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Evaluation of Food Qualities of Pap (Akamu) Obtained From Diverse Maize Flour Processing Methods: Implication for Farmers Education

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Abstract— **The study was to determine the effect of different processing methods on maize flour / pap quality and acceptability. In this study a laboratory analysis was conducted to determine food value of maize flour obtained with the use of various processing methods. The laboratory analysis was done according to America Official Analytic Chemists (AOAC). A second part of the work involved a consumer acceptability test using a seven point hedonic rating scale. A completely randomize design (CRD) with four (4) treatments, each replicated three (3) times was employed to level of consumer acceptability of flour and pap obtained. Treatment A involved Blanching of maize grains whereas treatment B, C, and D, fermentation of grain in potash solution, fermentation in daily use of fresh water and fermentation of grain in fresh water without daily changes. A well-structured questionnaire designed in a 7-point hedonic rating scale format was the administered to population sample of twenty (20) consumers panelist. Results obtained from the study shows that flour and pap obtained from maize grains treated with the varied fermentation processes had significant difference in moisture content, crude protein, crude fiber, ether extract, dry matter, ash, calcium and magnesium. The organoleptic study showed that consumers preferred flour and pap gotten from potash solution fermentation process for its color and taste, however the consumers also relished the taste of pap obtain from daily use of fresh–water maize grain fermentation technique. Fermentation of maize in daily use of fresh water and fermentation in potash solution is considered most appropriate maize flour processing, especially where the producers target is to increase protein value of the foodstuff but where color in addition to taste and relatively high protein level is needed then use of regulated quantity of potash should be considered.**

Index Terms— **Evaluation, Pap, Organoleptic, Farmer Education, Value Chain.**

I. INTRODUCTION

Farm produce have various value chain derivatives required for humans, livestock consumption and for industrial purpose. The knowledge of methods and skills to derive valued products and the demand for such products contribute to profit maximization. The methods and techniques for processing some agricultural products are culture based and most these processing methods have been in used for many centuries. One of such methods and techniques is fermentation which is known in cultures across the globe and it is a household technology in plant food processing because it is a means by which the nutritive value of plant products could be improved [8] [7]. In a separate study, [13] observed that the merit of locally fermented food includes enhancing its organoleptic and preservative properties, provision of nutritional quality, detoxification and production of antibiotics. Again,[18] noted that processing helps to remove anti-nutrients in feedstuff, improved quality and shelf life in storage. Processing could be used to fortify feed for animals [18] and fermentation helps to detoxify the anti-nutritional factors, increase palatability and improve bioavailability of nutrients.

Rice, maize, wheat, sorghum, millet, cassava yam, coco-yam, oil-bean and their derivatives are some of the crops whose products are subjected to fermentation process at different stages of processing. Among the various food crops, rice and maize are the oldest and the most widely cultivated world cereals. Maize is a member of *Poaceae*family and it is botanically referred to as Zea mays. It is an annual crop that is grown across a range of agro-ecological zones in Nigeria. Maize is grown on a wide of range soil; form fairly coarse sand to clay [11] but best performance is achieve in well drained sandy loam soils. [2][1][10]Reported that maize is the second most important cereal crop in Nigeria ranking behind sorghum in the number of people it feeds. Though maize is chiefly a carbohydrate rich food, it contains a sizeable amount of protein, mineral and vitamins. It therefore means that it is a complete food for low level income people[1].

