

## Proximate Composition and Sensory Properties of Moringa Fortified Maize-Ogi

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### Abstract

The effects of moringa leaf fortification on the nutritional value and consumer acceptability of maize ogi was investigated. The 'Ogi' produced from maize was fortified with moringa leaves at substitution levels of 0, 10, and 15%. The proximate content, mineral and vitamins content, swelling capacity, beta-carotene and the sensory properties of the ogi samples were determined. There was about 94% increase in protein content with 15% substitution of moringa leaf. The values of the mineral content and the crude fibre increased with increase in the level of substitution from 1.67 to 3.10 and 2.57 to 3.37%, respectively. There was increase in the values of the mineral contents of the ogi samples with increase in the level of moringa leaf substitution; calcium content (125.01-445.1 mg/100 g), magnesium (36.67-135.01 mg/100 g), iron (4.67-12.77 mg/100 g), potassium (21.67-233.33 mg/100 g), zinc (0.23-0.63 mg/100 g) and copper(0.37-0.53 mg/100 g). Beta -carotene of 1058.33 µg/100 g was obtained with 15% moringa leaf substitution. The swelling capacity decreased with increase in the level of moringa leaf substitution. The ogi sample with 10% moringa leaf substitution was rated close to the unfortified ogi sample. This study revealed that fortification of ogi with moringa leaves had effects on the nutritional and sensory attributes of the ogi samples.

**Keywords:** Nutritional quality; Acceptability; Moringa leaves; Fortification

### Introduction

Ogi is a fermented cereal porridge made from maize (*Zea mays*), sorghum (*Sorghum vulgare*) which is also known as guinea corn or millet (*Pennisetum tyopideum*). The colour of ogi depends on the colour of the cereal used such as cream or milk white colour for maize-ogi and the reddish-brown colour for sorghum-Ogi [1]. Ogi is a staple food of West Africa and it serves as a weaning food for infants. It is considered a common staple food in most African countries. The product serves different categories of people in terms of its uses, such as weaning food for babies, breakfast cereal for adults, a meal to enhance breast milk production for nursing mothers, and recovery diet for the sick [2].

The traditional preparation of ogi involves soaking of corn kernels in water for 1 to 3 days followed by wet milling and sieving to remove bran, hulls and germ. The pomace is retained on the sieve and later discarded as animal feed while the filtrate is fermented (for 2-3 days) to yield ogi, which is sour, white starchy sediment [3]. During ogi manufacture, nutrients including protein and minerals are lost from the grain thereby affecting nutritional quality adversely. Akinrele and Bassir [4] found that this cereal product was incapable of supporting the growth of rats. Studies have also indicated that the thin, watering porridge has very little nutritive value and the nutritional losses have been reported in the wet milling method of preparing 'ogi'

Ogi generally have been implicated for kwashiorkor among infant [5] and this has led to many research attempts in fortifying the ogi, to improve its nutritional value with plant protein sources: soy bean [1,6], cowpea [7,8] Fortification has been reported to improve protein from 1.4% to 13% in germinated and fortified preparation and increase lysine to more than 50% when cowpea is added [8], mellon [9], okra [10,11] Baobab fruit [12] and animal protein.

Moringa oleifera is a plant that is native to the sub-Himalayan areas of India, Pakistan, Bangladesh, and Afghanistan. It is also grown in the tropics for diverse uses [13]. The leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration and without loss of nutritional value. Recently a high demand of interest

has been placed on the nutritional properties of Moringa in most countries where it is native. This is as a result of the claims that it increases productivity of animals. Studies have revealed the leaves to combat malnutrition, especially among infants and nursing mothers. Moringa leaves contain more Vitamin A than carrots, more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas," and the protein quality of Moringa leaves is comparable to that of milk and eggs [14].

This work is therefore aimed at investigating the effect of moringa leaves powder fortification on the nutritive value and sensory properties of ogi thus producing an inexpensive, nutritionally balanced food for the populace especially the rural people.

### Materials and Methods

The white variety of maize grains used were obtained from a local market in Ogbomoso, Oyo State, Nigeria while the Moringa leaves were obtained from the Ladoko Akintola University of Technology research farm, Ogbomoso, Oyo State, Nigeria.

