International Journal of Home Economics, Hospitality and Allied Research, 3(2): 42-62.
DOI: https://doi.org/10.57012/ijhhr.v3n2.004
Received: June 15, 2024
Revised: July 1, 2024
Accepted: July 1, 2024
Published: 14 December, 2024

Original Research Report

Nutrient Composition of Stiff Porridge made from Carrots and Eggplant Flour and its Nutritional Benefit to Elderly

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Abstract: This study assessed the nutritional composition of stiff porridge made from carrots and eggplant flour and its nutritional benefit to elderly. The result revealed that significant differences existed in the proximate, mineral, vitamin and sensory attributes of the samples with moisture content of the stiff porridge ranging from 33.78 to 35.00%. Sample A (Stiff porridge from 100% eggplant) had the highest moisture content (38.00%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest moisture. Sample A (Stiff porridge from 100% eggplant) had the highest the calcium content (50.00%), Sample A (Stiff porridge from 100% eggplant) had the highest potassium (129.14 mg/100g) while sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest value of potassium (98.15 mg/100g). However, Sample C (Stiff porridge from 50% eggplant and 50% carrot) had the highest mean score for general acceptability (7.20) whereas sample A (Stiff porridge from 100% eggplant) had the least mean score (6.00). This study concluded that the potentials of eggplant and carrot as useful alternatives in the production of stiff porridge for healthy family feeding in Umuahia North Local Government Area in Abia State. Based on this study, the following recommendations are made: Utilization of 100% eggplant in stiff porridge production is recommended especially to individuals that are mineral deficient since it had increased mineral content, in addition to proximate composition. The stiff porridges should not be kept for quite long before consumption since it possesses high moisture. Sensitization of the general populace on the potentials of eggplant and carrot blends in the production of stiff porridge will contribute to enhancing their utilization and health benefits especially to the elderly

Keywords: Carrots, Eggplant, Elderly, Nutrients, Stiff porridge

1. Introduction

Eating good food can define our life in the wake of various illness and various health problems such as cancer, diabetes, etc. It is important for people to carefully watch what they eat and the rate at which such foods are consumed (Becky, 2017). Excessive consumption of certain types of foods can cause health risks. Diets that are carbohydrate dense could adversely affect glucose metabolism in the body, increasing the risk of diabetes, obesity and other diseases in the body. Stiff porridge, also known as "swallow," is a popular type of food in Nigeria and other parts of West Africa. It is made from starchy ingredients such as cassava, yam, plantain, or maize, which are cooked into a thick, dough-like consistency. The resulting porridge is then formed into balls or lumps, which are eaten with various soups, stews, or sauces. Stiff porridge is an important source of calories for millions of people in sub-Saharan Africa. It is also recommended as a functional food for the management of certain non-communicable diseases such as type II diabetes (Eli-Cophieet al., 2016; Mlothaet al., 2016).

According to the Population Division of the United Nations Department of Economic and Social Affairs (United Nations Department of Economic and Social Affairs: Population Division (UNDESA, 2015), the proportion of older persons aged 60 years and above make up 12.3% of the global population, and by 2050 that proportion will rise to almost 22%. Sub-Saharan Africa, which has the smallest proportion of elderly and which is ageing slower than the developed regions, is projected to see the absolute size of its older population grows by 2.3 times between 2000 and 2030 (UNDESA, 2015). People are living longer because of better nutrition, sanitation, health care, education, and economic well-being. The health, comfort and prosperity issue of the elderly in society is widespread every day (Marzieh Rohani, et al., 2018). One of the most important factors affecting the health of the elderly is their nutritional status.

Eggplant and Carrots are usually known for its perishability and seasonality (January to May for Carrots) and (January to early November for Eggplant). The reason the researcher embarked on this study was because the researcher observed that Eggplant and Carrots are only used in salads and preparations of curries. To increase their utilization and value, the researcher decided to use eggplant and carrots in the production of stiff porridge because of its ability to provide energy and satiety and nutritional compositions and to prolong their shelf life by turning them into flour and ensure its acceptability for all year-round consumption. One of the most challenging aspects of providing adequate nutrition for the elderly is the determination of their nutritional status. This problem arises from the fact that aging affects many of the anthropometric, biochemical, hematologic parameters used for assessing nutritional status of the younger generation. Secondly, individuals age at different rates. This makes the elderly a heterogeneous group, yet it is very essential that the nutritional status of the individual be assessed for necessary dietary intervention and this is what this research is all about.

1.1. Statement of Problem

Eggplant and Carrots are usually known for its perishability and seasonality (January to May for Carrots) and (January to early November for Eggplant). The reason the researcher embarked on this study was because the researcher observed that Eggplant and Carrots are only used in salads and preparations of curries. To increase their utilization and value, the researcher decided to use eggplant and carrots in the production of stiff porridge because of its ability to provide energy and satiety and nutritional compositions and to prolong their shelf life by turning them into flour and ensure its acceptability for all year-round consumption. One of the most challenging aspects of providing adequate nutrition for the elderly is the determination of their nutritional status. This problem arises from the fact that aging affects many of the anthropometric, biochemical, haemato logic parameters used for assessing nutritional status of the younger generation. Secondly, individuals age at different rates. This makes the elderly a heterogeneous group, yet it is very essential that the nutritional status of the individual be assessed for necessary dietary intervention and this is what this research is all about.

1.2. Purpose of the Study

The general purpose of the study is to assess the nutritional composition of stiff porridge made from carrots and eggplant flour and its nutritional benefit to elderly people specifically to:

a) Determine the proximate composition of the stiff porridge and its nutritional benefit to elderly
b) Examine the organoleptic properties of the stiff porridge
c) Determine the level of acceptability of the product.
d) Determine the cost implication of the produced stiff porridge.

