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Groundnut Paste and Nutrient Quality Stability Using Local Seeds

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Research on the effects of treatment of groundnut paste with the powdered seed samples of three common edible plants was conducted in the Plant Science and Biotechnology Laboratory, Rivers State University, Port Harcourt, Nigeria. The plant seed materials used were the Uziza seed (*Piper guineense*), Ewhuru seed (*Monodora myristica*) and Alligator pepper (*Afromomum melegueta*). The seed samples were aseptically treated and sundried for three days and crushed into powder. Groundnut paste was also prepared aseptically from fried and ground groundnuts. Ten (10) grams of the groundnut paste was weighed and varying concentrations of the powdered seed added to the pastes and labeled accordingly. The treated groundnut paste samples were allowed to store in the laboratory and their proximate and mineral compositions tested for a period of three months on a monthly basis to determine the effects of the applied powdered seeds. It was observed that moisture contents of the groundnut paste treated with the various seed powder reduced irrespective of the concentrations used. Uziza seed powder increased the ash content, lipid and protein content of the groundnut paste. Carbohydrate and the lipid values of samples treated with uziza seed reduced. Powdered Ewhuru seed increased the carbohydrate, lipid and protein and also increased the ash and fibre values at 2g and 4g concentrations. However, ash and fibre contents reduced at 6g, 8g and 10g. Alligator pepper powder increased Carbohydrate, lipid, and protein contents of groundnut pastes but reduced moisture, fibre and ash. The reduction of moisture by all the seed samples is commendable as too much moisture leads to faster deterioration of agricultural products. However,

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the general increase in the protein contents of the groundnut paste is a good attribute in terms of value addition to the product. In general, the addition of dried and powdered leafy vegetables to groundnut paste will enhance the quality of this cherished local delicacy. The fungal isolates which were responsible for spoilage were *A. niger, A. flavus, Fusarium, Penicillium* and *Candida* sp. These fungal isolates are of great public health importance as they could cause spoilage to the food and harm to consumers.

Keywords: Groundnut paste; uziza seed; ewhuru seed; alligator pepper; proximate composition.

1. INTRODUCTION

Groundnut (*Arachis hypogea L*) is a legume and occupies a relevant position in the monetary value of different countries mainly in developing nations of the world. It is believed to have originated from South Africa and have been domesticated in different part of the world. The major *Arachis hypogeaL* manufacturing countries include India, China and USA. *Arachis hypogea L* was introduced into Nigeria in the 16th century and has been estimated to have been planted on up to 1.4 million hectares of land [1]. The manufacturing of *Arachis hypogea L* has been hampered flossing its spoilage by fungi mainly *Aspergillus flavus* which secretes *aflatoxin* and application cancer in man. It has also been said that that the incidence of *Aspergillus flavus* is enhanced through broken shells at harvest, and kernel splitting at making. Faster scholars have said that the identification of this fungus in Tokyo, 1986 – 1990. Pound nut is consumed in Nigeria in a different means as boiled, fried, dried and usually consumed in mixing with other goods like maize, tapioca, egg in garden and cucumber. It can be processed into other forms as meals applied at traditional ceremonies like marriages, chieftaincy coronation, etc. Part of goods of *Arachis hypogea L* is kulikuli *(Arachis hypogea L* cake) a traditional recipe prepared after extracting oil from groundnut, fried and consumed as snacks [2]. It is filled with in protein and applied in feeding livestock and man. *Arachis hypogea L* is a filled with planted product that is raised in energy due to its raised fat and protein contents [3]. The carbohydrate material is relatively less being under 30% of the whole materials of fiber. It is acompanies crops whose major utilization is the means of oil for making soup, stew, sauces, confectionaries, pudding and bakery products. Another local product from *Arachis hypogea L* is "yaji" *Arachis hypogea L* flour that has been mixed with pound ginger, dried cereals, native pepper and added salt to taste. Dankwa is another local product from *Arachis hypogea L* which has been added pound native pepper, dried cereal, sugar, salt and made to balls. These condiments are seen among the Hausas. However, in the east and the southern Nigeria the most popular is the *Arachis hypogea L* paste called okwuse. Pound nut paste within called Okwuse is a cherished delicacy in the Niger Delta and among the Igbos. It is usually prepared by frying healthy *Arachis hypogea L* seeds and grinding the seeds in sterilized blender. The pound *Arachis hypogea L* paste is usually spiced with different spices to give it the needed taste. The recipe could be consumed with egg in garden, cucumber and any other food of interest [4]. The *Arachis hypogea L* paste is prepared both in the market place and at home and sold in the market, along road sides under unhygienic condition. This product is sold as they last without any knowledge of the base existence and the associated deteriorating fungi [5]. This study was carried out to evaluate the nutritional quality of groundnut pastes preserved using local seeds and the spoilage fungi.