It serves as a source of income to farmers and marketers. According to [15], maize grain is primarily an energy giving food, because of its high starch content. It is also rich in oil, but has fairly low level of high quality protein. Maize is also a raw material in brewing industries for alcohol production and livestock feed manufacturing. It is valuable source of food for human and feed for poultry and other livestock. Maize is among the crops with a variety of valued chain derivatives when processed which are best known in many localities by natives or local means such as *moi-moiawka*(Igbo), *akidi*(Efik/Igbo), *ogi or oki*(Efik/Ibiobio/Yoruba), *ekpangibekpot* (Efik/Ibiobio), *efreibekot*(Efik/Ibiobio), flour and pap or *akam*u (Igbo/Efik/Ibiobio). Pap is the paste obtained after fermentation, milling and sieving of maize grains. Preparation of pap through fermentation of maize grain is influenced by processing techniques employed and this could affect the color, taste, odour, microbial load and consumer acceptability of the product. The production of

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high quality pap, free from resenting odour, poor taste and color and which is relished by humans have been a problem due mainly to processing technique. Poor quantity pap produced from poor fermentation techniques could induce disease, retard growth and delay tissue repairs as a result of pathogens and presence of toxic substance. The quality of pap can be enhanced and fortify with the use of appropriate fermentation techniques and hygienic processing methods of maize grains. However there is paucity of information on the methods of producing high quality pap and existing local methods of maize flour processing have not given the require result with respect to producing accepted pap that is relish by all consumers. The aim of this study therefore is to determine the nutritional quality of pap through utilization of various methods to obtained maize flour. The findings of this study would be useful to the maize farmers, food processors, consumers and enhance marketability of maize flour.

Purpose of the Study:

The main purpose of this study was to determine quality and acceptability of pap processed from different maize processing techniques. The specific objectives of the study include determining;

i. Proximate composition of maize flour obtained from different maize grain fermentation method.
ii. Organoleptic qualities of maize flour obtained from various fermentation techniques.
iii. Degree of acceptability of pap obtained from different fermentation technique.

Research Hypotheses

I. There is no significant difference in the proximate composition of maize flour obtained from different fermentation techniques ($p<0.05$).
II. There is no significant difference in the organoleptic quality of maize flour obtained.
III. Fermentation techniques have no significant effect on the acceptability of pap obtained from different fermentation techniques ($p<0.05$).

II. MATERIALS AND METHODS

The research was quasi experimental that involved a laboratory work with Completely Randomized Design and Survey Research Design. The experiment was carried out at the Agric Science Laboratory Federal College of Education (Technical), Omoku. Omoku is located in River State, South-South Zone of Nigeria. Completely randomized design (CRD) was used in the study with four (4) treatments, each replicated three times. The treatment comprised of the following

I. Treatment A: Blanching: Soaking grains in hot water
II. Treatment B: Fermentation of grain in potash solution
III. Treatment C: Fermentation grain with daily use of flesh water
IV. Treatment D: Fermentation of grain in fresh water without changing

A well- structured questionnaire was designed to sample opinion of a population of maize consumers' location Omoku Rivers State of Nigeria. Questionnaire, tagged Organoleptic Qualities and Pap Acceptability Questionnaire (OQPAQ) design in a point hedonic rating scale format of: dislike extremely (DE) – 1, dislike moderately (DM) – 2, dislike slightly (DS) – 3, Like(L) - 4, like slightly (LS) - 5, like moderately (LM) – 6, and Like extremely(LE) – 7 was administered to a randomly selected twenty (20) member panel analyst.

Maize flour obtain in this study were subjected to proximate analysis using America Official Analytical Chemistry, AOAC,[4] and data were collected were subjected to analysis of variance (ANOVA).

III. RESULTS

A. Research Hypothesis 1: There is no significant difference in the proximate composition of maize flour obtained from the use of various pap processing methods.

Proximate analysis presented in table 1, shows that the flour samples A, B, C and D had varied moisture composition crude protein, crude fiber, ether extract, dry matter, ash, calcium and magnesium. Flour obtained from blanched maize grain had moisture, crude protein and crude fiber content of 7.52 ± 0.15, 9.87 ± 0.03 and 1.35 ± 0.01 respectively. The ether extract, dry matter, ash, calcium and magnesium content of the samples were 0.85 ± 0.01, 92.48 ± 0.09, 1.74 ± 0.00, 0.73 ± 0.01, 0.02 ± 0.01 respectively across the blanching treatment technique.

