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Full Length Research Paper

Chemical and nutritional value of maize and maize products obtained from selected markets in Kaduna State, Nigeria

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ABTRACT

Maize and maize products in selected grain markets within Kaduna were obtained and investigated for proximate and mineral composition analysis using Atomic Absorption Spectrophotometer (ABS) and flame photometer. Proximate composition of maize and maize products were in the range of 11.6- 20 .0% (moisture), 1.10 – 2.95% (Ash), 4.50 – 9.87% (protein), 2.17-4.43 (fat), 2.10- 26.70% (fibre) and 44.60-69.60% (carbohydrate). Significant differences exist between the mean values of the nutrient content of all the products except for moisture (P≤ 0.05). Mineral elements of the maize and maize products namely: phosphorus, magnesium and potassium were found to be high compared to other elements: zinc, calcium copper, sodium manganese and iron. Higher percentage of these minerals were concentrated in the maize bran. The important of maize and maize product in human diet is being discussed.

Keywords: Cereal, Flame photometer, Maize bran, mineralelement,proximate composition.

INTRODUCTION

Cereals are the most widely cultivated and consumed crops on globally. In Nigeria, specifically in the Northern part of the country, cereal provides a major food resource for man. It is the major source of energy and protein in the diet of many people. Maize is the second most important cereal crop in Nigeria ranking behind sorghum in the number of people it feeds. Estimated annual production of maize is about 5.6 million tones. (Central Bank of Nigeria report 1992).Maize is a multipurpose crop, providing food and fuel for human being and feed for animals (poultry and livestock). Its grain has great nutritional value and can be used as raw material for manufacturing many industrial products. (Afzal *et al.*, 2009).Due to nutritional composition of maize, it serves as a good.

Substrate for fungi development that many cause nutritional losses and production of toxic substances known as mycotoxin (Lancy, 1998).Information of food composition data and its chemical components is important in nutritional planning and source of data for epidemiological studies (Ali *et al.*, 2008). Several studies have been carried out in Nigeria on the nutritional composition of cereal, legume and tuber (Ajayi and Korede, 1991, Addo 1983and Kushiro *et al.*, 1992;) in most part of the country but little is done on maize and maize products from the northern part of the country..The present study aims to investigate the nutritional and mineral composition of maize and maize product from markets in Kaduna.

MATERIALS AND METHODS

Maize and Maize Product Samples

Maize and maize products for the study were purchased randomly from selected wholesale markets (grain markets) within Kaduna State. Samples were collected in sterile polythene bags with proper identification.

Determination of proximate compositions of maize and maize products nutrient content of grains

Moisture content

The moisture content was estimated by drying triplicates 10g weight of the sample at 105°C for 24hr and then reweighing after cooling in a desiccator. The moisture content is expressed as percentage of the dry weight.

Moisture content = Weight loss of sample x 100 / Weigh of the original sample.

$$\text{Moisture content} = \frac{\text{Weight loss of sample}}{\text{Weigh of the original sample.}} \times 100$$

Ash Content/Mineral content

Two grams of the dried sample was weighed in to a dry porcelain dish and then heated in a muffle furnace at 600^0C for 6 hours. It was cooled in desiccators and weighed. The percentage ash content was calculated thus:

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

Fat content

The fat content was determined using Soxhlet extraction method (AOAC, 1984). Two grammes of the sample was weighed into the Soxhlet extraction thimble. Cotton wool was used as plug to avoid loss of sample. The thimble was transferred into the Soxhlet extractor and sufficient petroleum ether was added until the latter is siphoned into the receiving flask which has been weighed. More ether was poured to cover the thimble completely and flask placed with the extractor on the electric heating mantle. The reflux condenser was heated gently for 3 hours, switched off and allowed to cool for 10 minutes. Recovered solvent was transferred into an air oven (100^oC) for 1 hour and then cooled in desiccators and weighed. The amount of oil produced was calculated and expressed as percentage of original sample.

$$\%\text{Fat} = \frac{\text{Weight loss of sample (extracted fat)}}{\text{Weight of sample}}$$