### Production of ogi

Ogi was prepared using a method described by Akingbala et al. [15] with slight modifications. Maize was thoroughly cleaned by picking out all broken kernels together with other foreign particles and then sorted to obtain the good ones. Then the maize kernels were washed, soaked in a bucket and allowed to steep for 72 hrs at room temperature (27°C).

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The steep water was changed each day for the three days. After the third day, the steep water was discarded and the grains wet milled using a grinding machine/grinder. The milled slurry was then wet sieved using a muslin cloth to remove bran, hull and germ. The pomace was then retained on the sieve and discarded while the ogi slurry was collected in a muslin cloth and hand squeezed to remove excess water leaving behind a semi wet ogi which was then dried 50°C for 48 h in the cabinet drier to obtain dry ogi powder.

### Preparation of moringa-ogi powder

*Moringa oleifera* leaf powder was produced as follows, freshly plucked Moringa leaves were weighed, cleaned (rinsed) and dried at 45°C in the cabinet dryer. It was then blended, allowed to cool and packaged in cellophane bags until it was needed for further use. Ogi powder was supplemented with dried moringa leaves at substitution level of 0,10, and 15, and then mixed thoroughly to obtain homogenous moringa-ogi powder.

### Determination of proximate composition

The different formulations of moringa- fortified ogi s the cabinet drier to obtain dry ogi powder the cabinet drier to obtain dry ogi powder samples were analyzed for moisture, ash, crude fibre, protein (N<sup>6</sup>.25), crude fat and the carbohydrate determined by difference according to the method described by AOAC [16] (Figure 1).

### Determination of minerals

Selected minerals including calcium, magnesium, iron, potassium, zinc, and copper were extracted from dry ashed samples and determined by atomic absorption spectrophotometer [16].

### Swelling capacity

The swelling power was determined by the method described by Tester and Morrison [17]. About 0.2 g ground samples (<60 mesh) was suspended in 10 mL of water and incubated in a thermostatically controlled water bath at 95°C in a tarred screw cap tube of 15 mL. The suspension was stirred intermittently over 30 min periods to keep the starch granules suspended. The tubes were then rapidly cooled to room temperature (27°C). The cool paste was centrifuged at 2200 x g for 15 min to separate the gel and the supernatant. Then, the aqueous supernatant was removed and the weight of the swollen sediment was determined.

### Sensory evaluation

Ogi was prepared by making the flour into slurry and heating it on fire with constant stirring using a clean stirrer until it forms a thick paste. The prepared ogi was then dished into sample plates labeled randomly. Sensory evaluation of the composite ogi samples was carried out by a trained panel of ten people comprising of the students of the Ladoke Akintola University of Technology, Ogbomoso who are familiar with the product. It was served hot on randomly coded plates. The parameters tested for are appeal, colour, mouth feel, and taste and flavour using a nine point hedonic scale ranging from 9 = like extremely to 1= dislike extremely.