Table 1: Mean proximate composition of maize flour using various pap processing Methods.

Sample/Extracts	A	B	C	D
Moisture Content %	7.52 ± 0.15	6.24 ± 0.01	6.74 ± 0.01	7.60%
Crude Protein %	9.87 ± 0.03	9.47 ± 0.02	11.76 ± 0.017	8.47%
Crude Fibre %	1.35 ± 0.01	1.28 ± 0.01	1.41 ± 0.01	1.366 ± 0.01
Ether Extract %	0.85 ± 0.01	0.91 ± 0.01	0.78 ± 0.00	0.85 ± 0.01
Dry Matter %	92.48 ± 0.09	93.76 ± 0.00	93.26 ± 0.01	92.48 ± 0.09
Ash %	1.744 ± 0.00	1.80 ± 0.00	1.69 ± 0.01	1.74 ± 0.00
Calcium %	0.73 ± 0.01	0.65 ± 0.00	0.742 ± 0.00	0.73 ± 0.00
Magnesium %	0.23 ± 0.01	0.14 ± 0.00	0.16 ± 0.00	0.20 ± 0.01

A) Blanched maize grain, (B) grain fermented in potash solution (C) grain fermented in daily change of fresh water and (D) grain fermented in unchanged fresh water.

Similarly data obtained from treatment B (flour obtained from maize fermented in/potash/water solution) had a moisture, crude protein , crude fibres, ether extract, dry matter, ash, calcium and magnesium levels of 6.24±0.01, 9.46±0.02 1.28±0.01, 0.91±0.01, 93.7±0.00, 1.80±0.00 0.65±0.00 and 0.14±0.00 respectively.

Again proximate analysis of sample C (flour, obtained from maize grains fermented in daily changed of fresh water) had its moisture composition of 6.74±0.01, 11.76±0.17, 1.41±0.01, 078±0.00, 93.26±0.01 1.67±0.01, 0.74±0.00 and 0.16±0.00 for moisture, crude protein, crude fibre, ether extract, dry matter, ash, calcium and magnesium respectively. In sample D (flour: obtained from maize gains fermented in unchanged fresh water) had a moisture and nutrient composition level of 7.60±0.06, 8.47±0.12, 1.36±0.01, 0.85 ± 0.01 92.48 ± 0.09, 1.74 ± 0.00, 0.73 ± 0.01 and 0.20±0.01 across moisture content, crude protein, crude fibre, ether extract, dry matter, ash calcium and magnesium parameter.

B. Research Hypothesis 2:There is no significant difference in the organoleptic quality of maize flour obtained through the use of different processing methods.

Effect of processing methods on organoleptic quality of maize flour is as shown is Table 2 below. Analysis of variance (ANOVA) conducted on the qualities of maize flour obtained from maize gains soaked in different water solutions showed significant ($p > 0.05$) difference among the A, B, C and D on organoleptic qualities (colour, odour and taste). Pap obtained from Samples A and B differsignifcally ($p > 0.05$) from one another in colour, However, the organoleptic properties of samples C and D did not differ significantly ($P>0.05$) from one another. It could be deduced that sample A andB were attractive to consumes while sample C and D were not attractive to

The consumers' interms of colour, odour and taste. It could also be deduced that fresh water without daily changing as a medium of soaking maize gains had negative effect on colour.

Table 2: Organoleptic qualities of pap processed from maize grains soaked in different media

Organoleptic parameters	A	B	C	D	SEM
Colour	5.25^{b}	6.15^{a}	3.7^{c}	3.7^{c}	0.45
Odour	4.00^{c}	5.9^{a}	5.00^{b}	3.1^{d}	0.54
Taste	4.10^{b}	5.10^{a}	4.00^{b}	3.15^{c}	0.55

Means in a row with different superscripts are significantly different from one another ($p<0.05$). A, B, C & D respectively represent grain blanching , grain fermented in hot water , grain fermentation in fresh water/potash solution, grains fermentation in daily change of fresh water and grains fermentation in unchanged fresh.