Crude Protein

One gram of each sample was weighed into a digestion flask. Ten grammes of potassium sulphate, 0.7g mercuric oxide and $20cm^3$concentrated sulphuric acid were added to the sample in the digestion flask. The flask was heated gently at an inclined angle until frothing subsides and boiled until the solution becomes clear. This was continued for half an hour. When the frothing is in excess, a small amount of paraffin wax was added. On cooling, 90ml of distilled water was added and mixed. A small piece of pumice was added to prevent bumping. 80ml of 2M sodium hydroxide solution was added while tilting the flask so that two layers are formed. The condenser unit was rapidly connected, heated and the distilled ammonia collected in 50ml boric acid / methyl red indicator. Fifty milliliters of the distillate was collected and titrated against 0.1M hydrochloric acid solution. The percentage nitrogen content percent was calculated thus:

$$\%\ N = \frac{(\text{Volume of acid} \times \text{Molarity of standard acid}) \times 0.014 \times 100}{\text{Weight of sample (g)}}$$

% Crude protein content = nitrogen content x 6.25

Total Carbohydrate

The total carbohydrate was determined by differential method. This was achieved by subtracting the total protein, lipid, moisture and ash content from 100 thus:

% carbohydrate (100 – (% moisture + % ash+ % fat + % protein + %fibre)

Determination of mineral elements in maize and maize products

Wet digestion

The digestion of samples for metal analysis was accomplished as described by (Van loon,1996). One gram (gm) of the pulverized maize sample was weighed accurately into 250 ml conical flask.15ml of HNO_3 was added to the flask followed by addition of 5ml of conc. H_2SO_4. The mixture was shaken to mix and heated on a hot plate preset at 160^oC until the brown fumes disappeared and white fume began to show. Ten (10) ml of H_2O_2 was carefully added and heating was continued to dryness. The digest was allowed to cool and 20ml de-ionized water was added to dissolve the residue. This was filtered quantitatively into 100ml volumetric flask. The residue in the conical flask was washed with 10ml de-ionized water into the filtrate. The filtrate was made up to the 100ml mark and transferred to a plastic bottle, aspirated into the machine for the trace metal analysis.

Analysis for minerals

Young Lin flame Atomic Absorption Spectrophotometer model 8010 was used for the determination of Ca, Mg, Fe, Mn, Zn and Cu while K and Na were determined using Spectrum Lab 22 flame photometer by the method described by (Khan and Zeb,2007) while Phosphorus (P) was determined using titrametric method.

RESULTS

The proximate composition of maize and maize products obtained from sampled areas is as shown in figure 1..The percentage carbohydrate was in the range of 44.8 – 69.6% moisture contents 11.6 – 20% , protein content 4.5 – 9.87 , fat 2.17 – 4.43 , fibre 2.10 – 26.77 and the ash content 1.10 – 2.95%.

Statistical analysis, using Anova, shows significant differences exists between the mean values of the nutrient content of the products except moisture at $p \leq 0.05$.

