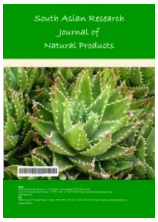

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Comparative Evaluation of Mineral and Vitamin Composition of Fermented Wet and Dried Maize Porridge (Akamu)

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Authors' contributions

This work was carried out in collaboration among all authors. Author RAA conceptualized the problem and designed the study. Author KMR performed the experiment under the supervision of author RAA. Author EO drafted the manuscript while author OOO handled the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to comparatively evaluate the nutrient composition of Wet and Dry Pap (akamu) Samples (WPS and DPS). 2 kg of white maize grains was steeped in 1000 ml of clean water for 3 days at room temperature (30±2°C). The water used was drained off and the wet grains were washed thoroughly with clean water before milling after which the resulting paste was mixed with 1000 ml of clean water. The slurry of the mixture was placed in a muslin cloth and was filtered. The filtrate was allowed to stand for 24 hours after which the supernatant was decanted. The product collected which is the pap (akamu) was placed inside muslin cloth and left to stand for 12 hours to facilitate draining. 0.5 Kg of the freshly prepared pap (akamu) was sun dried in a solar tent drier for 12 hours at 55±3°C to produce the Dry Pap Sample (DPS). Minerals, proximate and vitamin compositions of the samples were evaluated using standard methods. Analysis on the samples revealed that the amount of minerals was significantly higher in WPS Ca (63.34±0.36 mg/100 g), Mg (53.46±0.36 mg/100 g), K (43.05±0.05 mg/100 g), and Na (30.50±0.06 mg/100 g)

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than in DPS Ca (51.62±0.08 mg/100 g), Mg (29.76±0.42 mg/100 g), K (26.38±1.37 mg/100 g), Na (25.43±0.14 mg/100 g). However, similar evaluation to ascertain the amount of vitamins in the samples showed that the amount of vitamins B1, B2, B3 and B6 was significantly (P<0.05) higher in WPS B1 (1.49±0.42 mg/100 g), B2 (5.38±0.42 mg/100 g) B3 (1.15±0.03 mg/100 g) and B6 (5.98±0.23 mg/100 g) than in DPS B1 (0.9±0.11 mg/100 g), B2 (5.33±0.46 mg/100 g), B3 (1.83±0.02 mg/100 g) and B6 (4.17±0.81 mg/100 g). Proximate analysis on the samples revealed that moisture, protein, fat, ash, fibre content was significantly (P<0.05) higher in WPS than in DPS. However, carbohydrate content was significantly (P<0.05) higher in DPS (97.3±0.12 mg/100 g) than in WPS (81.4±0.16 mg/100 g). From this study, it can be deduced that drying to produce powdered pap results to significant nutrient loss. However being the only means by which the resource poor caregivers can boost the shelf-life this very important food product, supplementation with affordable and locally available nutrient dense sources is strongly advised.

Keywords: Maize; pap; mineral; vitamin; caregiver.

1. INTRODUCTION

Maize (*Zea mays*) is one of the most important cereals in the world. It is an ideal source of metabolizable energy, minerals and vitamins which however has a poor protein value [1]. In Nigeria, fermented maize is developed into porridge (pap) popularly known to as akamu in Igbo, ogi in Yoruba and koko among the Hausas which has indisputably become part of the staple diets for young adults, nursing mother, weaning ration for infants between the ages of 1-2years as well as a choice meal for patients with the need for soft and easily digestible foods [2].

In order to develop this product, fermented maize is ground to paste that is subsequently sieved to smooth slurry which settles and allows for the discharging of the resulting supernatant to form fresh pap (akamu) [3]. The preservation of this highly unstable product has been a source of serious concern to care givers especially the resource poor ones who cannot afford refrigeration and thus, often times take a step further to develop the fresh product into powder for storability and convenience [4]. Therefore, in order to evaluate the relevance of this practice, it is imperative to scientifically evaluate this advancement in the production process of the aforementioned product so as to boost the robustness of information available to caregiver.

2. MATERIALS AND METHODS

2.1 Pap (Akamu) Production

Exactly 2 kg of white maize grain procured from Samaru market Zaria was carefully sorted to get rid of contaminants, soaked in 1000 ml of clean water for about 3days at room temperature (30 ± 2°C). The water was drained off and the grains washed thoroughly with clean water. The wet grains were then wet milled with the aid of attrition mill and the resulting paste mixed with 1000 ml of clean water. The slurry of the mixture was then filtered with the muslin cloth. The filtrate was then allowed to stand for 24 hours after which the supernatant was decanted. The resulting fresh product (pap or akamu) from where the Wet Pap Sample (WPS) was sourced was placed inside muslin cloth and left to stand for another twelve hours for more water to drain off [7].