2. MATERIALS AND METHODS

2.1 Collection of Groundnut

Twenty kilograms of 3 varieties of freshly harvested and shelled groundnut was purchased from Rumuokoro market in Port Harcourt, and transported to School to Land Farm at Rumuodamaya for identification. The groundnut varieties identified were Samnut 21, Samnut 22 and Samnut 23. The groundnuts were transported to Ozuoba in Obio/Akpor Local Government Area, in Rivers State for further preparation.

2.2 Preparation of Groundnut Paste

The groundnut seeds were sorted and the bruised ones were removed from the unblemished ones. The seeds were wetted by sprinkling with water and small quantity of salt and mixed thoroughly and sundried for one hour. The dry seeds were then fried in a metallic frying pan using a low heated local oven powered by fire wood. Care was taken to ensure that the

seeds were well fried without allowing them to burn. Smooth frying was achieved by frying the groundnut seeds in garri. The fried seeds were allowed to cool before peeling. After peeling, the seeds were ground in manual blender and preserved for further studies [6].

2.2.1 Determination of proximate composition of groundnut paste and the plant materials

The various prepared samples were taking to Food Science Technology Laboratory in the Rivers State University for analysis. The method of analysis used was the AOAC [7].

2.2.2 Determination of ash

The crucibles were thoroughly washed, cleaned and placed in the oven for about 2 hours to dry and cooled to room temperature in the desiccators. Then 2g or the samples were accurately weighed into the crucibles labeled and placed in the furnace at 600^0C in triplicates, for 6 hours. At the end of the ash period when all the volatilizable materials had been burnt off, the sample were removed into the desiccators to cool to room temperature and reweighed.

Calculation

$$\% \text{ Ash} = \frac{\text{weight of ash}}{\text{weight of sample}} \times \frac{100}{1}$$

2.3 Determination of Carbohydrate (CHO)

Ten (10) ml of the sample extract was diluted in 100 ml distilled water. Then 1ml of the diluted filtrate was pipette into a test tube. The blanks were also pipette using 1ml of water. Further pipette was done with the standards in duplicate using 1ml diluted glucose. To all the tubes 5ml of freshly prepared anthrone reagent was added rapidly and the tubes stopper while mixing the contents thoroughly. This was then placed in a boiling water bath for exactly 12 minutes. At the end they were cooled to room temperature and the solutions transferred to 1cm glass cuvettes to read the absorbance at 630nm against the blanks.

Calculations

Total available carbohydrate (as % glucose)

$$\frac{(25 \times B)}{(A \times w)}$$

Result: Weight of sample = 1g = w

2.3.1 Determination of crude protein in groundnut paste

The crude protein was determined using the Micro Kjeldhal, [7]. In this method, 5ml of the sample was pipette into a micro kjeldhal flask for distillation. Fifteen millilitres (15ml) of 45% potassium hydroxide were added while the ammonia liberated was distilled into 10ml boric acid contained in the conical flask until 50ml of the distillate was obtained and was then titrated with 0.0529N sulphuric acid. The blank was also prepared in the same way.

$$\text{Calculations } \% \text{ N} = \frac{(\text{titre value-Blank}) \times \text{N (acid)} \times 1.4}{\text{Weight of sample}}$$

$$\% \text{ Crude protein} = \text{N } (\%) \times 6.25$$

2.3.2 Determination of lipid in groundnut paste

During this experiment, no weighing was carried out as the groundnut pastes sample was further analyzed. The groundnut paste was first of all mixed. The flat bottom flasks as well as the Soxhlet apparatus were thoroughly cleaned and kept in good working order. The sample was placed in the extraction thimble. 5ml (fifteen) of petroleum spirit was poured into the flask and fitted to the extraction unit, water was turned on in the tap to cool the condenser. The extraction commenced at maximum temperature of about 60^0C corresponding to the boiling point of the spirit for 6 hours, in the oven while the flasks were allowed to remain on the heater for a short period to dry off the residual petroleum spirit leaving fats and oils which were finally recovered and stored.