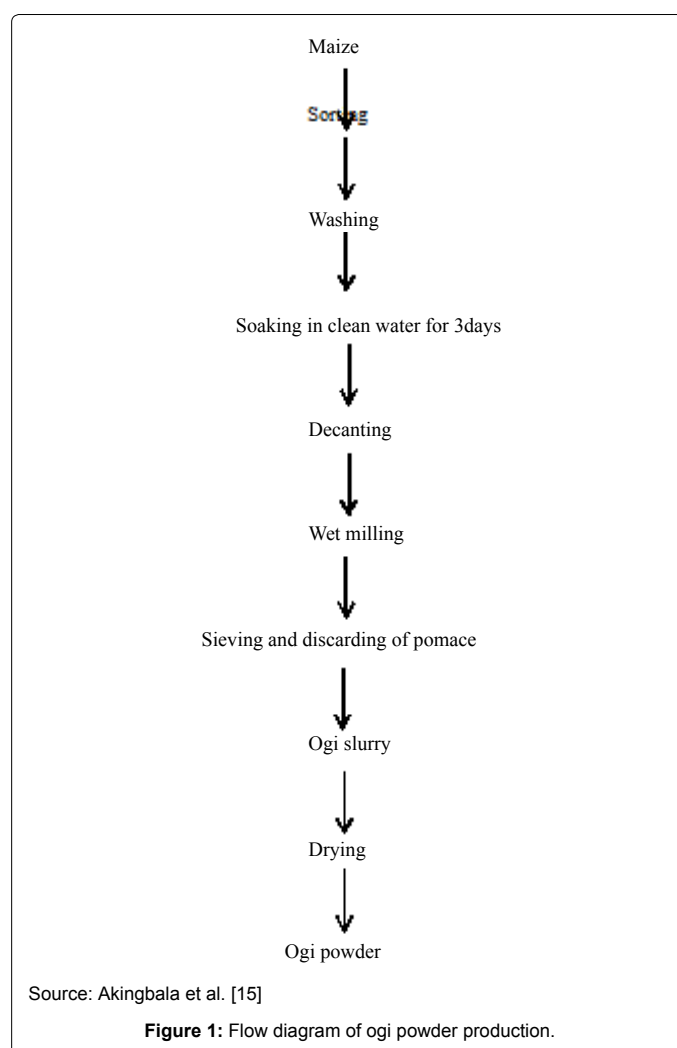
### Statistical analysis

Statistical analysis of all data was done with the Statistical Analysis Systems (SAS) package (version 9.2 of SAS institute Inc). Statistically significant differences (p<0.05) in all data were determined by General Linear Model procedure (GLM) while Least Significant Difference (LSD) was used to separate the means.

## Result and Discussion

### Proximate composition

The proximate composition of the powdered ogi samples is as presented in Table 1. There was increase in the protein content with increase in the level of substitution and it was significantly (p<0.05) different. The ogi sample with 15% moringa leaf substitution had the highest value of protein (17.63 %) while the ogi sample with 0% moringa leaf substitution had the lowest (9.10 %). There was about 94% increase in the protein content of the ogi sample. The protein content obtained is comparable to other fortified Ogi [12,18]. This is also a reflection of the report that moringa leaf is high in protein content. There was increase in the values of the mineral content and the crude fibre with increase in the level of substitution. Ogi sample substituted with 15% moringa leaf also recorded a high value in the crude fibre and mineral composition. There were no significant differences in the fat content of the ogi samples. The percentage carbohydrate for the samples ranged between 63.57% and 74.57%. The proximate composition of the samples revealed that the non- supplemented sample had the lowest values for crude protein and ash content. This is similar to the reports from studies in which ogi was supplemented with other substances such as okra seed meal, soybean [11,19,20]. These changes in nutritional value of the moringa leaf fortified ogi samples may be attributed to



Sample	Moisture content	Protein	Fat	Ash	Crude fibre	CHO
A	8.63 <sup>a</sup>	9.10 <sup>c</sup>	3.57 <sup>a</sup>	1.67 <sup>c</sup>	2.47 <sup>c</sup>	74.57 <sup>a</sup>
B	8.67 <sup>c</sup>	13.23 <sup>b</sup>	3.63 <sup>a</sup>	2.30 <sup>b</sup>	2.83 <sup>b</sup>	69.33 <sup>b</sup>
C	8.90 <sup>a</sup>	17.63 <sup>a</sup>	3.73 <sup>a</sup>	3.10 <sup>a</sup>	3.37 <sup>a</sup>	63.57 <sup>c</sup>

Means having the same superscript along the same column are not significantly different ( $p < 0.05$ ) from each other.

A – 100% maize-ogi; B – 90% maize-ogi and 10% moringa leaves powder; C – 85% maize-ogi and 15% moringa leaves powder.

**Table 1:** Proximate composition of *Moringa* fortified maize-ogi (%).

Samples	Calcium	Magnesium	Iron	Potassium	Zinc	Copper
A	125.01 <sup>c</sup>	36.67 <sup>c</sup>	4.67 <sup>c</sup>	21.67 <sup>c</sup>	0.23 <sup>c</sup>	0.37 <sup>c</sup>
B	360.02 <sup>b</sup>	95.05 <sup>b</sup>	7.37 <sup>b</sup>	183.33 <sup>b</sup>	0.43 <sup>b</sup>	0.53 <sup>b</sup>
C	445.1 <sup>a</sup>	135.01 <sup>a</sup>	12.77 <sup>a</sup>	233.33 <sup>a</sup>	0.63 <sup>a</sup>	0.53 <sup>a</sup>

**Table 2:** Mineral composition of moringa fortified maize- ogi samples (mg/100 g).

Samples	Beta-Carotene content ( $\mu\text{g}/100\text{ g}$ )
A	121.67 <sup>c</sup>
B	838.33 <sup>b</sup>
C	1058.33 <sup>a</sup>

Means having the same superscript along the same column are not significantly different ( $p < 0.05$ ) from each other. A – 100% maize-ogi; B – 90% maize-ogi and 10% moringa leaves powder; C – 85% maize-ogi and 15% moringa leaves powder.

