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Proximate, Mineral and Fatty Acid Composition of Gravy Prepared from Palm Bunch Ash (Ngu)

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ABSTRACT

Background and Objective: Palm bunch ash is one of the fruit bunch products of palm trees. Palm bunch ash can be obtained by burning the solid waste of palm bunch refuse. The study investigated the proximate, minerals and fatty acid composition of palm bunch ash and the gravy prepared from it. **Materials and Methods:** The samples (Ash 1 and Ash 2) were collected from Isiala Mbano in Imo State and the Faculty of Agriculture, Rivers State University respectively. Proximate composition and mineral concentration were determined using standard methods, and fatty acid composition was determined by using gas chromatography. **Results:** The findings from the result showed that ash content was highest for both Ash 1 (60.9%) and Ash 2 (79.3%). For the mineral concentration (mg/100 g), potassium had the highest concentration in Ash 2 (20719.94) than Ash 1 (11155.21). Calcium, magnesium, and zinc were in the range of 905.56-3051.82, 198.05-939.24, and 13.13-50.48 mg/100 g, respectively. For the fatty acid composition, the fatty acid with the highest concentration present in the palm bunch ash mixed with gravy was palmitic acid for both of the palm bunch ash samples. Saturated fatty acid was also found present in the palm bunch ash which are arachidic, decanoic, and stearic acid. Also present in the palm bunch ash were the unsaturated fatty acids which were linoleic, linolenic, and eicosadienoic acids. **Conclusion:** The study concludes that palm bunch ash contains some essential minerals and when combined with the gravy, some saturated and unsaturated fatty acids could be supplemented in animal feed.

KEYWORDS

Palm bunch ash, Abacha, gravy, tenderizers, trona, minerals, saturated and unsaturated fatty acids

INTRODUCTION

In Eastern Nigeria, palm bunch ash or Ngu is traditionally used as a food tenderizer in place of trona or cooking potash. It is used in the preparation of Abacha or African salad and crude palm oil[1]. According to Ogunsuyi and Akinnawo[2], palm bunch ash is the residue left over after burning palm bunches. It has high concentration of nitrogen, phosphorus, potassium, calcium and magnesium, making it a useful fertilizer and liming material for raising soil fertility, pH and nutrient uptake[3].

One of the by-products of palm trees is palm bunch ash as stated earlier, palm trees are economically significant trees that are primarily grown in the Southern part of Nigeria[4]. Palm fruits are harvested from palm bunches and used to produce palm oil; the empty palm bunch is the waste that results from

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processing the palm fruits. Currently, these wastes are used as organic fertilizers, biofuel in rural areas and to make soap. The waste produces significant amounts of solid waste by-products in the form of fibers, shells, and empty palm bunches that are discharged from the mills[5]. According to Ashfaqul Haque *et al.*[6], palm bunch ash, contains varying desirable amounts of nutrients like calcium, phosphorus, and magnesium, thus used as a food tenderizer. Food tenderizers like palm bunch ash have long been in traditional use, especially in developing nations where many people have low incomes. These tenderizers are thought to shorten cooking times, which lowers costs[7]. However, little is known about the nutritional composition of the various delicacies (gravies) made with palm bunch ash. To combat food and nutrition insecurities, particularly among those living the traditional lifestyle, dietary diversity is being promoted. For this reason, it is necessary to look into the proximate, mineral and fatty acid composition of palm bunch ash and the gravy prepared from it.

MATERIALS AND METHODS

Study duration: This work was done in the Department of Biochemistry and Food Science, Rivers State University, Nigeria from April to October, 2022.

Sample collection and preparation: The palm bunch were collected from two locations; sample 1 (Ash 1) was obtained from the Umuduru community in Isiala Mbano Local Government Area in Imo State, Eastern part of Nigeria with coordinates Latitude 5.6819°N and Longitude 7.2464°E. Sample 2 (Ash 2) was gotten from Faculty of Agriculture, Rivers State University Latitude 4°51′29.0772 and Longitude 6°55′.2904. The samples were gotten, washed, dried, and then burnt into ash completely. The ash was allowed to cool and sieved to get a fine particle of palm bunch ash. The gravy was made from palm oil and used for analytical purposes.

Determination of proximate composition: The proximate composition of the samples was determined using standard methods to determine crude protein, ash content, fiber, lipid, and moisture content. Carbohydrate content was determined using calculation by difference.

Determination of mineral concentration: Magnesium, potassium, and calcium were determined scientifically, and chromium and zinc were determined using Atomic Absorption Spectrophotometer (Flame AAS) mode: S4 = 71096.