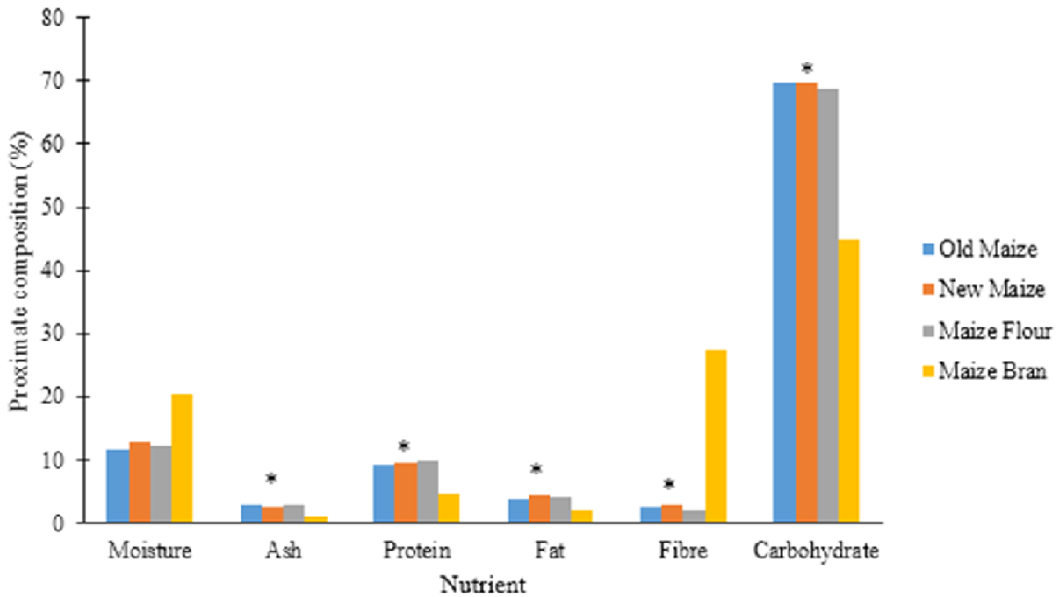

Figure1. Proximate composition of all maize products

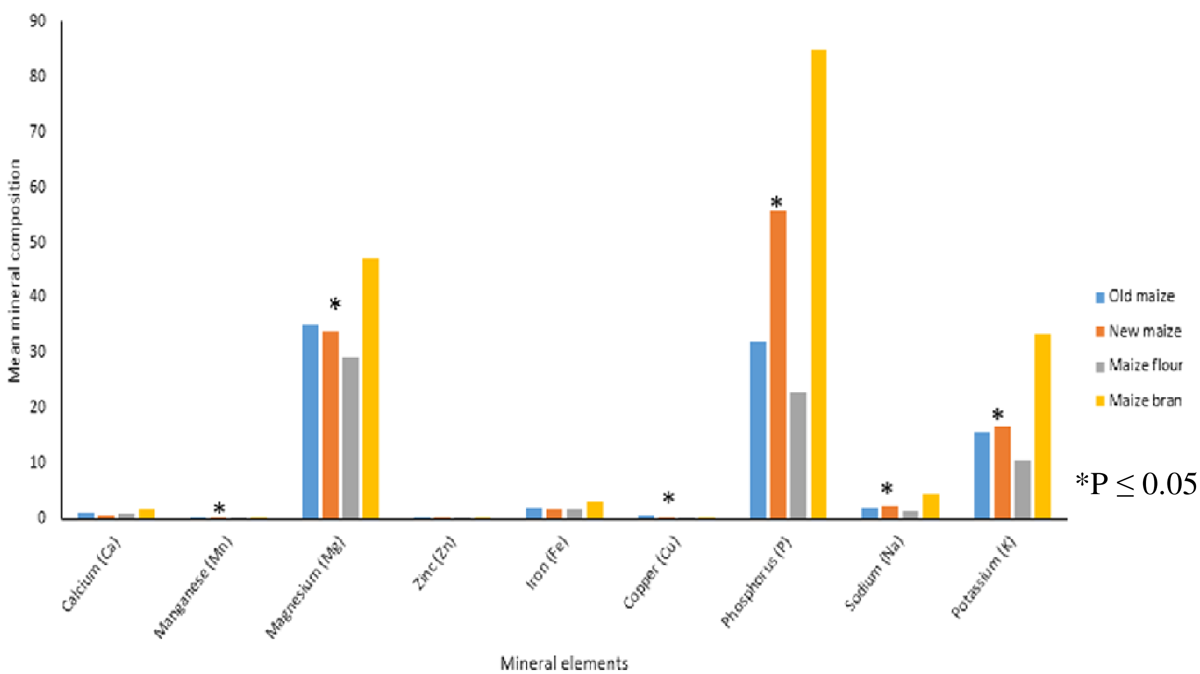

Figure 2. Mineral compositions of all maize products

The result of the mineral composition of the maize and maize products for the study is as presented in figure 2. Of all the minerals, phosphorus was found to be in the range of (23.00 – 85%), followed by magnesium (29.33 – 47%), Potassium (10.67 – 15.60%) and sodium (1.50 – 4.43) while other mineral content such as calcium, manganese, zinc, iron, copper were all in low percentages.

Statistical analysis show that statistical differences exist between the entire mineral contents of maize and maize products tested except calcium, iron and copper at $p \leq 0.05$

DISCUSSION

Determination of proximate and mineral element compositions of maize/maize products will go a long way in providing substantive nutritional information on maize, for effective guide on dietetics. The moisture content of the maize and its products in the current study is consistent and slightly higher than the earlier research on maize/maize products. Typically, Samir *et al.,*(1998) reported moisture content of maize/maize products as 9-19%. The slight variation (1.33%) may be attributed to the maize variety used, environmental factors and agronomic practices.

