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PROXIMATE AND SENSORY EVALUATION OF DRY PAP FORTIFIED WITH PIGEON PEAS

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ABSTRACT

The quality attributes of dry pap powder produced from maize and pigeon pea blends was investigated. Whole maize and pigeon pea grains were sorted, washed and blended in the following proportions to 100:0, 60:40 and 50:50 to obtain samples MAZ, PEG and MAP respectively. These blends were fermented together for 72hrs. The proximate composition and sensory properties of the pap were determined. The moisture, ash, fibre, protein, fat and carbohydrate content of the pap samples ranged from 6.59% in MAZ to 7.50% in MAP, 2.96% in MAZ to 3.77% in PEG, 3.16% in MAZ to 4.00% in MAP, 8.62% in MAZ to 16.89% in MAP, 1.94% in MAZ to 2.41% in MAP and 63.87% in MAP to 71.96% in MAZ. The results revealed that inclusion of pigeon pea significantly improved the ash, protein, fibre, and fat content of the pap. The mean sensory scores of the pap showed that the inclusion of pigeon pea in the pap did not adversely affect the sensory attributes as they competed favourably with the control sample. Their overall acceptability scores were 8.44 for sample MAZ, 7.29 for sample PEG and 7.40 for sample MAP. The study recommends inclusion of pigeon pea in pap production since it improved its proximate composition.

Keywords: Proximate, MAP, Composition, MAZ, Pap, Pigeon Pea, Maize.

Introduction

Pap is a smooth, free flowing thin porridge obtained from wet-milled, fermented cereal grain such as maize, millet, sorghum etc. and it serves as a major weaning food for infants, a breakfast meal for both children and adults and sometimes it is chosen as food for the sick (Abioye and Aka, 2015; Ukeyima *et al.*, 2019) The major disadvantage of sole cereal gruel such as pap is that the starchy nature of these foods makes them bind so much water, thus yielding a bulky gruel with decreased nutrient content (Mbaeyi-Nwoha and Obetta, 2016).). In addition, the high moisture content of papslurry predisposes it to spoilage; however the reduction in moisture content through drying can enhance the shelf life, provide convenience and allow for easy reconstitution of the pappowder (Esther *et al.*, 2013).

Fortification of food refers to the addition of essential micronutrients to food particularly added to correct specific nutritional deficiencies such as addition of vitamins and iron to breakfast foods (cereals and beverages) and fortification of sugar with vitamin A and fortification of table salt with iodine (Mbaeyi and Onweluzo, 2010). One cheap method of enhancing the nutritive value of pap is by adding legumes to it.According to Okafor *et al.* (2018), legumes are low-priced sources of protein-rich foods that have been important in alleviating protein malnutrition and in the tropics; they are the next important food crop after cereals.

Pigeon pea is reported to contain 20%–22% protein, 1%–2% fat, 65% carbohydrate, and 6.8% ash (Onweluzo and Nwabugwu, 2009) and rich in mineral quality and fiber content. Several studies have shown the enrichment of pap with different food substances such as bambara groundnut (Mbata *et al.*, 2009), pawpaw (Ajanaku *et al.*, 2010), groundnut seed (Ajanaku *et al.*, 2012), soybean (Adeleke and Oyewole, 2010), crayfish(Ajanaku *et al.*, 2013), cowpea (Oyarekua, 2009), among others. However, there are limited reports on the use of pigeon flour in enriching dry pap; thus the need for this study.

The aim of this study is to evaluate the nutritional composition of dry pap fortified with pigeon pea flour.

The specific objectives of the study include:

1. To produce flour from pigeon pea seeds.
2. To produce dry pap from blends of fermented maize and pigeon pea flour.
3. To determine the proximate composition of the pap produced.
4. To determine the sensory acceptability of the formulated products.