1.3. Research Questions

The following research Questions guided the researcher

a) What is the nutritional composition of stiff porridge made from eggplant and carrots?
b) What are the organoleptic properties of stiff porridge produced from eggplant and carrots?
c) What are comparative analysis between organoleptic properties of stiff porridge produced from eggplant and carrots?
d) What is the acceptability of the product

2. Materials and Methods

2.1. *Design for the Study:* The study adopted a mixed method research design, namely, research and development (R&D), Experimental and descriptive survey research design. R & D was used to develop the composite flour and the stiff porridge samples; laboratory experimental test was used to assess the Nutrient composition, while survey design was used to assess the organoleptic attributes

2.1.1. Ethics Statement

The study ethical approval was received by the authors from the College of Applied Food Sciences and Tourism, Michael Okpara University of Agriculture Umudike. Informed consent was gotten in writing from the participants.

2.2. Area of the Study

The study was carried out in Food and Diet Therapy Laboratory of Home Economics Department at Michael Okpara University of Agriculture Umudike (MOUAU), Abia State Nigeria. Ikwuano Local Government Area of Abia State, Nigeria.

2.3. Population and Sample

The population for the study was 50 elderly 23 non academics and 17 academics who were staff in College of Applied Food Sciences and Tourism, Michael Okpara University of Agriculture Umudike. Sample size for the panelists were 20 respondents of 11 non academics and 9 academic staff. Purposive sampling techniques was employed to select the 20 panelists for the sensory evaluation from the from the population. These were those who were available at the time of the evaluation.

2.4. Instrument for Data Collection and Study Procedure

This involves the procedures that the researcher used in processing the raw materials into stiff porridge. The eggplant and carrots were used to prepare the stiff porridge according to the usual method the Nigerian stiff porridge (swallow) is prepared, by pouring 500 ml of water into a stainless-steel pot. The water was allowed to boil at 100°C. Two hundred and fifty (200) g of each composite flour was added to the boiling water while stirring vigorously and continuously with a wooden paddle until it forms a gelatinized (Stiff porridge) paste. The paste was covered and left on the fire for about 5 minutes to cook. It was further stirred, packed and wrapped with thin labeled polythene wraps.

Production of Carrot flour

The carrots were carefully selected, the green head parts were cut off before the carrots was washed in water. Thereafter, they were cut in coin shapes before they were spread on the tray and dried under the sun for 3 days. Thereafter, they were transferred to the oven at 50ºC for 1 hour to remove the available moistures and milled using attrition mill to obtain carrot flour which was sieved using 2 mm mesh size. The flour was packaged in a polyethylene for further use.

Production of Eggplant flour

The eggplant was washed thoroughly under running tap water to remove soils and foreign particles. They were cut into slices without peeling off the skin by using manual slicer, so that they are in uniform thickness and size. The eggplant was dried at two temperatures, which is 40 and 50°C in hot air oven for 72 h. The dried eggplants were grinded into powder form by using heavy duty blender and sieve through 250 sieves on a shaker. All grounded samples were packed into plastic bag. They were sealed properly and wrapped with aluminum foil to protect the samples from light. Then, they were stored in a freezer at -20°C.

Formulation of eggplant and carrot flours

The eggplant and carrot flours were formulated into three different proportions as shown in Table 1. Amala will serve as the control.

Table 1: Flour blends formulation (%)

Eggplant flour	Carrot flour
100	0
0	100
50	50

Processing of Raw Materials

This involves the procedures that the researcher used in processing the raw materials into stiff porridge. The eggplant and carrots were used to prepare the stiff porridge according to the usual method the Nigerian stiff porridge (swallow) is prepared, by pouring 500 ml of water into a stainless-steel pot. The water was allowed to boil at 100°C. Two hundred and fifty (200) g of each composite flour was added to the boiling water while stirring vigorously and continuously with a wooden paddle until it forms a gelatinized (Stiff porridge) paste. The paste was covered and left on the fire for about 5 minutes to cook. It was further stirred, packed and wrapped with