The percentage ash content falls within the range reported in the literature, Duxton *et al.,* (2000) reported ash content of maize in the range of 1.4 – 3.3%. The ash content of maize bran is however, lower. May *et al*., (2005) reported ash content of maize/bran as 5.1%. The lower moisture content is important as it enables long storage by minimizing fungal contamination and spoilage of the maize/maize products Maize bran is an important source of protein supplement and energy for ruminant (Ghol, 1981).

The percentage protein of maize in the current study was found closely related to those reported on different maize varieties in Nigeria. Notably Ujabadenyi and Adebolu (2005) reported protein of three maize varieties growth in Nigeria within the range of 10.67 – 11.25.The protein content of maize/maize products can be improved through technological processes by moving gene responsible for protein synthesis from the ribosomal DNA of high protein plant

The percentage fat obtained for maize and maize products in this study was consistent and in agreement with other researchers (Matida *et al*., 1993; Ikenie et al., 2002) but slightly differs from the findings of Ujabadenyi and Adebolu,(2005) that found higher fat content in the range 4.17 – 5.0%. The observed differences may possibly be genetical or environmental factors.

Crude fibre was found to be the fourth largest chemical present in maize grain after carbohydrate, protein fat and moisture content. Percentage fibre was put at a range of 0.8 – 2.32%, but the result of fibre content obtained in this study **wa**s in agreement with the findings of Ajabadenyi and Aebolu 2005, who reported a fibre content in the range of 2.07 – 2.97, for maize variety grains in Nigeria.

The maize bran was found to have higher percentage of fibre content which is in agreement with the findings of Mlay et al, 2005, who found the fibre content in maize bran to be 31.9%. Maize bran has been found to be very effective in decreasing faecal transit time.

The carbohydrate content of maize and maize products obtained for this study varies, with old maize having the highest carbohydrate content, followed by maize flour then new maize and the least maize bran which similar to the findings of Ayatse *et al; (1983*) and Ujabadenyi and Adebolu (2005) who reported a similar value of 65.63 – 70.23%) carbohydrate contents of maize grown in Nigeria. However Wilson et al (1999) had slightly higher carbohydrate content of about 72-73% of maize kernel. The composition of maize starch may be genetically controlled.

The carbohydrate content of the maize bran was found to be lower than the findings of Mlay *et al*, (2005), who recorded a higher carbohydrate content of 73.3%. The observed difference may possibly be due to the variety of maize from which the pericarp (bran) is removed.

The mineral composition of maize and maize products showed that higher percentages of magnesium, phosphorus, potassium, but with a low concentration of calcium, manganese, zinc, iron, copper, and sodium which is in agreement with the findings of Oshodi et al.,(1999).They concluded that these element are the most abundant mineral in Nigeria agricultural products. Similarly Hussaini *et al.* (2008) showed that Nitrogen fertilizer application up to 60kg/Na ha^{-1} significantly increased the concentration of Nitrogen, phosphorous magnesium and potassium. This observed higher concentration of these elements in our study may possibly be due to application of fertilizer during cropping. The low concentration of calcium and zinc in recorded in this study tallies with the findings of Matilda *et al.* (1993), who found that cereal are poor in these minerals.

However, the observed differences in mineral composition in these products may be due to genetic factor and environmental factors like irrigation frequency, soil composition and fertilizer used (Ikram *et al*. 2010).

The maize flour and maize bran have higher concentration of most of these mineral(phosphorous, magnesium, potassium) however, the maize bran used in this study was found to contain much higher percentages of these mineral, Most of the nutritionally important minerals are found in maize bran a factor to be reckoned with notably in milling of maize. Eating whole maize is found to be more beneficial, as the removal of the bran to make flour may have resulted in removing the vital component of the maize

CONCLUSION

The data indicate that maize and maize product is high in carbohydrate and protein. Whole maize should be eaten as the removal of the pericarp (bran) amount to the removal of most important minerals.

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