Materials and Methods

Materials

One kilograms of maize grains and pigeon pea were purchased from Eke Oko market in Orumba North Local Government Area of Anambra State and were taken to the Food Processing Laboratory of Food Technology Department Federal Polytechnic Oko for further processing and analysis

Preparation of Dry Pap

Dry Pap (Akamu) was prepared using modified traditional method as previously described by Okafor *et al.* (2019). The maize samples were washed in distilled water and soaked in a plastic container with cover. The water was decanted after two days of soaking and wet milled into slurry using a sterilized warring blender. This was followed by sieving the slurry using muslin cloth. The sieved maize was allowed to stand for about one hour so that the starch would sediment. The supernatant was drained off leaving wet maize. The remaining water was later drained out by placing a heavy object on the Akamu and bagged with muslin sack. The resulting wet starch was thinly spread on cabinet trays and dried in a cabinet dryer at 65°C for 8hrs. The dried starch was allowed to cool before it was packaged in an airtight container prior to further use.

Flow Chart For the Production of Pap

Maize g rains

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Sorting

↓

Washing

↓

Soaking (for 2 days)

↓

Washing and milling

↓

Sieving

↓

Decanting

↓

Wet ogi

↓

Drying (at 65^0C for 8 hrs)

↓

Milling

↓

Powdered ogi

Flow chart for processing of instant powdered ogi

Processing of Pigeon Pea Powder

The flour was prepared according to the method described by Adeola *et al.* (2017). The seeds were sorted and cleaned. The seeds were then boiled in water for 20 min and drained. The boiled seeds were allowed to cool for about 5 - 10 min before dehulling. Dehulled seeds were washed in clean water, to separate the seeds from the seed coats, and dried at 80°C to less than10 % moisture content in air cabinet dryer. The dried seeds were milled in a hammer mill and sieved to obtain fine flour which was packaged in an airtight container prior to further use.

Flow Chart for the processing of Pigeon Pea Powder

Pigeon pea seeds

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Sorting

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Boiling (for 20 mins)

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Decanting

↓

Cooling

↓

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Dehulling

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Drying (at 80^{0}C for 18 hrs)

↓

Milling

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Sieving

↓

Pigeon pea flour

Formulation of Instant pap and Pigeon Pea Blends

Instant pap was produced by blending the dried pap and pigeon pea flour in the proportions. the proportions includes., 100:0, 60:40, 50:50.

Proximate Analysis

The proximate analysis of the cake samples was carried out using the analytical methods of AOAC (2019). the parameters analysed includes moisture, carbohydrates, crude fibre, ash content and crude protein

Sensory Evaluation

Thirty (30) untrained panelists who were conversant with the product were randomly selected from students of Food Technology Department, Federal Polytechnic Oko. The products were presented immediately after preparation. Water at room temperature was provided for the judges to rinse their mouth after each taste to avoid carrying over the taste from one sample to the other. The attributes evaluated were aroma, taste, flavor, mouthfeel and overall acceptability using a 9 point hedonic scale as described by Iwe (2002) as follow: 1-Dislike extremely, 2-Dislike very much, 3-Dislike moderately, 4-Dislike Slightly, 5-Neither like nor dislike, 6-Like slightly, 7-Like moderately, 7-Like very much, 8-Like extremely.

Statistical analysis

The data generated was subjected to Analysis of Variance (ANOVA) using version 21 of the software while the means will be separated using Duncan Multiple Range test at 95% confidence test.

RESULTS AND DISCUSSION

Table 1: Proximate composition (%) of pap produced from fermented maize and pigeon pea

Parameters (%)	MAZ
Moisture	6.59^c ± 0.11
Ash	2.96^c ± 0.36
Fibre	3.16^c ± 0.01
Protein	8.62^c ± 0.01
Fat	1.94^c ± 0.05
Carbohydrate	76.73^a ± 0.02

***Values are means and standard deviation of triplicate determination Means with different superscript in the same row are significantly different (p<0.05).**

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.**Key**:**MAZ**: 100:0 Maize-pigeon pea;**PEG**: 60:40 Maize-pigeon pea; **MAP**: 50:50 Maize-pigeon pea.