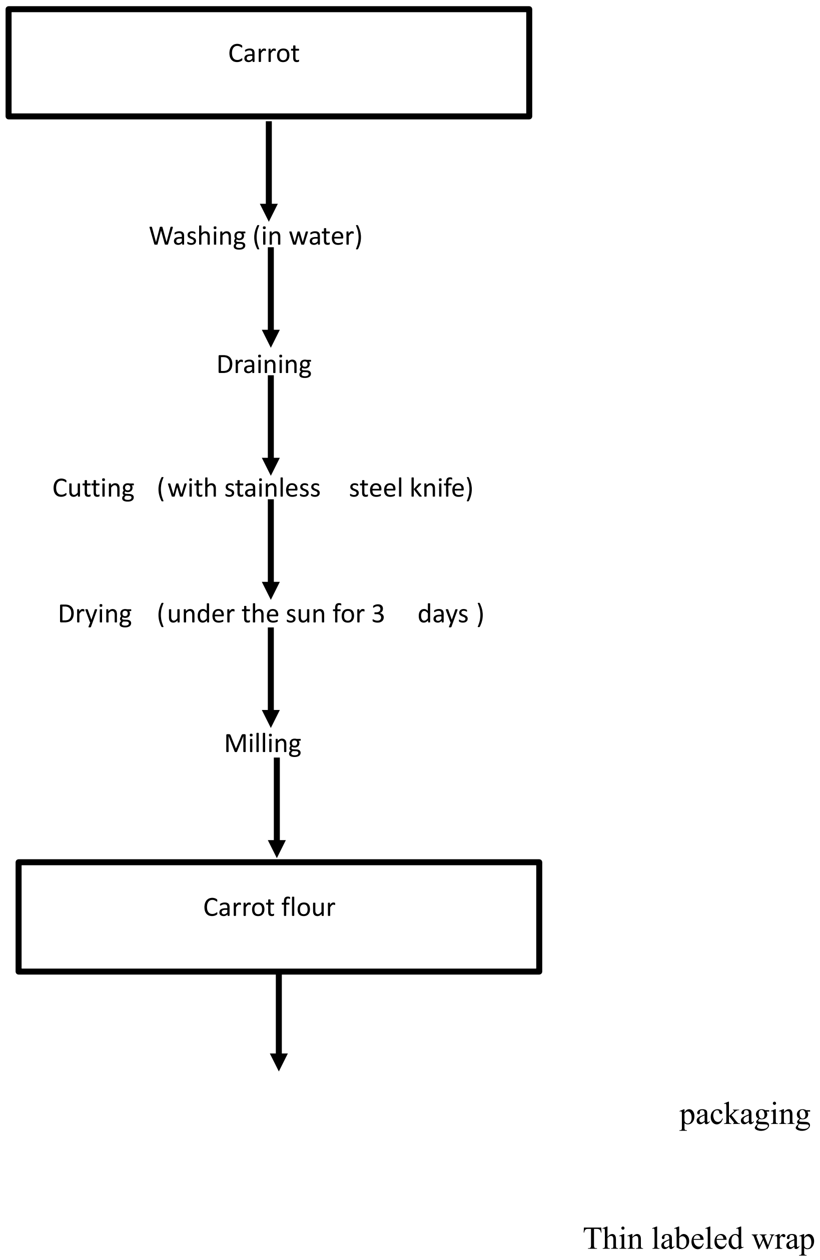
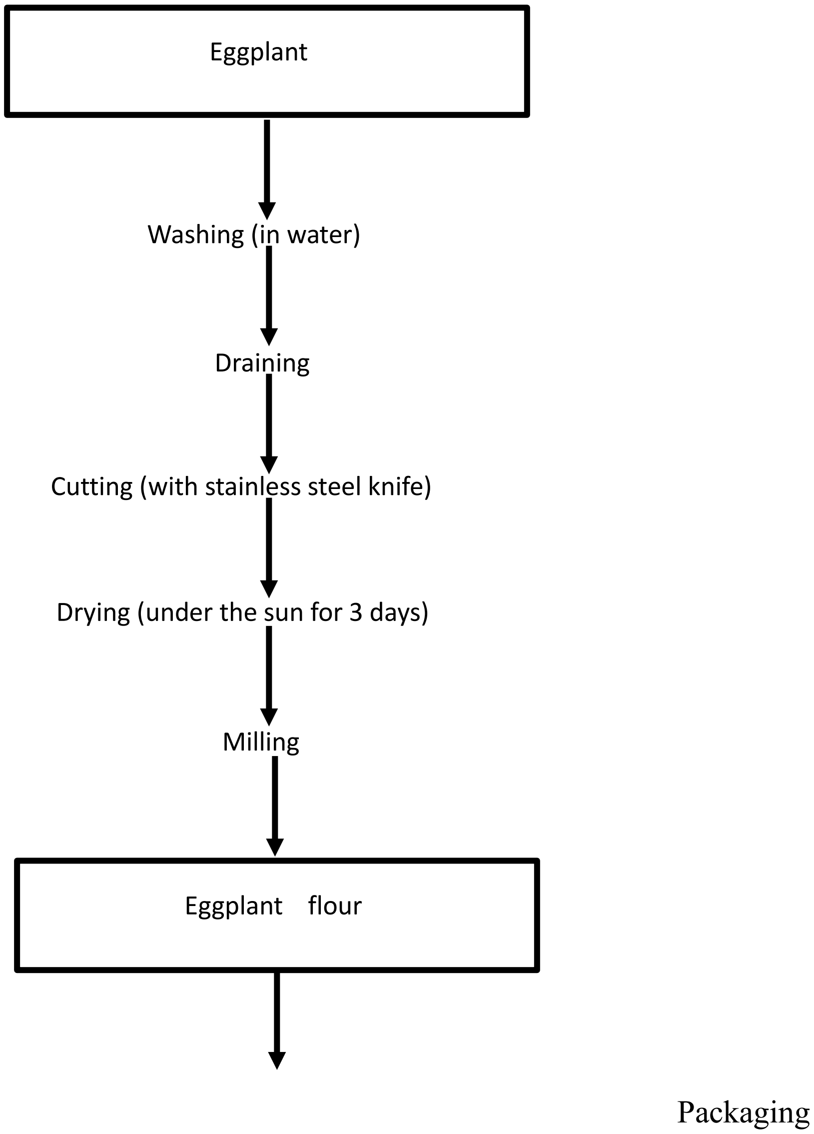


Figure 1:1flow chart on flour production



PROXIMATE COMPOSITION

Moisture Content Determination

The moisture content was determined using the gravimetric method (AOAC, 1990). Three moisture cans were dried in the oven and the put into desiccators to cool them off before weighing. A measured weight of each sample (5g) was weighed into the moisture can before placing them in the oven. The can and its content were dried at 105ºC for 3hours. It was cooled in desiccators and reweighed. The weight was recorded. The cycle of heating, cooling and weighing was repeated until constant weight was obtained. The moisture content was determined by weight difference and expressed as percentage of sample weighed. It is given as:

$$\%Moisture = \frac{W_2 - W_3}{W_2 - W_1} X \frac{100}{1}$$

Where,

W_1 = Weight of empty moisture can

W_2 = Weight of can and sample before drying

W_3 = Weight of can and sample after drying

Ash Content Determination

The ash content was determined using the furnace incineration gravimetric method recommended by AOAC (1990). The crucibles were dried in the oven and cooled in the desiccators before weighing. Exactly 5g of each sample was weighed and put into the crucibles.