Determination of fatty acids: Fatty acid composition was determined using a Gas Chromatography-Mass Spectroscopy (Agilent 6890 gas chromatograph with a 5973 MS detector equipped with 60 m×0.25 mm, i.d. 0.25 µm/MS DB-WAX capillary column) for a mixture of the gravy and the palm bunch ash.

Statistical analysis: Values were expressed as Mean±Standard Deviation. The ANOVA was used to show there was any statistical difference at $p<0.05$ using SPSS version 21.

RESULTS

The proximate composition of palm bunch ash is displayed on Table 1. The moisture content was lower in Ash 2 (8.25) and highest in the gravy which was significant. There was no evidence of fat and crude protein in Ash 1 and Ash 2. The following was the order of the ash content: Ash 2 (79.3)>Ash 1 (60.9)> gravy (1.94).

The mineral composition of palm bunch ash is displayed on Table 2. The concentration (mg/100 g) of potassium in Ash 1 (20719.94) was higher than Ash 2 (11155.21), and the gravy (883.94). In contrast to Ash 1 (905.56) and the gravy (30.23), the calcium concentration in Ash 2 (3051.82) was the higher. Zinc, Magnesium and Phosphorus were higher in Ash 1 (50.48; 939.24; 22.5) in comparison to Ash 2 (13.13; 198.05; 5.85), and the gravy (0.64; 0.77; 1.00), respectively.

Table 1: Proximate composition (%) palm bunch ash

Sample	Moisture	Fat	Ash	Crude protein	Crude fibre	Carbohydrate
Ash 1	24.09±0.66[a]	ND	60.9±0.7[a]	ND	10.29±0.09[a]	4.72±1.27[a]
Ash 2	08.25±0.40[b]	ND	79.3±0.4[b]	ND	2.744±0.04[b]	9.71±0.04[b]
Gravy	37.70±1.04[c]	40.59±0.60[c]	1.94±0.08[c]	4.57±0.29[c]	14.07±0.51[c]	1.16±0.08[c]

Values were expressed as Mean±Standard Deviation. Values in a row with different alphabetical superscript do differ significantly ($p<0.05$)

Table 2: Mineral composition of palm bunch ash (mg/100 g)

Sample	Zn	K	Cr	Mg	Ca	P
Ash 1	50.48	20719.94	0.58	939.245	905.56	22.5
Ash 2	13.13	11155.21	3.06	198.05	3051.82	05.85
Gravy	00.64	00883.94	Nil	0.77	30.235	01.00

Zn: Zinc, K: Potassium, Cr: Chromium, Mg: Magnesium, Ca: Calcium and P: Phosphorus

Table 3: Fatty acid composition of gravy combined with the palm bunch ash

Fatty acids	Gravy+Ash 1	Gravy+Ash 2
Myristic acid	03.22	03.09
Myristoleic	00.04	01.55
Palmitic	47.81	46.99
Palmitoleic	03.37	00.19
Oleic	02.34	28.24
Stearic	35.48	11.77
Linoleic	04.33	00.19
Linolenic	00.26	00.44
Arachidic	01.33	00.95
Eicosenoic	01.29	03.52
Eicosadienoic	-	03.07
Docosanoic	00.53	-
Total saturated	88.37	65.87
Total unsaturated	11.63	34.13
Omega 6	04.33	03.26
Omega 3	00.26	00.44

Table 3 displays the fatty acid composition of gravy combined with the palm bunch ash. Palmitic acid had the highest concentration both for Ash 1 (47.81) and Ash 2 (46.99). the concentration of stearic acid and linoleic acid was higher in Ash 1 (35.48, 4.33) when compared with Ash 2 (11.77, 0.19). whereas the concentration of oleic and linolenic acid was higher in Ash 2 (28.24, 0.44) in comparison to Ash 1 (2.34, 0.26). The total unsaturated fatty acid was higher in Ash 2 (34.13) in comparison to Ash 1 (11.63).

DISCUSSION

The proximate, mineral and fatty acid composition of gravy prepared from palm bunch ash (Ngu) was studied. There was low moisture content in Ash 2 in comparison to Ash 1 and the gravy. There was evidence of fat and crude protein in Ash 1 and Ash 2. The ash content was in the order of Ash 2>Ash 1> gravy. For the minerals concentration, Ash 1 had higher potassium, zinc, magnesium, and phosphorus concentration when compared with Ash 2. While the calcium concentration was higher in Ash 2. The findings of the fatty acid composition revealed palmitic acid with the highest value for both Ash 1 and Ash 2. The total saturated fatty acids were higher in Ash 1 combined with the gravy while the total unsaturated fatty acids were higher in Ash 2 when combined with the gravy.

