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# CHANGES IN SELECTED CHEMICAL COMPOSITIONS OF FERMENTED SORGHUM AND MAIZE GRAIN FLOURS

**LAWAL, R. T.**
Science Laboratory Technology Department
Osun State Polytechnic
Iree, Osun State
**NIGERIA**

**SULIMAN, W. K.**
Chemistry Department
Oduduwa University Ile-Ife, Osun State.
**NIGERIA**

**ISHOLA, A. D.**
Science Laboratory Technology Department, Osun State Polytechnic
Iree, Osun State
**NIGERIA**

**OLAYIWOLA, A. T.**
Microbiology Department
Oduduwa University, Ile-Ife, Osun State
**NIGERIA**

**AJAO, F. D.**
Food Technology Department
Osun State Polytechnic
Iree, Osun State
**NIGERIA**

## ABSTRACT

The sorghum and maize grain flours were fermented by solid state method for 72 hours. The minerals and antinutrient contents were determined using standard methods. All chemicals used were of analytical grade and the values are reported in mg/100g. The mineral analysis of fermented sorghum and maize grain showed that the levels of sodium, potassium, calcium, magnesium and iron decreased markedly in samples B and C compared to others, there were marked reduction in the levels of calcium and magnesium in sample D while sample B gave the lowest amount of iron. The effect of fermentation on the antinutritional content showed that there was decrease in phytates, oxalates, tannins and phenols content of some of the fermented samples. The result showed that fermentation has been able to reduce the contents of the entire antinutrient.

**Keywords**: Sorghum flour, maize flour, fermentation, nutrient, antinutrient.

## INTRODUCTION

Corn is cross pollinated while sorghum is self-pollinated and produces heads over a longer time period because tillers develop over several weeks and consequently, shorten the fertilization. In a longer drought, sorghum produces fewer and smaller heads but is rarely without kernels. Sorghum foliage resists drying. At miniature stress, corn leaves lose a greater percentage of their water contact than do sorghum leaves, and waxy coding than do sorghum leaves. This coating often gives the leaf sheaths a sticky first appearance (Hassan and Umar, 2004). Sorghum in cereal grain is the fifth most important cereal crop in the world, largely because of its natural drought tolerance and versatility as food (Nyannor *et al.*, 2007). Sorghum can be substituted for wheat flour in a variety of baked food. Its neutral sometimes sweet flavour and light color make it easily adaptable to variety of dishes sorghum improves the texture of recipes and digest more slowly with a lower glyceric index, so it sticks a bit longer than other flours or flour substitutes (Lemme *et al*., 2004). Ready-to-eat breakfast cereals are of four basic types: flaked, made from corn, wheat, or rice that has been broken down into grits, cooked with flavours and syrups, and then pressed into flakes between cooled rollers; puffed, made by exploding cooked wheat or rice from a pressure chamber, thus expanding the grain to several times its original size; shredded, made from pressure-cooked wheat that is squeezed into strands by heavy rollers, then cut into biscuits and dried; and granular, made by a process in which a stiff dough made from wheat and malted barley flour, salt, yeast, and water is fermented, baked thoroughly, and then, after being crumbled and rebaked, is ground into rough grains. As a final step in each process, the cereal is treated to restore vitamins lost through cooking and often coated with sweet flavouring (Encyclopedia, 2012). Fermentation in food processing is the conversion of carbohydrates to alcohols and carbon dioxide or organic acids using yeasts or bacteria under anaerobic conditions. Fermentation usually implies that the action of microorganisms is desirable. The science of fermentation is also known as zymology or zymurgy. The term "fermentation" is used to produce alcoholic beverages such as wine, beer, and cider. Fermentation is also employed in the leavening of bread ($CO_2$ produced by yeast activity); in preservation techniques to produce lactic acid in sour foods such as sauerkraut, dry sausages and yogurt; and in pickling of foods with vinegar (acetic acid) (Encyclopedia, 2012). The objective of the study was to assess mineral and antinutrient composition of fermented sorghum and maize grain flours.

## MATERIALS AND METHODS

### Samples Collection and Pretreatment

The popcorn, sorghum and maize grain sample used for this study were bought from Iree Market, Boripe Local Government Area of the State of Osun. Other materials used include conical flask, beaker, filter paper, aluminum foil, weighing balance, measuring cylinder and alcohol. The sorghum and maize grain were washed thoroughly with alcohol to remove dirt and other contaminant and it was spread to air dried separately. After drying, the sample were grinded into powder form using grinding machine and packaged in an air tight container separately and stored in a refrigerator for further analysis.

### Sample Fermentation

The sorghum and maize flour was weighed separately using a weighing balance. Each sample was weighed and labeled in a different beaker (250ml) as follows:

**Samples**

| | |
|---|---|
| A | 20gram of sorghum |
| B | 20gram of maize |
| C | 10gram of sorghum and 10gram maize |
| D | 7.5gram of sorghum and 12.5gram of maize |
| E | 12.5gram of sorghum and 7.5gram of maize |

100ml of distilled water was added to each sample and left for 72 hours in a beaker covered with aluminum foils and the sample was left for 72hours.