Samples B and C were similar but sample A differed significantly ($p> 0.05$) from samples B and C and D. The pap odour from the four samples were significantly ($p<0.05$) different from one another. Treatments, A, B, C and D showed similarity in odour due to the specialized procedures assigned to samples. The unpleasant pap odour was obtained from sample D whose water medium was not changed daily, it could be deduced that fermentation microbes stimulated degradation and built up of biochemical with offensive odour. The pap taste was significantly different ($p<0.05$) from one another, ample A differed significantly from samples B and D but sample A was not significantly ($p>0.05$) different sample C. This showed that daily of water medium is a sure way to reduce the cost, energy not labour of soaking grains for pap in boiled water.

C. Research Hypothesis 3: Processing method has no effect on the acceptability of pap obtained through the use of various methods to process maize into flour.

Analysis of variance (ANOVA) conducted to determine the degree of acceptability (colour, texture and odour) of pap processed from maize grains soaked in various water media differed significantly ($p> 0.05$) across the samples. The maize flour samples A differed significantly from sample D ($p<0.05$) in colour but samples A and B did differed significantly ($p<0.05$). Again there was no significant difference between sample B and C ($p<0.05$) but samples B and C differed significantly from samples A and D. The mean difference in colour across samples A, B, C, D were 3.80, 4.8 and 3.80 respectively (table 3).

Table 3: Mean acceptability of maize flour

Acceptability /sample	A	B	C	D	SEM
Colour	3.80^{b}	4.8	4.80^{a}	3.80^{b}	0.33
Texture	4.25^{b}	4.80^{a}	4.80^{a}	4.90^{a}	0.20
Odour	4.95^{a}	4.90^{a}	5.25^{a}	4.30^{b}	0.31

Means in a row with different superscripts are significantly different from one another ($p<0.05$).A, B, C & D respectively represent grain blanching (grain fermented in hot water), grain fermentation in fresh water/potash solution, grains fermentation in daily change of fresh water and grains fermentation in unchanged fresh.

The texture of maizeflour was significantly ($p<0.05$) differed from one another. The texture of flour from sample A differed from that of samples B,C and D but samples B,C and D were not significantly($p<0.05$) differed from one another. The mean values for samples across A, B, C and D were 4.25, 4.80, 4.80 and 4.90 respectively. The odour of the flour were significantly ($p<0.05$) from one another. Samples A, B and C were not differ significantly ($p>.0.05$) from one another but differed significantly ($p<0.05$) from sample D. the values for samples A, B, C and D were 4.95, 4.90, 5.25 and 4.30 respectively.

IV. DISCUSSION

The proximate composition of the maize flour obtained from different fermentation techniques revealed that the flours contain substantial food nutrients needed by man and farm animals. This result is in line with the report that maize is rich in vitamins, carbohydrate essential minerals [10]. Percentage crude protein of 11.76 ± 0.17 obtained in this study with the fermentation of maize grain in daily change of fresh water showed that the crude protein of the sample is consistent and within the range and even slightly higher than 10% standard crude protein content of harvested maize grain [17].

The recorded variation in moisture content across the various processing methods can be attributed to drying process. The standard for rash level in maize is 1.4% but across the treatments an ash level of 1.69 and 1.80% percentage ash was obtained. Probably the continuous and regular change of water disallowed complete hydrolysis of protein constituent through reduction and deactivation of enzymes and microbial activity during the process of fermentation. However since there is no evidence that the suspected deactivation process affected early and complete fermentation of maize grain, except that it removed unhealthy aroma or odour characterized with fermentation of starchy food products in unchanged water medium, its adoption as a potential practice in maize kernel fermentation for production of pap or Akamu should be sustained. Over the years pap producers in most parts of Southern Nigeria where the fermentation of maize kernel into paste and flour for preparation of pap is predominant the fermentation process of soaking grains in unchanged fresh water medium have subsisted, even when the end product of such practices has consistently been associated with less returns to investment sue mainly to resenting odour associated with either the paste or the end product (pap). In addition to poor odour and low consumer preference, this study have also isolated a protein content of 8.47%, (lower that standard maize protein level of 10%) as part of consequence of fermenting maize with the use of unchanged water medium.