2.3.3 Determination of crude Fibre in groundnut paste

The sample was weighed accurately (0.2g) into the crucible whose weight had been determined and extracted with petroleum spirit. The samples were left standing for some time to evaporate the spirit before being treated with acid. The pre-extracted samples were placed in beakers containing 1.25% sulphuric acid and boiled with the acid for 30 minutes. The acid was then removed by suction fibre-tec and washed several times with distilled water. After extracting with acid, the sample were placed in beakers containing 1.25% sodium hydroxide and boiled for about 30 minutes. They were further washed with boiling water and extracted by suction each

time. The contents were washed and dried in the oven at 105^0C until a constant weight was obtained. After this, the crucibles were cooled down by placing them in the desiccators and weighed again. With the weight noted they were placed in the muffled furnace at about 600^0C and ignited to get rid of all the organic matter. The loss in weight during incineration represented the weight of crude fibre in the sample from which the percentage present in the sample was calculated thus:

Calculation

$$\% \text{ Crude fibre} = \frac{\text{Loss in weight}}{\text{Weight of sample}}$$

2.3.4 Determination of moisture content and percentage dry

The metal dishes were properly washed and dried in the oven for about I hour and then cooled in the desiccators. They were then weighed while empty and with 5gm of each sample and the weight recorded. They were then transferred into the oven and dried for about 12 hours in triplicate. After this period of drying, the dishes and contents were cooled in the desiccators and reweighed again. The drying was done until a constant weight was obtained.

Calculations

$$\text{Moisture (\%)} = \frac{\text{Loss in weight on drying x 100}}{\text{Initial weight of sample}}$$

$$\text{Dry matter (\%)} = \frac{\text{Oven dry weight (g) x 100}}{\text{Initial weight of sample}}$$

2.3.5 Collection and preparation of plant materials

Six plant materials were purchased from Rumuokoro markets comprising three different seeds samples viz: Uziza seed, Ewhuru seed and Alligator pepper. The seed samples were washed and sun dried for five days. The leaf samples were crushed into powder by blending in a manual blender and each of the samples stored in a clean plastic container and labeled accordingly for further studies.

2.3.6 Isolation of spoilage fungi from groundnut paste

A ten-fold dilution was used where 1g of the samples was weighed and transferred into the first (original) test tube containing 9ml of sterile normal saline and agitated. The 1ml from the first dilution was transferred into the second test tube and 1ml from the second dilution was transferred into the third test tube. Different sterile pipette was used to conduct this process. An aliquot from the first and the third dilution was inoculated onto separate petri dishes containing SDA. This was immediately incubated for 7 days at 25^OC [8].

2.3.7 Characterization and identification of fungal isolates

The fungal isolates were characterized and identified using the macroscopic and microscopic examination according to Barnett and Hunter (1998). In the macroscopic examination, the colony colour was observed and noted while in the microscopic, cotton blue in lacto phenol was stained at the center of a sterile glass slide and a small portion of the fungus was placed on the slide using a sterile inoculating needle. This was examined under the microscope at a lower power (x10) and a higher power (x40) (Olds, 1983).

