of 89.28% while Sample B had 7.26%, 60.34%, 8.0%, 4.30%, 3.0%, 17.10% and 92.74% for moisture, fat, protein crude fibre, ash, carbohydrate and dry organic matter respectively. The anti nutritional properties revealed that sample A had 0.056mg/100g phytate, 0.038mg/100g oxalate, tannin (0.011mg/100mg), saponin (0.113mg/100g) and 0.015mg/100g flavonoid while sample B showed that phytate had 0.124mg/100g, oxalate 0.26mg/100g, 0.041/100g (tannin), saponin 0.266mg/100g while flavonoid had 0.058mg/100g. The results of the study showed that both fermented and unfermented African bush mango (*Irvinigia garbonensis)* kernel has good nutrient values which can be consumed for body growth and maintenance.

Keywords: *African bush mango, proximate, anti nutritional properties, Irvinigia gabonensis, nutrients*

INTRODUCTION

African bush mango belongs to the family *Irvingiaceae.* It is known as wild mango or bush mango or Dika nut plant. It is an edible African Indigenous fruit tree that produces fruits and seeds (Atangara *et al*., 2002). The *Irvingia* species exist in two varieties, *Irvingia gabonensis* and *Irvingia wombolu*. Both species are reported to be gregarious and largely distributed in Africa. The fruit mesocarp of *Irvingia gabonensis*, is appreciated as snack or fresh fruit. Ground kernels are used to thicken and flavour soups. Bush Mango tree or dika tree (*Irviniacea spp*) is very valuable for its edible yellow mango like fruit, its kernel and the termite – resistant wood (Harris, 1996; Ayuk, *et al.,* 1999 and Adeosun, *et al.,* 2008). It grows naturally in the humid, lowland forests of tropic Africa but widely planted in central and western Africa (Ladipo *et al.,* 1995; Akubor, 1996). The fruit is a drupe with a thin outer skin, soft fleshy pulp when ripe and a hard stony nut encasing an extremely soft kernel (Okafor, 1978). There are two species of bush mango tree, the sweet edible pulp *(Irvinigia gabonesis*) and bitter inedible pulp (*Irvinigia wombolu*) (Ejiofor, 1994). The kernels of edible specie of *Irvinigia gabonensis* are called Ugiri in Igbo or Apon in Yoruba. Two species of the tree (*Irvinigia gabonensis*) which has a sweet edible pulp are common, however, kernels from both species exhibits similar valuable food properties. They are processed by grinding and crushing and then used to thicken soups and stews which a valuable local delicacy in Nigeria, Ghana, Gabon and Republic of Benin (Eka, 1980). Oil extracted from the kernel is raw materials for manufacturing pharmaceutical binders, confectioneries, edible fats, soaps and cosmetics (Okafor,