Source of proximate composition of sample MAZ: Fasoyiro and Arowora (2013)

Table 2: Sensory evaluation of pap produced from fermented maize and pigeon pea.

Parameters	MAZ	PEG	MAP
Colour	$8.50^{a} \pm 0.53$	$7.70^{a} \pm 1.16$	$7.40^{a} \pm 1.35$
Taste	$8.00^{a} \pm 1.41$	$6.80^{b} \pm 1.87$	$6.70^{b} \pm 1.95$
Flavour	$7.70^{a} \pm 1.49$	$7.10^{a} \pm 1.72$	$6.70^{b} \pm 2.20$
Consistency	$7.90^{a} \pm 1.54$	$6.40^{b} \pm 2.37$	$7.90^{a} \pm 0.99$
Overall Acceptability	$8.44^{a} \pm 0.79$	$7.29^{b} \pm 1.47$	$7.40^{b} \pm 1.62$

****Values are means and standard deviation of triplicate determination Means with different superscript in the same row are significantly different (p<0.05).**

Key:**MAZ**: 100:0 Maize-pigeon pea; **PEG**: 60:40 Maize-pigeon pea; **MAP**: 50:50 Maize-pigeon pea.

Discussion

The proximate composition of maize pap fortified with different levels of pigeon pea flour is shown in Table 1. The samples were compared with that of whole pap. The moisture content of the pap samples ranged from 6.59% in the control sample (MAZ) to 7.50% in sample MAP. The result showed that a significant difference ($p<0.05$) existed in the moisture content of the pap samples. It was observed that the maize pap co-fermented with pigeon had higher moisture content compared to the control sample. Similar observation was made by Okwunodulu *et al.* (2019) for sorghum pap co-fermented with soybean although their values are higher (14.06-14.16) than the ones obtained in this study. The varied results could be due to differences in the raw materials used; including the differences in the fermentation period. The lower moisture content obtained in this study suggests that the pap powder can store for long as spoilage of food is due to high moisture.

The ash content of the pap also increased significantly ($p<0.05$). The percentage ash content of the samples ranged from 2.96 – 3.77% with sample PEG having the highest score although it did not significantly differ ($p>0.05$) from that of sample MAP. As ash is an index of mineral content of meal, fortified maize pap will go a long way in enhancing the mineral content of pap successfully to meet the mineral need of the weaning infants (Okwunodulu *et al.*, 2019). Crude fiber contents of the pap sample increased from3.16% in sample MAZ (100% maize) to 4.00% in sample MAP (50%maize: 50% pigeon pea) which implied that inclusion of pigeon pea was responsible for the increase in crude fiber as shown in the Table. These values are slightly lower than 4.85 – 5.91% fibre reported by Adeola *et al.* (2017) for complementary food produced from blends of sorghum, pigeon pea and soybean flour.Consumption of 1.04 to 3.55g/d of gruel samples will meet fiber recommended dietary intake(RDI) of 5g/d for infants aged between to one year which made them a good fiber source (Niba, 2003). Crude fiber is a carbohydrate subtype consisting of soluble and insoluble portions which increases roughages content of diet responsible, normalizing infant's bowel movement, prevents constipation, aids easier evacuation of stool and helps control blood pressure. Dietary fiber helps in prevention of several diseases such as cancer, constipation, diabetes an/d intestinal diverticulitis (Salvin, 2005; Elleuch *et al.*, 2011).

Protein is an energy substrate which is crucial for regulation and maintenance of infants' and young children's body (Okwunodulu *et al.*, 2018). Crude protein content obtained in this study ranged from 8.62% in sample MAZ (100% maize) to 16.89% in sample MAP (50% maize: 50% pigeon pea). This will meet the recommended protein content for complementary foods of 13g/d for infants aged from 0 to 2years (Byid-Bredbenner *et al.*, 2013). The fortified samples are excellent protein source as it could meet the protein RDI per serving. These samples are liable to prevent marasmus and kwashiorkor as well. Therefore, significant increase in protein content recorded in the pap could be traced to the added pigeon pea which contained higher proteins than maize (Okwunodulu *et al.*, 2019).