Palm bunch ash contains varying levels of essential minerals, with Zinc (Zn) ranging from 0.8-19.0 mg/100 g, Potassium (K) at 3510 mg/100 g, Chromium (Cr) levels unspecified, Magnesium (Mg) between 26 and 270 mg/100 g, Calcium (Ca) ranging from 300-1200 mg/100 g, and Phosphorus (P) not provided. These values are relevant in the context of daily intake recommendations, such as the WHO guidelines for Zn[8,9].

The ash content of a sample reveals the amount of inorganic residue left after drying at 500°C[10]. The result demonstrates the presence of high ash content in palm bunch ash, supporting the findings of Arfiana *et al.*[11], and Ojo *et al.*[12], as well as the findings of Petterson and Nordfjell[13] on the lack of crude protein and fat. The lack of fat and protein is because the ash content remains after heating has removed the protein and fat.

The term minerals' refers to food components that are essential to an organism's development and overall functioning. Minerals such as magnesium is required for the development of nerves and muscles, whereas potassium is a crucial component of bodily fluids and the motility of cells. Calcium supports the growth of bones and teeth, the contraction and relaxation of muscles, and the health of the heart. In addition to helping the body carry fat as phospholipids support a healthy acid/base balance, phosphorus controls the release and utilization of bodily energy[14]. According to Weyh *et al.*[15], Zinc plays a role as an antioxidant and influences the structure of multi-protein complexes, such as the T-cell receptor, as well as the stability of biological membranes.

The concentration of calcium was higher than WHO[8,9] standards for Ash 2. While the concentration of potassium was higher than WHO[8,9] standards for both Ash 1 and Ash 2.

Palm bunch ash which could be gotten from palm oil plant had palmitic acid with the highest value. According to Mancini *et al.*[16], the main constituent of palm oil is palmitic acid which is a saturated fatty acid. Saturated fatty acids are a component of cellular membranes and are utilized in the metabolism of energy and hormone synthesis. Also, they have been connected to a higher risk of developing cardiovascular disease and other chronic illnesses. The study supports the findings of Nainggolan and Sinaga[17], who found that palm oil has a relatively high saturated fat content in comparison to other liquid oils. Omega 6 and Omega 3 fatty acids are essential for healthy brain development and growth. Omega 6 is a kind of polyunsaturated fatty acid that supports the maintenance of the reproductive system and the stimulation of skin and hair growth. Compared to Ash 2, Ash 1 had a composition that was higher in Omega 6 and lower in Omega 3. This is consistent with the research by Thoumi[18], who previously revealed that palm oil contains the two most significant essential fatty acids, linoleic and linolenic acid.

The study presented that high ash content in palm bunch ash was rich in some minerals: Potassium, Calcium, and Zinc. This, therefore, implies its use in agriculture or as an animal feed supplement and its potential as a soil fertility enhancer. One limitation of this study, is the absence of crude protein and fat in the ash, making it less nutritious. Another limitation is the presence of high saturated fatty acids in the gravy combined with Ash 1, as high saturated fatty acids is correlated with cardiovascular disease. It is therefore recommended, that studies on the impact of palm bunch ash on longer durations to be conducted to ascertain any health risks that may result. Furthermore, more research is needed to be done on the bioavailability of minerals in palm bunch ash and possible health toxicity during high concentrations.

CONCLUSION

The present study investigated the proximate, mineral, and fatty acid composition of palm bunch ash and the gravy prepared from it. The proximate composition showed that the ash content was relatively high, protein and fat were not detected in the ash. Potassium, calcium, and magnesium were present in considerable amounts. The fatty acid composition showed palmitic acid has been the major component in both the Ash 1 and Ash 2 mixed with the gravy. These findings suggest that the palm bunch ash might contain some minerals that could be of nutritional value.

SIGNIFICANCE STATEMENT

This study investigated the proximate and fatty acid composition of gravy prepared from palm bunch ash (Ngu) and observed high concentrations of potassium and calcium. There were variations in mineral and fatty compositions of Ash 1, Ash 2, and the gravy prepared mixed with each ash. These findings would enhance the consideration of palm punch for use as fertilizers or in animal feed as additives. The high potassium and calcium concentrations which were more than the WHO standard might be beneficial and harmful depending on the intended usage.

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