2.2 Production of Dry Pap Sample (DPS)

Exactly 0.5 Kg of the freshly prepared pap (akamu) was sun dried in a solar tent drier for 12 hours at 55 ± 3°C. Dried pap was further milled and sieved with a 0.8 mm mesh size screen to obtain fine papflour which was held in an airtight container [8].

2.3 Determination of Minerals

Mineral content of both wet and dry samples was determined according to the standard methods of the Association of Official Analytical Chemists AOAC [5] using an atomic absorption spectrometer. The samples were separately ashed at 550°C and the ash was boiled with 10 ml of 20% hydrochloric acid in a beaker and then filtered into a 100 ml standard flask. Phosphorus was determined colorimetrically using the vanadomolybdate method [6].

2.4 Analysis of Vitamin B1 (Thiamin)

Analysis of wet pap and dry samples for their respective Vitamin B1 content was performed in accordance with the description of the AOAC [5] method. Precisely weighed 1.5 g of test sample was put into a 200 ml volumetric flask, followed by the addition of 100 ml of 0.1 NHCl. The resulting mixture was heated in a water bath at 100°C for 30 min. After cooling, the content of

the flask was made up to mark with 0.1M HCl solution and mixed thoroughly. The solution was filtered with the aid of the Whatman No. 1 filter paper. The initial 20 ml of the filtrate was disposed, while the remaining filtrate (100 ml) was transferred into centrifuge tube containing 0.5 g frankonite powder (a flocculant that precipitates the particles faster during centrifugation) stirred for 10 min using RAM 2718 stirrer, then centrifuged at 5,000 rpm for 5 min to separate layers. The supernatant liquid was thrown away, while 5 ml of absolute alcohol and 5 ml of the potassium ferric-cyanide solution in sodium hydroxide solution were added after it was previously frozen at 0°C. A pinkish coloration of the mixture was observed after 10 min of mixing, and then 10 ml of toluene solution was added, stirred for 10 min and centrifuged for 10 min at 5,000 rpm. A very clear pink colour was transferred to the toluene layer. Thiamine standard (0.5 mg) was prepared and 10 ml of the thiamine standard solution was treated same as sample above. The standard and sample solution was read at 530 nm wavelength using the SP 30UV spectrophotometer. The amount of thiamine present in each sample was determined as thus:

$$Thiamine(\mathrm{mg/100g}) \ {}_{=absorbance}^{absorbance} \times wtofstd/wt.ofsample \times 100$$

2.5 Analysis of Vitamin B2 (Riboflavin)

Vitamin B2 in test samples was evaluated with the method of the AOAC [5] method. Exactly 1.5g of test samples were separately introduced into a flask after which 100 ml of acetic acid: water mixture (50:50) was added and heated on a boiling water bath at 100°C for 30 min. The mixture in the flask was cooled to 20°C, then made up to the mark with acetic thiamine (mg/100 g) The mixture was stirred for 10 min using the stirrer and then filtered in the dark. The initial 20 ml of the filtrate was discarded. 0.5 mg of riboflavin standard solution was prepared and 10 ml of the standard solution was transferred into 200 ml volumetric flask and given same treatment as previous samples. The fluorescence of the standard and sample solutions was read using spectrophotometer at 460 nm wavelength. The amount of riboflavin in each sample was calculated as follows:

$$Riboflavin(\mathrm{mg/100g}) \ {}_{=}^{absorbance}_{absorbance} \times wtofstd/wt.ofsample \times 100$$

2.6 Analysis of Vitamin B3 (Niacin)

The method of AOAC [5] was explored to quantify the amount of Vitamin B3 in the test samples. Exactly 1.5g each of the test samples was separately introduced into 200 ml volumetric flask. This was followed by the addition of hydrochloric acid solution (5N; 5ml), 5.0 ml of dichloromethane and 90 ml of deionized water. The mixture was stirred and heated on a boiling water bath at 100°C for 30 min. It was then cooled and the content of the flask was made up to the mark with distilled water, filtered using Whatman No. 1 filter paper. The initial 20 ml of the filtrate was discarded. 0.5mg of niacin (standard solution) was prepared and 10 ml of the stock solution was taken and treated same as sample above. The absorbance of the standard and sample solutions were read at 410 nm wavelength using spectrophotometer and calculation followed thus:

$$\mathrm{niacin(mg/100g)} \ {}_{=stdreading}^{samplereading} \times stdwt/wt.ofsample \times 100$$

2.7 Statistical Analysis

Data generated from the study were expressed as mean ± standard deviation. The difference in means from the two sample groups were compared using student's t-test. $P<0.05$ was considered significant.