1978; Agor, 1994; Ayuk *et.al*., 1999; Okafor *et al*., 1999). The leaves, barks and root of *Irvinigia gabonesis* are also medicinal. Ethno- medicinal treatments utilize the bark kernels, leaves or roots as potential application in food and pharmaceutical industry. The dika tree (irvinigiacea spp) is very valuable for its edible yellow mango like fruit and the termite resistance wood (Ayuk *et al.,* 1999). The *Irvinigia gabonesis* kernel is very significant in the diet of rural women in West Africa (Ekpe *et al.,* 2007) and for controlling dietary lipids and weight gain (Leakey *et al.,* 2005 and Ogunsina *et al.,* 2008). *Irvinigia gabonensis* has been prized for its healing properties and now has become one of the most exciting discoveries in weight loss industry (Leakey *et al.,* 2005). *Irvinigia gabonensis* (Apon) is a tree found in West Central Africa, also known by the native as the wild mango or bush mango. The tree is valued for its dika nut in addition to producing a yellow edible fruits. *Irvinigia gabonensis* is high in fat, similar to other nuts and seed contain extraordinary fibre content (14%). Africa mango shows beneficial effects on diabetes patients and obesity as well as containing antimicrobial, antioxidant and GI activity. Africa mango constitutes an important part of the rural diet in West Africa for controlling dietary lipids and weight gain. Powdered dika kernel is commonly cooked with vegetables into "Ogbono" soup, a valuable local delicacy in Nigeria, Ghana and Gabon especially. *Irvinigia gabonesis* has played important role in the nutrition, economy and traditional medicine in western and south western to Tropical Africa from Nigerian to Angola through the help of the United Nations. A number of scientific contributions have been made available to enhance the production and commercial use of *Irvinigia* (Bajaj *et al.,* 1988).The kernels of Africa mango have classified use as oil seeds. The seeds are ground into paste, also known as dika bread, which is valued for its food thickening properties. The resulting product is used in soups, stews, the fat extracted from the kernels is similar to margarine or cooking oil. Flour may also be produced from the kernels. Numerous studies exist on the potential application of Africa mango in food, cosmetic and pharmaceutical products, and initiatives on phenotypic variation, amino acid profile, soil conditions and economic potential of the plant species document addition commercial interest (Burkill, 1994). The seeds are good source of nutrients, containing vitamins and minerals such as calcium, magnesium, sodium, phosphorous and iron. The pulp is also an excellent source of calcium (262mg per 100g) and vitamin C (66.7mg per 100ml). (Leakey *et al*., 2005). The tree grows naturally in the humid, low land forests of tropical Africa. It is widely planted in central and western Africa (Bajaj *et. al,* 1988). The kernel contains about 8.9% protein, 19.7% carbohydrate, 62.8% lipids, 5.3% dietary fibre and 3.2% ash by weight (Adeosun *et al.,* 2008). Fermentation is one of the oldest biotechnologies used in the enhancement of the nutrient content and preservation of food through the biosynthesis of vitamins, essential amino acids and proteins, by improving protein and fibre digestibility and by degrading antinutritional factors (FAO, 1983). Several food industries utilise microorganisms and the fermentation process in the preparation of foods (Ekundayo and Ojokoh, 2004). Fermentation process tends to reduce the toxicity of some foods (Namibisan and Sundaresan, 1985).The fermenting organisms include lactic acid bacteria, acetic acid producing bacteria and some alcohol producing yeast. Fermentation is a process of improving the organoleptic properties of the food by making the food more palatable and more edible. Fermentation process helps to remove toxins associated with food. These toxins are hazardous to health. This study investigated the effect of fermentation on the proximate and anti nutritional properties of African bush mango (*Irvinigia garbonensis*

MATERIALS AND METHODS

Sample Collection

Fruits of African bush mango (*Irvinigia garbonensis*) were purchased from market in Boripe Local Government of Osun State during the fruiting season on the onset of raining season. The mesocarp was peeled off to expose the endocarp. The seeds coats were broken to obtain the kernels. Other materials used are nylon, and jute bag.

Methods

The extracted kernels were divided in to two samples, sample A was fermented African bush mango kernels while sample B was unfermented one. Sample A was packed in to the jute bag and fermented for 48 hours. They were dried in the oven after fermentation. The two samples were blended separately in to air tight polythene bag and kept for analysis.

Determination of the proximate composition of African bush mango samples: Crude protein, either extract, ash, moisture content, crude fibre and total carbohydrate content of the sample were estimated by standard methods (AOAC, 1990).

Determination of anti-nutritional Composition

Determination of Tannic Acid (Tannin): Method of Makkar and Good child, (1995) was used. The tannin equivalent in the form of phenol was calculated from a standard curve.

Determination of Trypsin inhibitors: Trypsin inhibitor was determined by the method of as modified by Clarke and Oloso (1992).

Determination of Phytic Acid (Phytate): Phyatate content was determination by the anion exchange method as described by Harlnd and Oberleas (1986).