No doubt the poor and resenting aroma observed in the unchanged water maize grain treatment could be associated with increased activity of various microbes linked with carbohydrate, protein and fat hydrolysis and other biochemical processes arising form both microbial and enzymatic activities which took place at varying rates within the unchanged water medium but the observed low protein level of the product shows that the complex microbial, enzymatic and biochemical activity must have lead to deamination and breakdown of the protein to ammonia that escaped as gas. These assertions agree with the documentation of [14] and[9] which report that microbes from the environment make it impossible to control quality of maize flour in the traditional method of preparation. According to ukachukwu (2000) processing methods help the mobilization of available feed nutrient in a feedstuff ad reduces the anti_nutrients presence in such feedstuff. The study did show a significant variation in crude fiber among treatments but the observed crude fiber level acoss the variation treatment was relatively lower than 2.3% standard maize crude fiber level[17]. This shoes that the entire retting produce has significant effect in the reduction of crude fiber level in maize grains.

Again dry matter among treatment did not differ significantly; calcium and magnesium were high but observed variations were also not significant among treatment. A similar trend was observed on either extracts or ash. The ash level treatments is between 1.69 and 1.80; a value that is far higher than 1.4% standard recorded as ash level of maize. However, the relationships between retting or fermentation process and ash content in maize grain could not be determined immediately but [5] and [12] had earlier reported that fermentation techniques improved the nutrient content of *ogi* flour and that some nutrients could be leached through sieved residue.

In terms of organoleptic properties maize flour colour from potash solution treatment was more acceptable to the consumers, the observed variation with this implies that carbohydrate reacted with potassium in the potash solution and this must have led to oxidation of the oxygen molecules in the starch causing change in nature of the component in food product preparation in various parts of Nigeria, in addition to its use in preparation of ukazi soup, it is also used in steaming of meat and other products that needed soften before consumption. In most of the African dishes it is used to improve the intrinsic value of the dishes but not as an ingredient but as additive. Result obtained with its use in maize seed fermentation is similar to the report documented in [18] and [2] with respect to processing of Lyon beans.

The hot water treatment might have had deactivating effect on the colour pigments thereby causing colour disharmony on the processed pap and flour. [18] and [19] had earlier reported that processing and phyto-chemicals have effect on feed colour and feedstuff acceptability by humans and livestock.

The decreasing rate of fine texture recorded across the daily change of fresh water, potash solution through the blanching method to the use of fresh water without change treatments show the decreasing degree of texture to the various water media can enhance completelythe retting of maize grains. This goes to support [18] report that method of food product processing has effect on the texture of feed produced and that poorly processed food has poor texture hence poor intake by farm animals but differs with the observation of Otitoju (2009) who report that un-sieved dried milled flour and sieved drilled milled diddiffer significantly with each other.

V. CONCLUSION

In conclusion, the media used in maize grains fermentation and subsequent processing methods influenced the proximate composition, food values and organoleptic quantities of the flour and pap obtained, hence there is bound to be effect marketability, returns to investment and acceptance and consumption of pap that is eventually obtained.

VI. RECOMMENDATIONS

Medium of soaking maize grains for fermentation influences the proximate composition, food value and organoleptic properties of the pap obtained. It is recommended that a combination of methods could be used to obtain maximum result. Therefore graded quantity of potash should be used in processing maize grains to pap but the dietary recommended level should be a guide, the soaking media should be changed daily. Farmers and processors should be trained in principle and practice of utilizing these methods to boast food security.

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