**Table 3:** Beta-Carotene content of moringa fortified maize-ogi samples.

Samples	Swelling capacity
A	28.13 <sup>a</sup>
B	27.59 <sup>b</sup>
C	22.79 <sup>c</sup>

Means having the same superscript along the same column are not significantly different ( $p < 0.05$ ) from each other. A – 100% maize-ogi; B – 90% maize-ogi and 10% moringa leaves powder; C – 85% maize-ogi and 15% moringa leaves powder.

**Table 4:** Swelling capacity of moringa fortified maize-ogi samples.

Samples	Colour	Taste	Mouth feel	Appeal	Flavour	General acceptability
A	7.60 <sup>a</sup>	7.20 <sup>a</sup>	6.60 <sup>a</sup>	7.00 <sup>a</sup>	6.70 <sup>a</sup>	7.50 <sup>a</sup>
B	6.50 <sup>b</sup>	6.20 <sup>ab</sup>	5.50 <sup>ab</sup>	5.80 <sup>b</sup>	5.60 <sup>ab</sup>	6.10 <sup>b</sup>
C	5.70 <sup>c</sup>	5.70 <sup>b</sup>	5.20 <sup>b</sup>	5.40 <sup>c</sup>	5.10 <sup>b</sup>	5.80 <sup>b</sup>

Means having the same superscript along the same column are not significantly different ( $p < 0.05$ ) from each other.

A – 100% maize-ogi; B – 90% maize-ogi and 10% moringa leaves powder; C – 85% maize-ogi and 15% moringa leaves powder.

**Table 5:** Sensory evaluation of moringa fortified maize-ogi samples.

the relatively higher protein, fat and ash contents of moringa leaves compared to the non-supplemented ogi sample.

The result of the analysis of selected minerals is as presented in Table 2. There was an increase in mineral content with increase in moringa leaves powder addition; this was recorded in each of the minerals such as in the increase in calcium from 125 mg/100 g to 445 mg/100 g, and increase in the iron content from 4.67 mg/100 g to 12.77 mg/100 g. Since moringa are good sources of beta carotene, there was an increase in the beta-carotene content with increase in the level of substitution (Table 3). There was an increase from 121.67 to 1058.33  $\mu\text{g}/100\text{ g}$  with increase in moringa substitution. Fortification of ogi sample with moringa leaves will go a long way to alleviate the problem of vitamin A deficiency since beta-carotene is a precursor of vitamin

A. Vitamin A deficiency is a great concern in developing countries, Nigeria inclusive.

The swelling capacity of the samples is as presented in Table 4. There was a decrease in swelling capacity with increased moringa leaves powder addition. The values for the swelling capacity ranged from 22.79 to 28.13% and the values are significantly ( $p < 0.05$ ) different. The sample that has no moringa leaves substitution had the highest value while the ogi samples substituted with moringa leaves had lower values. The results from this study indicated a reduction in swelling capacity with increase in moringa leaves substitution and this means that more of the ogi can be consumed in terms of quantity [21] (Table 5).

The results of the sensory analysis showed that the sample with 10% moringa leaves substitution was rated close to the samples with 0% substitution ogi in terms of taste, mouth feel, and flavour but was significantly different from it in terms of colour, appeal and general acceptability. This could mean that the sensory and the nutritional attributes could be married to obtain nutritional and acceptable ogi samples [22].

## Conclusion

This study revealed that incorporation of 15% moringa leaf in the production of ogi powder produced from maize significantly improved the nutritional qualities of the ogi samples. The sample with 10% moringa leaf substitution had comparable sensory properties with unfortified samples. This could mean that an acceptable moringa fortified ogi can be produced at 10% level of substitution.

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