Determination of Oxalate: Oxalate content was determined using the method of Ngodi *et al*. (2005)

Determination of Saponin: 2g of each was weight in to 250ml beaker and 100ml of is isobutyl alcohol was added and left for 5 hours on a UDY shaker for uniform mixing to obtain a uniform solution. The mixture will then be filtered through a No 1 what man filter paper. The filtrate is transferred to another 100 ml beaker and was saturate with magnesium carbonate solution. The mixture was then filtered to obtain a clear colorless solution to be read on a spectrophotometer at 380 nm. 0 ppm to 10 ppm of standard saponin solution was prepared from 1000 ppm saponin stock standard solution and was saturated with magnesium carbonate as above and also filtered. The absorbance of the saponin standard solution (0-10ppm) was also read in 380 nm to obtain the gradient of plotted curve.

RESULTS AND DISCUSSION

Table 1. The proximate composition of both fermented and unfermented irvingia gabonensis kernel

PARAMETER	FERMENTED *Irvinigia garbonenses*	UNFERMENTED *Irvinigia garbonenses*
Moisture Content	10.72±0.02	7.26±0.01
Crude Protein	13.43±0.03	8.0±0.02
Crude Fat	41.5±0.01	60.34±0.01
Crude Fibre	3.70±0.02	4.3±0.01
Ash Content	6.8±0.03	3.0±0.02
Carbohydrate	22.80±0.02	17.10±0.01
Dry Organic Matter	89.28±0.01	92.74±0.02

Mean ± SD of triplicate determinations

Table 1 depicts the results of proximate composition of both fermented and unfermented irvinigia gabonensis [edible bush mango kernels]. The moisture content of fermented edible bush mango kernel was 10.72% while unfermented was 7.26%. The difference in percentage between the two was as a result of fermentation which could have increase the moisture content of fermented one. Through, the two moisture content compared favourably with the moisture content of legumes which range between 7.0-11.0% (Akroyed and Doughty, 1964). The value obtained is an indication that it can store for a long period without spoilage and will not be susceptible to microbial infection. The crude fat of fermented kernel was 41.5% while unfermented kernel of *irvinigia gabonensis* was 60.34%. The fat content of the two kernels were high and this is an indication that it is rich in oil which could be used as base materials in the manufacture of pharmaceutical binders, soups, cosmetics, confectioneries and edible fats (Ayuk *et al,* 1999). Also fat is important in the diet because it aids the absorption of fat soluble vitamins (Bogert *et al.,* 1994). The protein content of fermented to unfermented *irvinigia gabonensis* was 13.42% and 8.0% respectively. The protein values were low when compared with protein rich food like soybeans, cowpeas and melon ranging between 23.1-33.0% (Olaofe *et al.,* 1994). The recommended daily allowance for children range from 23.0-36.0g and for adults 44.56g. The crude fibre of fermented kernel of *irvinigia gabonensis* was 3.70% while unfermented was 4.30%. The reduction in fibre content was as a result of fermentation. The World Health Organization (WHO) has recommended an intake of 22.0-23.0g of fibre for every 1000 Kcal of diet (Fadare and Ajaiyeoba, 2008). Though it does not contribute to the nutritive value of foods, the presence of fibre (roughage) in the diet is necessary for digestion and for elimination of wastes, (Vadivel and Janardhana, 2005). The contraction of muscular walls of digestion tract is stimulated by fibre, thus contacting constipation (Narasinga *et al.,* (1989). The ash content of fermented kernel was 6.80% while unfermented one was 3.0%. The ash content of unfermented kernel compared well with the value (1.5- 2.5%) obtained for legumes nut seeds and tuber of legumes. The value of ash obtained in this study showed that the sample is a good source of minerals, therefore it can be recommended

for animal feeds (Pomeranz and Clifton, 1981). The values obtained for carbohydrate (by difference) were 22.80% for fermented kernel while 17.10% for unfermented kernel. This also indicated that fermented *irvinigia gabonensis* is a good source of energy and is capable of supplying the daily energy need of the body. The dry matter of fermented kernel was 89.28% while unfermented was 92.74%. This dry matter content was high. It could be attributed to experimental procedure as well as the cultivars of *irvinigia gabonensis*.