3. RESULTS

The micronutrient composition of wet pap and dry pap sample (akamu) is shown below.

Table 1. Mineral composition of wet pap sample and dry pap samples (Akamu)

Minerals (mg/100 g)	Samples	
	WPS	DPS
Ca	63.34±0.36[a]	51.62±0.08[b]
Mg	53.46±0.36[a]	29.76±0.42[b]
P	12.72±0.46[a]	6.07±0.02[b]
K	43.05±0.05[a]	26.38±1.37[b]
Fe	3.23±0.02[a]	1.40±0.28[b]
Zn	6.18±0.04[a]	4.22±0.18[b]
Na	30.50±0.06[a]	25.43±0.14[b]

Values are mean ± SD of three determinations. Values with different superscript are significantly different (P<0.05). WPS= wet pap (akamu) sample; DPS= wet pap (akamu) sample

Table 2 Vitamin Composition of wet pap sample and dry pap samples (Akamu)

Vitamins (mg/100 g)	Samples	
	WPS	DPS
B1	1.41±0.42[a]	0.9±0.11[b]
B2	5.38±0.42[a]	5.33±0.46[a]
B3	1.15±0.03[a]	1.83±0.02[b]
B6	5.98±0.23[a]	4.17±0.81[b]

Values are mean ± SD of three determinations. Values with different superscript are significantly different (P<0.05). WPS= wet pap (akamu) sample; DPS= wet pap (akamu) sample

4. DISCUSSION

Nutrients are substances found in food. It is the essence for which food is considered relevant to human and animal. Micronutrients which are minerals and vitamins are required in small quantities for proper functions of the body. Potassium for instance is useful in the maintenance of body fluid volume, electrolyte and cell function [9]. Phosphorus on the other hand is concerned with growth, maintenance and repair of damaged body tissues and in conjunction with calcium and magnesium, support proper bone growth and maturation [10]. Sodium functions both as an electrolyte and enzyme cofactor. Zinc ion, plays both catalytic and structural roles in enzyme activity. It is also an antioxidant capable of protecting cells from the damaging effects of oxygen radicals released during lymphocyte activation [11]. Some vitamins are co-enzymes and thus have catalytic functions. For instance, Vitamin B1 is a component of the coenzyme thiamin pyrophosphate (TPP) one of the drivers of carbohydrate metabolism, while B2 is found in coenzymes Flavin adenine mononucleotide (FMN) and Flavin adenine dinucleotide (FAD). Table 1 shows the mineral composition of test samples, i.e. Wet Pap Sample and Dry Pap Sample. Minerals evaluated included calcium (Ca), magnesium (mg), phosphorus (P), potassium (K), iron (Fe), Zinc (Zn) and sodium (Na). The values recorded for the Wet Pap Sample was significantly (P<0.05) higher than the values reported for the Dry Pap Sample. This finding is consistent with the work of Eugene and Juliana [12] which reported that boiling and frying decreased minerals such as iron (Fe) and Zinc (Zn).Table 2 shows the vitamin composition of both wet and dry pap samples. Vitamins evaluated were vitamins B1, B2, B3 and B6. There was no significant difference in the values of vitamin B2 recorded for the test samples. However, the amount of vitamins B1, B3 and B6 reportedly present in Wet Pap Sample (WPS) was significantly (P<0.05) higher than in Dry Pap Sample (DPS). This may be attributed to the degree of sensitivity of the cohesive force existing between the sugar molecules and the vitamins to heat. The result generated is consistent with findings of Eugene and Juliana [12] which reported that boiling and frying significantly decreased the vitamin content of groundnut (*Arachishypogaea*).

5. CONCLUSION

This study has revealed that the Wet Pap Sample is nutritionally denser that the Dry Pap Sample which may have lost a larger proportion of its thermally unstable nutrients to heat. Thus, since this is the only available means by which the resource poor caregivers can boost the shelf-life this very important food product, supplementation with affordable and locally available nutrient dense sources is strongly encouraged.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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