It was covered and placed in a muffle furnace set at a temperature of 550ºC and allowed to burn for about 2-3 hours (until the sample becomes a grey ash). The crucibles were carefully removed from the muffle furnace and cooled in a desiccator. The crucibles containing the samples were weighed and percentage ash content were determined using the formula below.

$$\%Ash = \frac{W_2 - W_3}{W_2 - W_2} \times \frac{100}{1}$$

Were,

W_1 = weight of the crucible

W_2 = weight of sample + crucible

W_3 = weight of crucible + ash

Crude Fiber Determination

The crude fiber was determined using the method described by James, (1995). Exactly 5g of each sample was defatted (during fat analysis). The defatted sample was treated with 200ml of 1.25% H_2SO_4 and boiled under reflux of 30minutes. The resultant mixture was filtered by hang with several portions of hot water using a two-fold muslin cloth to trap the particles. The were had samples were carefully transferred to a beaker and boiled for 30minutes with addition of 200ml of 1.25M NaOH solution. The digested samples will then wash severally with hot water. The had samples were carefully scraped and transferred into a wedge muslin porcelain crucible and dried in the oven at 150ºC for 3hours, cooled in a desiccator and weighed. The cooled samples were put in a muffle furnace and burnt at 550oC for 2hours (until they become ash). Again, the samples will cool in a desiccator and reweighed.

The crude fiber content was calculated gravimetrically as:

$$\%\text{Crude Fiber} = \frac{\text{Loss in weight incineration}}{\text{Weight of sample}} \times \frac{100}{1} = \frac{W_2 - W_3}{\text{Weight of sample}}$$

Were,

W_2 = Weight of crucible sample after washing and drying in oven

W_3 = Weight of crucible + sample ash

Crude Protein Determination

The Micro-kjedahl method as described by James (1995) was used to determine the protein content of the different flour samples. Digestion: One-half gram (0.5g) of each of the sample was mixed with 10ml of concentrated sulphuric acid in a kjedahl digestion flask. A table of selenium catalyst was added to it and the mixture was heated (digested) under a fume cupboard until a clear solution was obtained in a separate flask. The digests were carefully transferred into a 100ml volumetric flask and made up with distilled water. Exactly 100ml of each digest was mixed with equal volume of 45% sodium hydroxide (NaOH) solution and poured into a kjedahl distilling apparatus.

Distillation: The mixtures was distilled and the distillate collected into a 10ml 4% boric acid solution containing three (3) drops of mixed indicators (mixture of methyl red and Bromocresol green). A total of 50ml distillate was obtained and titrated against 0.02N Tetraoxosulphate VI acid (H2SO4) solution. Titration was done from the initial green color to a deep red or pink end point. The total nitrogen was calculated and the value obtained was multiplied with the factor 6.25 to obtain the crude protein content as follows:

%Crude Protein = %N × 6.25

$$\%N_2 = \left(\frac{100 \times N \times 14 \times V_F \times T}{W \times 1000 \times V_A} \right)$$

Were,

W = Weight of sample

N = Concentration of (H_2SO_4) titrant = 0.02N

V_F = Total volume of the digest = 100ml

V_A = Volume of the digest distilled

T = Titre volume

Fat Content Determination

The fat content of the flour sample was determined by continuous solvent extraction in a Soxhlet reflux apparatus by James (1995). Exactly 1g of each sample was weighed and wrapped in a porous paper. The wrapped sample was carefully placed inside Soxhlet reflux flask containing 200ml of petroleum ether. The upper end of the reflux flask was connected to a condenser. By heating the solvent in the flask through electro-thermal heater, it vaporizes and condensed into the reflux flask. Soon the wrapped samples were completely immersed in the solvent and remained in contact with bit until the flask is filled up and siphoned over thus carrying oil extract from the sample down to the boiling flask. This process was allowed on repeatedly for about 4hours before the defatted samples was removed. The solvent will recover and the extraction flask with its oil content was dried in the oven at 60ºC for 3 minutes (i.e. to remove any residue solvent). After cooling in a desiccator, the flask was reweighed. The fat content is given by:

$$\%\text{Fat Content} = = \frac{W_2 - W_1}{W_3} \times \frac{100}{1}$$

Were,
W_1 = Weight of empty flask
W_2 = Weight of flask oil + extract
W_3 = Weight of sample used

Carbohydrate Determination

The carbohydrate content of the flour samples was determined by estimation using the Arithmetic difference method described by AOAC (1990) and James (1995). The carbohydrate was calculated and expressed as the Nitrogen free extract (NFE) as shown below:

% CHO =% NFE =100 - % (a + b + c + d + e)
a = protein content
b = fat content
c = ash content
d = crude fiber content
e = moisture content

MINERAL ANALYSIS

Determination of magnesium

Magnesium content of the Different flour samples was determined by the complexometric titration method of Onwuka (2018). The Different flour sample (10 g) was mixed with 50 ml of distilled water. Twenty milliliters of the Different flour extract were dispersed into conical flask and treated with pinches of the masking agents (Hydroxylamine hydrochloride, Sodium cyanide and Sodium potassium ferrocyanide). The flask was shaken and the mixture dissolved. Twenty milliliters of ammonia buffer were added to it to raise the pH to 10.00. The mixture was then titrated against 0.02 N ethylenediaminetetraacetic acid (EDTA) solution using Eriochrome Black T as indicator. A reagent blank was also titrated and titration in each case was done from deep red to a permanent blue end point. Magnesium content of the Different flour samples was calculated separately using the following formula:

$$\text{Mg (mg/100g)} = \frac{100}{W} \times \frac{T-B\ (N \times Mg)Vf}{Va} \times \frac{}{1} \qquad \text{- (Eqn 10)}$$

Where W=Weight of sample
T = Titre value of sample
B = Titre value of blank
Mg =Magnesium equivalence
Va = Volume of extract titrated
Vf = Total volume of extract
N=Normality of titrant (0.02N EDTA).