### Mineral Analysis

Minerals analysis sodium, potassium, calcium, were determined by using flame photometer (model 405, corning UK) using NaCl and KCl salt as standards. All other metals were determined by atomic absorption spectrophotometer (AAS) (Perkin-Elmer model 403, Norwalk CT, USA). All chemical used were of analytical grade and the minerals are reported in mg/100g. Phytate and tannin were determined using AOAC (1995) methods while oxalate content was by the titrimetric method (AOAC, 1995) and phenol by Makkar *et al*., (1997)

## RESULTS AND DISUSSION

### Results

From table 1, the sodium and potassium contents were found to increase in the two samples while calcium and magnesium contents were to decrease while iron recorded the lowest values. Phytates, oxalates and tannins recorded lower values while phenols recorded highest values in the two samples.

**Table 1: Mineral Composition (Mg/100g)**

| Parameter | A | B | C | D | E |
|---|---|---|---|---|---|
| Na | 72.10+0.03 | 81.09+0.03 | 85.80+0.02 | 55.80+0.03 | 60.10+0.02 |
| K | 60.80+0.04 | 80.12+0.05 | 88.00+0.04 | 38.00+0.04 | 55.70+0.10 |
| Ca | 54.30+0.20 | 42.80+0.00 | 42.00+0.03 | 22.00+0.06 | 38.10+0.01 |
| Mg | 48.10+.0.20 | 34.10+0.01 | 30.60+0.01 | 12.60+0.10 | 32.00+0.03 |
| Fe | 0.18+0.01 | 0.09+0.02 | 0.30+0.05 | 0.33+0.01 | 0.40+0.00 |

n=2

**Table 2: Antinutrients Composition (Mg/g)**

| Parameter | A | B | C | D | E |
|---|---|---|---|---|---|
| Phytates | 0.43±0.02 | 0.39±0.02 | 0.29±001 | 0.31±0.03 | 0.41±0.10 |
| Oxalates | 0.18±0.01 | 0.05.±0.03 | 0.46±0.02 | 0.55±0.04 | 0.73±0.02 |
| Tannins | 0.18±0.00 | 0.11±0.01 | 0.10±0.00 | 0.08±0.00 | 0.15±0.01 |
| Phenols | 4.86±0.05 | 3.33±0.02 | 3.03±0.01 | 3.08±0.03 | 4.69±0.06 |

n=2

## DISCUSSION

Mineral composition from the table 1 revealed that fermented sorghum and maize samples contained high level of sodium (Na), Potassium (k), Calcium (Ca) and Magnesium (Mg) and Iron (Fe). These samples are excellent source of sodium with (85.80±0.02) which was the highest followed in the descending order by potassium and calcium with (80.12±0.05) and (54.30±0.20). The samples were found to have lower amount of iron (0.18±0.01). The high sodium and calcium content make the sample attractive as natural source of sodium and calcium supplementation for pigment and lactating women as well as for children and the elderly people (Madgi, 2004). Sodium in association with potassium is useful for maintenance of body fluids, (Omole, 2003). Magnesium also plays a role in regulating the acid alkaline balance of the body (Fallon and Enig, 2001), while calcium assist in bone formation. The values for all these elements showed that they are good source of both the macro and micro elements to the body. The reduction in antinutrient of oxalate content could be as a result of microbial activities that took place during fermentation process. The values are lower than those reported for fluted pumpkin (Akpabio *et al.,* 2008) and for popcorn and groundnut flours by other authors (Oyeleke *et al*., 2012 and Ojokoh *et al*., 2012). Oxalic acid and its salts in high quantities can have deleterious effect on human nutrient and health, mainly by decreasing calcium absorption and aiding the formation of kidney stones (Savage, 2002).

Low values in tannin of fermented samples will make the detected nutrient in the samples available for full utilization by the body for both its metabolic and physiological activities since antinutrients especially tannins are known to inhibit minerals uptake in human body. Increases in sodium, potassium and decreases in iron of the fermented samples may not be unconnected to decreases in tannin content of the fermented samples. This is because tannin in food depresses growth by decreasing digestibility (Oladele and Oshodi, 2008).

The reduction in phytate content may be attributed to leaching out of phytate ions into soaking water under the influence of concentration gradient. Phytate have been implicated in decreasing protein digestibility by forming complexes and also by interacting with enzymes such as trypsin and pepsin (Azza and Ferial, 2010). The reduction in phenol was attributed to leaching out of phenols into the fermentation water. This result is in accordance with those reported by Azza and Ferial (2010) may be attributed to enzymatic hydrolysis of polyphenols by enzymatic action during fermentation. Generally, the value obtained for phytate, tannin, oxalate and phenol in this research work are within the level of acceptable edible sample (sorghum and maize) through proper processing before consumption is still necessary (Ekop and Eddy, 2006).

## CONCLUSION

The results of these studies have shown that fermented sorghum and maize grain flours the percentage of the nutrient and antinutrient were in lines with food consumption.

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