3. RESULTS AND DISCUSSION

Table 1 showed the effects of treatment of groundnut paste with powdered uziza seed. The results indicated that moisture values ranged from 10.478±0.2 to 18.50±0.0, with control having the highest value while 2g recorded the least value. Ash content ranged from 6.50±0.00 to 10.53±1.6 with the least value recorded in the control samples least and highest values for control while 10g of the treated samples had the highest value. Meanwhile, fiber values ranged from 1.66±0.66 to 6.20±0.0 with the control having the highest value and 4g indicated the least ash values. Carbohydrate ranged from 0.00±0.0 to 13.30±6.18 with the control having the lowest value while 6g recorded the highest. The protein concentrations observed varied from 15.60±0.00 to 26.89±11.36 with the control and 10g being the least and highest recorded respectively. In addition to the above results, lipid values ranged from 20.50±0.00 to 30.4±16.54 with control having the least value and 2g recorded the highest values. This results of the effects of treatment of groundnut paste with different concentrations of powdered seeds of uziza *(Piper guinensis*) as revealed from the research indicated a significant reduction in moisture content, while all other parameters such as ash, fiber, carbohydrate, protein and lipid significantly increased at ($p<0.05$).

Table 1. Effects of treatment of uziza seed on the proximate composition of ground nut paste

Treatment with Uziza seed	Proximate composition (%)					
	Moisture	Ash	Fibre	CHO	Protein	Lipid
Control	18.50±0.0[b]	6.50±0.0[b]	6.20±0.00[b]	0.00±0.00[a]	15.60±0.00[a]	20.50±0.00[a]
2g	10.478±0.92[a]	7.42±0.5[a]	1.86±0.52[a]	13.54±6.06[b]	26.567±12.91[a]	30.49±16.54[a]
4g	10.678±1.12[a]	7.38±0.62[a]	1.66±0.66[a]	13.30±6.18[b]	26.39±12.92[a]	30.16±16.29[a]
6g	11.49±1.04[a]	7.98±0.50[a]	2.70±0.61[a]	14.40±6.01[b]	26.63±11.76[a]	30.10±15.25[a]
8g	11.57±1.17[a]	10.38±1.68[a]	2.71±0.52[a]	14.40±5.90[b]	26.73±11.58[a]	29.88±15.14[a]
10g	11.67±1.14[a]	10.53±1.6[a]	2.367±0.76[a]	14.63±5.60[b]	26.89±11.36[a]	29.00±14.53[a]

Key: CHO=carbohydrate

Table 2. Effects of treatment with Ewhuru on the proximate composition of groundnut paste

Ewhuru seed	Moisture	Ash	Fibre	CHO	Protein	Lipid
Control	2.60±0.00 [a]	8.13±0.00 [c]	15.60±0.00 [c]	44.40±0.00 [b]	14.80±0.00 [a]	25.70±0.00 [b]
2g	6.76±1.14 [b]	4.01±0.27 [b]	9.29±0.43 [ab]	26.08±7.29 [a]	34.30±2.02 [b]	11.70±0.92 [a]
4g	6.56±1.67 [b]	3.62±0.37 [b]	8.81±0.51 [a]	26.05±7.81 [a]	34.16±2.37 [b]	11.37±1.05 [a]
6g	5.95±1.49 [b]	2.63±0.50 [a]	7.91±0.63 [a]	21.66±1.37 [a]	33.43±1.79 [b]	10.34±1.08 [a]
8g	6.13±1.42 [b]	2.68±0.48 [a]	7.89±0.66 [a]	21.68±1.69 [a]	33.08±2.49 [b]	10.43±0.95 [a]
10g	5.99±1.88 [b]	2.79±0.59 [c]	7.57±1.23 [a]	21.35±2.20 [a]	33.31±2.57 [b]	10.73±0.90 [a]

Key: CHO=carbohydrate

Table 3. Effects of treatment with Alligator pepper on the proximate composition of groundnut paste

Alligator pepper	Moisture	Ash	Fibre	CHO	Protein	Lipid
Control	8.50±0.00[b]	9.50±0.00 [c]	14.80±0.00 [b]	39.50±0.00 [b]	18.45±0.00 [a]	9.25±0.00 [a]
2g	5.87±0.64 [a]	2.98±0.59 [b]	7.28±0.71 [a]	21.37±0.74 [a]	52.16±5.85 [b]	10.82±0.62 [ab]
4g	5.80±0.61 [a]	2.89±0.56 [b]	7.12±0.74 [a]	21.25±0.75 [a]	49.72±5.03 [b]	10.76±0.54 [ab]
6g	5.21±0.84 [a]	1.84±0.51 [a]	6.48±0.54 [a]	20.67±0.55 [a]	48.40±6.08 [b]	9.83±0.64 [ab]
8g	5.27±0.76 [a]	1.83±0.51 [a]	6.60±0.64 [a]	20.77±0.55 [a]	48.09±5.37 [b]	8.67±2.09 [b]
10g	5.30±0.72 [a]	1.76±0.69 [a]	6.42±1.02 [a]	20.54±0.93 [a]	48.36±5.60 [b]	11.98±1.95 [a]