Determination of sodium

Sodium was determined using the flame photometry method (Onwuka, 2018). Jaway digital flame photometry was setup according to the manufacture's instruction. It was switched on and allowed for about 10 minutes to equilibrate. Standard sodium solutions were prepared separately and diluted in series to contain 10, 8, 6, 4 and 2 g of sodium. After equilibrating the instrument, 1 ml of each standard was aspirated into it and sprayed over the non-luminous flame. The optional density of the result emission from each standard solution was recorded. Before filtering, sodium was put in place with standards measured, the test sample extracts were measured in time and their graphs were plotted into standard course which was used to extrapolate the content of sodium. Sodium content of the Different flour sample was calculated as shown below:

Sodium (mg/100g) = x/1000 × Vt/Va× D × 100/w

Where: X = concentration of the test element from the curve.

Determination of phosphorus

Phosphorus content of the Different flour samples was determined according to the method of Onwuka (2018) by using hydroquinone as a reducing agent. Five grams of the Different flour samples were mixed with 50 ml of distilled water. Five milliliters (5 ml) of the test solution were pipetted into 50 ml graduated flask. Then 10 ml of molybdate mixture was added and diluted to mark with water. It was then allowed to stand for 30 min for colour development. The absorbance was measured at 600 nm against a blank. A curve relating absorbance to mg phosphorus present was plotted. Using the phosphorus standard solution, and following the same procedure for the sample, a standard curve was plotted to determine the concentration of phosphorus in the sample, whereas the formula below was used to assess the phosphorus content of the Cuban oregano:

$$\% \text{ Phosphorus} = \frac{\text{graph reading x solution volume}}{100}$$

Determination of manganese

The method described by Achikanu *et al*. (2013) was in determination of manganese content of the Different flour samples. Five grams of the Different flour samples was pipetted into a test tube in duplicate and 0.25 ml of concentrated sulphuric acid (H_2SO_4) was added and boiled for 1 hour in a boiling water bath. A spatula tip full Sodium periodate was added and heated for another 10 minutes, cooled and the absorbance taken at 520 nm against the blanks.

Determination of zinc

Zinc was determined by the method of Onwuka (2018). One gram of the Different flour samples was first digested with 20 ml of acid mixture (650 ml concentrated HNO_3, 80 ml perchloric acid (PCA). Five milliliters of the digest were collected and diluted to 100 ml with H_2O. This now served as sample solution for Atomic Absorption Spectroscopy (AAS) reading. Also a standard solution of respective elements concentration of 0.0 to 1.0 was taken. The readings were used to plot a standard zinc curve for extrapolation and zinc was calculated as follows:

$$Zn = \frac{Vf}{Vs} \times \frac{1}{10} \times \frac{100}{W} \times Df \qquad \text{(Eqn 11)}$$

W= Weight of sample analysed

Vf = Volume of extract
Vs = Volume of extract used

Df = Dilution factor

VITAMIN ANALYSIS

Determination of vitamin B_1 (thiamin)

Five (5) grams of Different flour samples were homogenized with 50 ml of ethanol sodium hydroxide. It was filtered into 100 ml flask; 10 ml of the filtrate was pipetted, and color was developed by the addition of 10 ml potassium dichromate before reading at 430 nm wavelength in a spectrometer. A standard thiamin solution was prepared and diluted. Ten (10) ml of solution was analyzed. The readings were made with the reagent blank at Zero (Onwuka 2019). The formula below was used to calculate thiamin as shown below:

$$\text{Thiamin (mg/100g)} = \frac{100}{W} \times \frac{Au}{As} \times C \times \frac{Vf}{Va} \times D \qquad \text{(Eqn 13)}$$

Where: W = Weight of sample analyzed

Au = Absorbance of test sample

As = Absorbance of standard solution

V_f = Total volume of filtrate Va =
Volume of filtrate analyzed D =
Dilution factor where applicable.
C = Concentration of the standard.

Determination of vitamin B_2 (Riboflavin)

The method of Onwuka (2018) was used to determine the riboflavin content of the Cuban oreganoes. Five (5) grams of each Different flour sample were extracted with 100 ml of 50 % ethanol solution, shaken for 1h and were filtered. Ten milliliters potion was treated with equal volume of 5 % potassium permanganate ($KMnO_4$) solution and 10 ml of 30 % hydrogen peroxide (H_2O_2). The mixture was allowed to stand on a water bath for 30 min, after which 2 ml of sodium sulfate (Na_2SO_4) solution was added. It was diluted to 50 ml with distilled water prior to measuring in spectrophotometer at 510 nm wavelength. The reading was taken with the reagent blank at zero. The formula below was used to calculate riboflavin:

$$\text{Riboflavin (mg/100g)} = \frac{100}{W} \times \frac{Au}{As} \times C \times \frac{Vf}{Va} \times D \quad \text{- - - - - -(Eqn 14)}$$

Where: W = weight of sample analyzed

A_u = Absorbance of the test sample

As = Absorbance of standard solution

V_f = Total volume of filtrate

V_a = volume of filtrate analyzed
C = Concentration of the standard
D = Dilution factor where applicable.