Table 2. Anti-nutrients properties of both fermented and unfermented irvinigia (Concentration mg/100g).

Anti-nutrient	Fermented *Irvinigia garbonenses*	Raw *Irvinigia garbonenses*
Phytate	0.056 ±0.01	0.124±0.01
Oxalate	0.038 ±0.03	0.26±0.01
Tannin	0.011 ±0.01	0.041±0.02
Saponin	0.113 ±0.01	0.266±0.03
Flavonoid	0.015 ±0.02	0.058±0.01

Mean ± SD of triplicate determinations

The table also depicts the anti nutrients properties of both fermented and unfermented *irvinigia gabonensis,* phytate of fermented to unfermented kernel is between 0.056mg/100g to 0.124mg/100, oxalate 0.038mg/100 to 0.260mg/100. Tannin was 0.011mg/100g to 0.041mg/100g, saponin 0.113mg/100g to 0.266mg/100. Flavonoid was 0.015mg/100 to 0.058mg/100 respectively. Comparing the phytate contents of fermented with unfermented kernel; it was low in value reported for peanut (1.36%), Ndjouenkeu *et al.,* (1996) and the value reported for dehulled and whole soybeans (1.07-65%) (Okafor and Ujor 1994); Pomeranz and Clifton (1981) but it is lower than the (0.18%) value reported for raw locust beans (Eka, 1980). Considering the processing effect on the phytate content of *irvinigia gabonensis*, fermentation has reduced it. This is in line with the work of Idowu *et al.,* (2013) who reported 31.1% reduction in phytic acid content of kenkey (fermented maize) and 45.5% reduction reported by Sadasivam and Manickam (1996) in fermentation of common beans to Tempe. It is also in agreement with the result of Ngodi *et al*., (2005). Fermentation has been reported of playing significant role in reducing phytic acid content of cereals, legumes and tubers as a result of the activities of endogenous phytase from both raw material and inherent microorganism which hydrolyse phytic acid in many fermented food preparation into inositol and orthophosphaste (Fadare and Ajaiyeoba, 2008). The oxalate is capable of chelating divalent cationic minerals like calcium, magnesium, iron and zinc thereby reducing biovailability of such minerals. The tannin content of *irvinigia gabonensis* for both fermented and unfermented is lower than the reported values of some undehulled common beans 0.95%. Though fermentation reduced the value, reduction in tannin due to fermentation might have been caused by the activity of Phenol oxidase or fermented

microflora anti tannins (Fadare and Ajaiyeoba, 2008; Fagbemi *et al*, 2005). The negative nutritional effects of tannins are diverse and incompletely understood, but it cause growth depression by decreasing the digestibility of proteins and carbohydrate. This is not likely the consequence of interaction of tannins with either proteins or starch to form enzyme resistant substances (Burkill, 1994). The saponin value of fermented kernel is reduced when compared with that of fermented one, this reduction will improved the organoleptic properties of *irvinigia gabonensis* since sapons are a factors that contribute to undesirable organoleptic properties of some legume product. There was reduction in the value of flavonoid of both fermented and unfermented *irvinigia gabonensis* kernel. The positive nutritional effect of flavonoids that they are bioactive compounds producing different antihypertensive action mechanism (Ndjouenkeu *et al.*, 1996)

In conclusion, the results of the study showed that both fermented and unfermented *irvinigia gabonensis* kernel has good nutrient values and the two varieties can be crushed, grinded, used in preparation of stew called Ogbono or Apon. The stew is good for consumption for both old and young ones as it will combine effectively with other food components in providing the required elements to the body. Based on the results obtained for both fermented and unfermented *Irivinigia garbonensis*, it can therefore be recommended in preparation of stew.

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