Key: CHO=carbohydrate

The result as recorded in this research is in line with the reports of early researchers on the reduction of moisture in some home recipes such as cake upon the addition of some vegetables, fruits and nuts [9]. Generally speaking, the addition of vegetables, nuts and fruits in soups have often resulted in increased thickening of the soup an indication of moisture reduction. In the traditional system, certain plant leaves are used as herbal remedies for the stoppage of diarrhea in children. These leaves include the scent leaf and bitter leaf because of certain photochemical found in them [10].

Tables 2 showed the presence of moisture ranging from (2.60±0.00 to 5.99±1.88) with 10g being the highest and control the least of the treated samples. It also showed a range of (2.63±0.50 to 18.13±0.00) ash concentration, the least and highest values at 6g and control of the treated samples respectively. Meanwhile, (7.57±1.23 to 15.60±0.0) was the range of values recorded for fiber indicating control and 10g as the highest and least respectively. This was followed by (21.35±2.20 to 44.40±0.00) concentrations range of carbohydrate for which 10g and control were the least and highest respectively. The protein concentrations observed were (14.80±0.00 to 34.30±2.02). Control and 2g being the least and highest recorded respectively. In addition to the above results, a range of (10.34±1.08 to 25.70±0.00) values for lipid was observed with 6g and control obtaining the least and the highest respectively. This result of the effects of the treatment of groundnut pastes with varying concentrations of ground Ewhuru seed samples recorded a reduction in carbohydrate, ash, lipid and fiber. Although, moisture and protein recorded values that were significantly higher than the control ($p<0.005$).

Table 3 showed the presence of moisture, with the highest value at the control level (8.50±0.00) and least at the 6g concentration (5.21±0.84). Also, highest value for ash was seen in the control (9.50±0.00) while its least value (1.76±0.69) was seen in the 10g. Meanwhile, fiber recorded (14.80±00.0) for control as the highest value and (6.42±1.02) concentration at the 10g as the least. Carbohydrate revealed (39.50±0.00) for moisture as the highest and (20.54±1.02) for 10g as the least value. The highest value of protein was seen in the 2g which recorded (52.16±5.85) concentration while (18.45±0.00) which was the least was obtained for the control. In addition to the above result, lipid was seen to have (11.98±1.95) concentration at the 10g as the highest and (8.67±2.09) concentration as the least at the 8g concentration. This result of the effects of the treatment of groundnut pastes with varying concentrations of ground alligator pepper samples recorded a reduction in moisture, ash, fibre and carbohydrate. Protein value also increased significantly. However, lipid value for the control was the same in treatments with 10g and significantly similar at 2, 4 and 6g. Samples treated with 8g was significantly lower than the control($p<0.005$). The fungal isolates identified were *Aspergillus niger, A. flavus, Fusarium* sp, *Penicillium* sp and *Candida* sp. These fungal isolates could cause spoilage as well as harm especially if the pastes which were contaminated with fungi are consumed. Foodborne fungi, such as yeasts and moulds, has been reported in a previous study to cause major food deterioration, resulting in significant economic losses. Molds may also generate mycotoxins, which have been linked to a variety of acute and chronic human illnesses [11].

4. CONCLUSION

The result from this work revealed that the addition of the various seed powders to groundnut paste reduced moisture an indication that they could prolong the shelf life of ground nut paste. Other nutrient elements and minerals were also affected. In general, the use of powdered uziza seed greatly improved the proximate parameters assessed on ground nut paste. However, the mineral composition of the ground nut paste was generally increased by the addition of powdered samples of Ewhuru seed at various concentrations. The fungal isolates identified as spoilage organism are capable of producing mycotoxins which could be of great public health importance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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