2.5. Data Collection Technique

The 9-point hedonic scale was used for data collection the 9-point hedonic scale was subjected to face validation by five experts Two from Home Economics department, two from Human Nutrition and Dietetics and one from Hospitality Management and Tourism. All validates were from College of Applied Food Sciences and Tourism, Michael Okpara University of Agriculture Umudike. The date for the study was collected in two phases: determination of proximate composition and organoleptic attributes of stiff porridge samples.

2.6. Data Analysis Technique

All experiments in this study were reported as mean of duplicate analyses. One way analysis of variance was carried out using the Statistical Product of Service Solution version 23.0 to compare between the mean values while treatment means was separated using Duncan multiple range test at 95 % confidence level (P<0.05).

3. Results and Discussion

Table 1: Table title

Table 1: Proximate composition of stiff porridge from eggplant and carrot

Samples code	Moisture content (%)	Protein (%)	Fat (%)	Crude fiber (%)	Ash (%)	Carbohydrate (%)
A	38.00^{a}±0.08	4.32^{a}±0.07	0.76^{a}±0.05	1.60^{b}±0.07	2.12^{a}±0.05	53.20^{a}±0.06
B	35.00^{b}±0.03	3.67^{b}±0.06	0.55^{b}±0.06	1.98^{a}±0.05	1.90^{b}±0.07	43.51^{b}±0.09
C	33.78^{c}±0.09	3.10^{c}±0.06	0.26^{c}±0.03	1.32^{c}±0.08	1.61^{c}±0.06	40.07^{c}±0.07

$^{a-c}$: Values are means $\pm$ standard deviation of duplicate determinations. Mean values in the same column wit different superscript are significantly different (P<0.05).

Keys: A = Stiff porridge from 100% egg plant
B = Stiff porridge from 100% carrot
C = Stiff porridge from 50% eggplant and 50% carrot

3.1. Description/discussion

The moisture content of the stiff porridge ranged from 33.78 to 35.00%. There were significant differences (P<0.05) among the moisture contents of the stiff porridge samples. Sample A (Stiff porridge from 100% eggplant) had the highest moisture content (38.00%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest moisture content (33.78%). report by Adeyeye *et al*. (2020) revealed that egg plants have a higher moisture content (90.89%) than carrots, which Ajenu *et al.* (2021) reported to be 84.10%. The range of moisture content obtained in stiff porridge made in this study was within 24.49 to 37.50% reported for stiff porridge from pearl millet and African yam bean blends (Dendegh*et al*., 2021). Food products with moisture contents greater than 14% are less likely to be stable at room temperature because they promote the growth of microorganisms, which produce odors and flavors (Twinomuhwezi*et al*., 2020). The high moisture content generally obtained in the stiff porridge samples, especially sample A, indicated that it may be less stable for a long time at room temperature without spoiling (Offor, 2015).

The protein content of the stiff porridge ranged from 3.10 to 4.32%. There were significant differences (P<0.05) among the protein contents of the stiff porridge samples. Sample A (Stiff porridge from 100% eggplant) had the highest protein content (4.32%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest protein content (3.10%). This implies that eggplant used in processing the stiff porridge have higher protein content than the carrot. Previous study has already shown than carrot have minute protein (0.9%) (Ajenu *et al*., 2021).

The fat content of the stiff porridge ranged from 0.26 to 0.76%. There were significant differences (P<0.05) among the fat contents of the stiff porridge samples. Sample A (Stiff porridge from 100% eggplant) had the highest fat content (0.76%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest fat content (0.26%). This connotes that the eggplant used in processing of the stiff porridge have more fat than the carrot. The range of fat content obtained in stiff porridge made in this study was lower than 3.80 to 5.20% reported for stiff porridge from pearl millet and African yam bean blends (Dendegh *et al*., 2021) and 1.82 to 2.37% reported for stiff porridge from plantain based stiff porridge fortified with moringa leaf powder (Karim *et al*., 2015). Nevertheless, among stiff porridge made in this study, the highest fat content obtained in sample A implied that it possessed a higher tendency to contribute in providing the body with energy, contributing to the absorption of fat-soluble vitamins, and acting as structural elements of cell walls (Ezekiel *et al*., 2020).

The crude fiber content of the stiff porridge ranged from 1.32 to 1.98%. There were significant differences (P<0.05) among the crude fiber contents of the stiff porridge samples. Sample B (Stiff porridge from 100% carrot) had the highest crude fiber (1.98%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest crude fiber content (1.32%). The highest fiber content in sample B was expected since Ajenu*et al.* (2021) reported that carrot is a good source of dietary fiber. The range of crude fiber content obtained in stiff porridge made in this study was within 1.30 to 2.20% obtained in stiff porridge from pearl millet and African yam bean blends (Dendegh *et al*., 2021) but higher than 0.69% obtained in maize stiff porridge (Ebere *et al*., 2017). Nevertheless, the highest crude fibre obtained in sample B implied that its consumption may contribute more to lowering plasma cholesterol and decreasing the incidence of colon cancer (Ezekiel *et al*., 2020).

The ash content of the stiff porridge ranged from 1.69 to 2.32%. There were significant differences (P<0.05) among the ash contents of the stiff porridge samples. Sample A (Stiff porridge from 100% eggplant) had the highest ash content (2.32%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest ash content (1.69%). This was quite visible in the mineral contents of the stiff porridges. Iwe *et al*. (2016) opined that the ash content of food gives an idea of the total quantity of the mineral elements. The range of ash content obtained in stiff porridge made in this study was lower than 70.29 to 74.29% reported for stiff porridge from plantain based stiff porridge fortified with moringa leaf powder (Karim *et al*., 2015) and value (66.14%) obtained in maize stiff porridge (Ebere *et al*., 2017). Among stiff porridge made in this study, the highest ash content obtained in sample

A implied that its intake has a higher tendency to contribute to building strong teeth and bones, blood clotting, reducing pain after exercise, regulating heartbeat, and assisting in muscle contraction in humans (Ezekiel *et al*., 2020).