Crude fat content of the samples increased with increase in pigeon pea inclusion in the blends as shown in the significant higher fat content (2.41%) in sample MAP (50% maize: 50% pigeon pea) than sample MAZ (100% maize). Fat contribution by the pigeon pea harmonized with FAO/WHO recommendations of vegetable oil inclusion in infant and children foods to increase the energy density and transport vehicle for fat soluble vitamins. Fat is a good source of energy, fat soluble vitamins and helps to increase food palatability as it absorbs and retains flavours (Uwaegbute, 2008).

Carbohydrate content of the pap samples which increased from 63.87% in sample MAP (50% maize: 50% pigeon pea) to 76.73% in sample MAZ (100% maize) implies that maize had more carbohydrate than pigeon pea. Carbohydrate content of the pap decreased with increase in pigeon pea inclusion in the blends as recognized in the Table. Significant ($p<0.05$) different between all the pap samples again may signify significant variations in carbohydrate contributions of various blends. Carbohydrates provides energy needed to fuel children's metabolism, supports growth, keeps their brain and nervous systems working and maintains overall health (Okwunodulu and Ukeje, 2018).

The mean sensory scores for pap prepared from fermented maize and pigeon pea is shown in Table 2.

Colour scores of the gruel samples ranged from 7.40 in sample MAP (50% maize: 50% pigeon pea) to 8.50 in sample MAZ (100% maize). The slight decrease in colour score observed in the samples PEG and MAP may be attributed to inclusion of pigeon pea. Colour score levels showed no significant difference (p>0.05) amongst the samples. Colour is an important sensory feature of any food product which decides acceptability as consumers eat with their eyes and use what they observed to predict quality (Byid-Bredbenner *et al.*, 2013).

Higher taste score (8.00) of sample MAZ (100% maize) than 6.70 from sample MAP (50% maize: 50% pigeon pea) could be due to familiarity of the panelists with taste maize pap. There was significant difference (p<0.05) between the control samples and fortified samples. Notwithstanding, the panelists still preferred the fortified samples to some extent as indicated in Table 2. Higher taste score of 100% maize pap may mean that taste attributes which include sweet, sour, bitter and other basic taste were not influenced unlike in those formulated with pigeon pea (Okoye *et al.,* 2007).

The flavour scores of the samples ranged from 6.70 in sample MAP to 7.70 in sample MAZ. The score of the control sample significantly differed (p<0.05) from those of the fortified samples which were not significantly different (p>0.05).

Higher consistency value of 7.90 was recorded for samples MAZ and MAP while sample PEG had the least value of 6.40. Consistency is an index used to check the smoothness, which in turn decides ease of swallowing. All the pap samples are generally smooth which signified absence of swallowing problems (Okwunodulu *et al.,* 2019).

Sample MAZ (100% maize) scored highest (8.44) by the panelists probably because they were used to pap prepare from 100% maize. However, the overall acceptability of the fortified samples was not adversely affected as their mean scores were 7.29 for sample PEG and 7.40 for sample MAP. General acceptability depends on combination of all other sensory parameters and any product with maximum acceptability levels in most of the attributes will have maximum overall acceptability (Oluwole, 2009). Maximum acceptability score (8.44) was justified with maximum scores in all the attributes evaluated.

Conclusions

Fermentation of maize with pigeon pea in pappreparation is compatible as different proportions of the formulations contributed significant increase in protein, fat, ash, and crude fiber, and lowered carbohydrate contents. Improvement in these nutrients will be useful in addressing protein energy malnutrition, hence better nutritional status of children especially when utilized as weaning diet. Maize-pigeon pea papis therefore a good candidate for complementary feeding, breakfast meal for elderly people and those recovering from sickness to combat hidden hunger and protein energy malnutrition (PEM) problems among children of developing countries.

Recommendation

This study recommends inclusion of pigeon pea during maize fermentation since it improved its nutritional value. Further studies should also be conducted on the samples in other to ascertain the level of anti-nutrients present in them.

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