Table 2: MINERAL CONTENTS OF STIFF PORRIDGE FROM EGG PLANT AND CARROT (mg/100g)

Table 2: Mineral composition of stiff porridge from eggplant and carrot

Samples code	**Calcium (mg/100g)**	**Magnesium (mg/100g)**	**Potassium (mg/100g)**
A	$50.00^{a}\pm0.08$	$17.05^{a}\pm0.02$	$129.14^{a}\pm0.07$
B	$43.02^{b}\pm0.05$	$15.34^{b}\pm0.03$	$111.03^{b}\pm0.01$
C	$32.23^{c}\pm0.02$	$14.29^{c}\pm0.06$	$98.15^{c}\pm0.03$

[a-c]: Values are means $\pm$ standard deviation of duplicate determinations. Mean values in the same column with different superscript is significantly different (P<0.05).

Keys: A = Stiff porridge from 100% egg plant

B = Stiff porridge from 100% carrot

C = Stiff porridge from 50% eggplant and 50% carrot

3.2. Description/discussion

The calcium contents of the stiff porridge ranged from 32.23 to 50.00 mg/100g. There were significant differences (P<0.05) among the calcium contents of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest the calcium content (50.00%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the least calcium content (32.23%). The trend of the results was expected since many researchers like Mărăzan, Anghel, Rotariu, and Cozma (2021) showed that carrot have lower calcium (261 mg/kg) than eggplant which have 28.00 to 59.63 mg/100g (Niño-Medina, Muy-Rangel., Gardea-Béjar, González-Aguilar, Heredia, Báez-Sañudo, Siller-Cepeda and Vélez de la Rocha, 2014).The range of calcium obtained in stiff porridge processed in this study was higher than 21.60 to 39.10 mg/100g reported for stiff porridge from yellow maize varieties (Mekonen *et al*., 2022) and values (0.68 to 1.11 mg/100g) obtained in stiff porridge from pearl millet and African yam bean blends (Dendegh, Yelmi and Dendegh, 2021). The differences in the calcium contents of the stiff porridges could be attributed to the fact that their raw materials differed. Among stiff porridge made in this study, the highest calcium content obtained in sample A indicated that its intake may contribute more in averting osteoporosis and colorectal adenomas, in addition to reducing hypertensive disorders of pregnancy, lowering of blood pressure especially among youths, lowering of cholesterol values and blood pressure in the progeny of mothers during pregnancy (Cormick and Belizan, 2019).

The magnesium contents of the stiff porridge ranged from 14.29 to 17.05 mg/100g. There were significant differences (P<0.05) among the magnesium contents of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest the magnesium content (17.05%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the least magnesium content (14.29%). This could be attributed to the fact that eggplant is a good source (35.84 to 93.90 mg/100g) of magnesium (Agnan *et al*., 2020). The range of magnesium obtained in stiff porridge made from this study was higher than 0.41 to 0.90 mg/100g reported for stiff porridge from pearl millet and African yam bean blends (Dendegh *et al*., 2021). Among stiff porridges made in this study, the highest value of magnesium sample A implied that its consumption may be of greater benefit since magnesium is an element required as a cofactor for numerous enzymatic reactions and is thus, essential for the biochemical functioning of several metabolic processes (Gerry and Stephen, 2017).

The magnesium contents of the stiff porridge ranged from 14.29 to 17.05 mg/100g. There were significant differences (P<0.05) among the magnesium contents of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest the magnesium content (17.05%) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the least magnesium content (14.29%). This could be attributed to the fact that eggplant is a good source (35.84 to 93.90 mg/100g) of magnesium (Agnan *et al*., 2020). The range of magnesium obtained in stiff porridge made from this study was higher than 0.41 to 0.90 mg/100g reported for stiff porridge from pearl millet and African yam bean blends (Dendegh *et al*., 2021). Among stiff porridges made in this study, the highest value of magnesium sample A implied that its consumption may be of greater benefit since magnesium is an element required as a cofactor for numerous enzymatic reactions and is thus, essential for the biochemical functioning of several metabolic processes (Gerry and Stephen, 2017).

The potassium content of the stiff porridge ranged from 98.15 to 129.14 mg/100g. There were significant differences (P<0.05) among the potassium contents of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest potassium (129.14 mg/100g) while sample C (Stiff porridge from 50% eggplant and 50% carrot) had the lowest value of potassium (98.15 mg/100g). The highest potassium content in sample A could be that heating of the stiff porridge on fire did not degrade the nutrient or that eggplant have higher potassium than carrot. Among the stiff porridges processed in this study, the highest potassium content obtained in sample A implied that its intake may contribute more in the reduction of risk of diabetes, particularly in individuals on thiazide diuretic treatment, amongst others (Stone, Martynand Weaver, 2016).

Table 3: Sensory properties of stiff porridge samples

Samples code	Appearance	Taste	Texture	Mouldability	General acceptability
A	$6.00^{c}\pm0.34$	$8.50^{a}\pm0.17$	$6.00^{c}\pm0.18$	$7.10^{c}\pm0.10$	$6.00^{c}\pm0.23$
B	$6.40^{b}\pm0.19$	$7.60^{b}\pm0.13$	$7.00^{b}\pm0.14$	$7.50^{b}\pm0.18$	$6.80^{b}\pm0.14$
C	$7.10^{a}\pm0.18$	$7.00^{c}\pm0.22$	$7.80^{a}\pm0.15$	$8.05^{a}\pm0.19$	$7.20^{a}\pm0.21$

$^{a-c}$: Values are means $\pm$ standard deviation of 20 determinations. Mean values in the same column with different superscript is significantly different (P<0.05).

Keys: A = Stiff porridge from 100% egg plant
B = Stiff porridge from 100% carrot
C = Stiff porridge from 50% eggplant and 50% carrot

[Insert Table]

3.3. Description/discussion

Table 3: shows the sensory properties of the stiff porridge samples from eggplant and carrot. The mean scores for appearance of the stiff porridge ranged from 6.00 to 7.10. There were significant differences (P<0.05) among the panelist's ratings for appearance of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest mean score for appearance (7.10) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the least mean score (6.00). Appearance determines how fulfilling a food product is before its consumption (Maina, 2018). The highest mean score of appearance obtained in sample A could be attributed to its lowest carbohydrate content. This is in line with the assertion by Okwunodulu, Eze, Ndife and Ukom (2019) that carbohydrate impact food colour when heated. The mean score for appearance obtained in this study was lower than 6.54 to 7.25 obtained in cassava based stiff porridge substituted with cooking banana and African yam bean (Ogbonnaya *et al*., 2018) but was within than the values (5.80 to 8.00) Nwokeke, Adedokun and Osuji (2013) reported for reconstituted cassava-African yam bean seeds stiff porridge blends. The higher mean scores of appearances obtained in sample A is of great importance since consumers eat with their eyes and use the appearance of foods to predict quality (Oluwole, 2009). However, the mean scores for appearance obtained in this study translates from like slightly to like moderately in 9-point Hedonic scale (Iwe, 2014).

The mean scores for taste of the stiff porridge ranged from 7.00 to 8.50. There were significant differences (P<0.05) among the panelist's ratings for taste of the stiff porridge. Sample A (Stiff porridge from 100% eggplant) had the highest mean score for taste (8.50) whereas sample C (Stiff porridge from 50% eggplant and 50% carrot) had the least mean score (7.00). Taste refers to the proximal sense that requires direct contact of food with stimuli on the tongue to determine the quality of the ingested food (Romagny, Ginon and Salles, 2017). stiff porridge. The highest mean score for taste obtained in sample A could be attributed to the fact that it possesses highest fat content (Table 4.1). This claim corroborates the report by Rios *et al.* (2014) that in addition to influencing rheological properties of food products, fat positively affects their taste. However, the mean score for taste obtained in this study was higher than 6.50 to 7.50 obtained in stiff porridge produced from cassava and cocoyam flour blends (Bamidele *et al*., 2015), and values (4.95 to 7.57) obtained in stiff porridge from sweet cassava and guinea corn flour blends (Awolu*et al*., 2020). This variation in taste could be ascribed to the fact that their raw materials differed. Interestingly, the mean scores for taste in the stiff porridge made in this study translates from like slightly to like moderately in 9-point Hedonic scale (Iwe, 2014).

Implications and suggestions for further research

This research will be of immense benefit to researchers who intend to carry out similar study. The method of processing the stiff porridge will also be beneficial to processors of stiff porridge in Abia State and Nigeria at large. Findings of this study might be incorporated in Nigeria's food composition table so that provision of dietary guidance using such food composition database as a reference material could be more effective in developing nations like Nigeria. The researcher therefore, suggests the following for further studies:

i. The phytochemical and vitamin contents of the stiff porridge should be analyzed.
ii. The digestibility profile of the stiff porridge should be studied.

The pasting properties of the stiff porridge should be evaluated that provision of dietary guidance using such food composition database as a reference material could be more effective in developing nations like Nigeria.

4. Conclusion

This study showed the potentials of eggplant and carrot as useful alternatives in the production of stiff porridge for healthy family feeding in Umuahia North Local Government Area in Abia State. Stiff porridge is an important source of calories for millions of people in sub-Saharan Africa. It is consumed by both children and adults. The results of proximate composition showed that stiff porridge processed with 100% eggplant (Sample A) had the more moisture, protein, fat, ash, and carbohydrate contents while sample B (Stiff porridge made with 100% carrot) higher crude fiber. In terms of minerals, the highest calcium, magnesium, and potassium were also obtained in sample A. Interestingly, all the stiff porridge samples possess appreciable mean scores of appearances, taste, texture, mouldability, and general acceptability with sample C (Stiff porridge from 50% eggplant and 50% carrot) been more preferred by the panelists. Therefore, the stiff is nutritious and as well have the tendency to contribute to mitigating malnutrition in Umuahia North Local Government Area in Abia State.

5. Recommendation

Based on this study, the following recommendations are made:

i. Utilization of 100% eggplant in stiff porridge production is recommended especially to individuals that are mineral deficient since it had increased mineral content, in addition to proximate composition.
ii. The stiff porridges should not be kept for quite long before consumption since it possesses high moisture.
iii. Sensitization of the general populace on the potentials of eggplant and carrot blends in the production of stiff porridge will contribute to enhancing their utilization.

Policy/clinical practice recommendations are required here.

Acknowledgements

The authors wished to acknowledge and appreciate the staff of Food and Diet Therapy Laboratory of

Home Economics Department, Food Science laboratory of Michael Okpara University of Agriculture, Umudike and Root crops Research institute Umudike for use of the laboratories

Conflict of Interest

The authors declare that there is no conflict of interest

Author Contributions

OCA and NLA conceptualized the idea, designed the study and prepared the stiff porridge. EUB and AG planned and organized the organoleptic evaluation exercise and collected the data from laboratories. OCA, NLA analyzed the data and approved the final draft of the manuscript

Data Availability Statement

The datasets/or analyzed in this article can be obtained from the corresponding author on reasonable request. Furt

Funding Information

No funding was available for this research

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Publisher: Department of Home Economics and Hospitality Management Education, University of Nigeria, Nsukka, Nigeria