

Full Length Research Paper

## Proximate composition and sensory properties of moringa fortified yellow maize-ogi

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'Ogi' was produced from yellow variety of maize to obtain a fermented gruel from ogi and the effect of moringa leaves fortification on the nutritional value and the sensory properties of yellow maize-ogi was investigated. The moringa leaf powder was substituted into yellow maize-ogi in these formulations; 100:0, 90:10 and 85:15. The effects of the moringa leaves powder substitution on the proximate content, mineral content, beta- carotene, swelling capacity and the sensory properties were determined. The sample with 15% moringa leaf substitution had about 95% increases in protein content. The crude fibre and ash contents increased from 2.33 and 1.75% to 3.57 and 2.33% with sample substituted with 15% moringa leaf having the highest. 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 increased from 136.0 to 466.0 mg/100 g; magnesium from 31.67 to 123.00 mg/100 g; iron increased from 5.23 to 14.77 mg/100 g; potassium from 33.33 to 215.00 mg/100g; zinc from 0.20 to 0.73 mg/100 g and copper from 0.27 to 0.60 mg/100 g. Beta – carotene of 1126.67 µg/100 g was obtained with 15% moringa leaf substitution. The swelling capacity decreased with increase in the level of moringa leaf substitution. This study revealed that fortification of ogi with moringa leaves at 10% improved the nutritional quality of ogi and was still generally acceptable.

**Key words:** Maize, yellow maize-ogi, substitution, moringa leaves, fortification.

### INTRODUCTION

'Ogi', a fermented gruel or porridge made from maize (*Zea mays*), sorghum (*Sorghum bicolor*) or millet (*Pennisetum glaucum*) is a common food in West Africa. It serves as a major weaning food for infants, a breakfast meal for both children and adults and sometimes it is chosen as food for the sick (Oyewole, 1997). The colour of ogi depends on the colour of the cereals from which the ogi is made, white to cream for maize, reddish brown for sorghum and dirty grey for millet (Ohenhen and ikenebomeh, 2007). The nutritional value of Ogi is deficient in some nutrients especially lysine because of the poor processing techniques involved in its traditional production (Adeyemi and Beckly, 1986; Adeniyi and Porter, 1978; Adeyemi et al., 1987).

Maize is the third most important cereal food in the world and it is a staple food for more than one billion people in

sub-saharan African and Latin America (Akinbode and Bamire, 2015). It's high in carbohydrates but lacks essential micronutrients such as vitamin A. New varieties of maize called yellow maize which is rich in vitamin A have been developed in Nigeria to alleviate the problem of vitamin A deficiency (Uchendu, 2013).

*Moringa oleifera* is an underutilized perennial tree with various uses. The young leaves are edible and can be consumed fresh, cooked and eaten like spinach or used for soups and salads. The leaves can also be stored as dried powder for many months without refrigeration and without loss of nutritional value. *Moringa* leaf is an inexpensive source of cheap and abundant source of proteins, carbohydrate, minerals, vitamins and fibres to most vulnerable groups. Edible leaves from vegetable plants are rich source of beta-carotene a precursor for

vitamin A (Eroarome, 2004). The powder has the highest protein content than any other vegetable. Fresh leaves of *Moringa oleifera* contain at least twice more proteins than the protein of milk and of eggs (Broin, 2006).

Several authors have reported improvement in the nutritional quality of ogi by fortifying it with other food substances such as soybean (Nnam, 2000, Oluwamukomi *et al.*, 2005; Adelekan and Oyewole, 2010); cowpea (Sanni *et al.*, 2001, Egounlety *et al.*, 2002); mellon (Osundahunsi and Aworh, 2003), okra (Akingbala *et al.*, 2005, Aminigo and Akingbala, 2004), The yellow variety of maize used was obtained from a local market in Ogbomoso, Oyo State, Nigeria while the Moringa leaves were obtained from the research farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

### Production of ogi

Ogi was prepared using a method described by Akingbala *et al.* (1981) with a slight modification. The yellow 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 grains were washed, soaked in a bucket and allowed to steep for 72 h at room temperature (27 °C). The steep water was changed each day for the three days. After the

### Preparation of Moringa-ogi powder

Moringa-ogi powder was produced by blending ogi powder and moringa powder in the different proportions needed for the formulations i.e. 100:0, 90:10 and 85:15 and then thoroughly mixed to obtain homogenous ogi samples.

### Determination of Proximate Composition

The different formulations of moringa- fortified ogi samples were analyzed for moisture, ash, crude fibre, protein (N\*6.25), crude fat and the carbohydrate determined by difference according to the method described by AOAC (2005).

### 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 (AOAC, 2005).

### Swelling capacity

The swelling power of the ogi sample was determined by the method described by Tester and Morrison (1990). About 0.2 g ground samples (< 60 mesh) was suspended in 10 mL of water and incubated in a thermostatically

Baobab fruit (Adejuyitan *et al.*, 2012) and groundnut seed (Ajanaku *et al.*, 2012). This work is therefore aimed at investigating the effect of moringa leaves powder fortification on the nutritional composition and sensory properties of ogi produced from yellow variety of maize thus producing nutritionally and affordable weaning food or breakfast food for the populace.

## MATERIALS AND METHODS

third day, the steep water was discarded and the grains were 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 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 at 50 °C for 48 h in the cabinet drier to obtain dry ogi powder.

### Preparation of Moringa Powder

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.

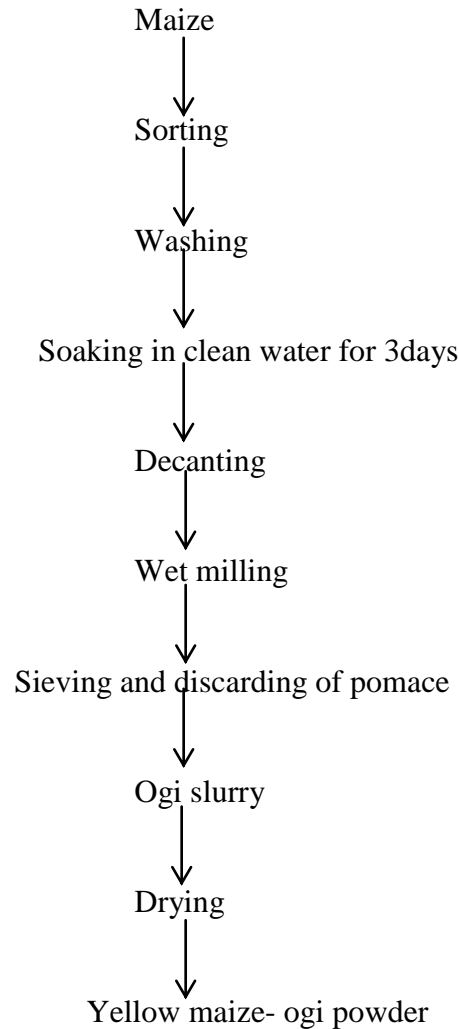
controlled water bath at 95 °C in a tarred screw cap tube of 15 mL. The suspension was stirred intermittently over 30 min periods to keep the starch granules suspended. The tubes were then rapidly cooled to room temperature (27 °C). The cool paste was centrifuged, at 2200 x g for 15 min to separate the 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 by heating on fire with constant stirring until a thick paste was formed. The prepared ogi was then dished into sample plates for the panelist. Sensory evaluation of the composite ogi samples was carried out by a panel of ten people comprising of the students of the Ladoke Akintola University of Technology, Ogbomoso who are familiar with the product. The parameters tested for are appeal, colour, mouthfeel, 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, 2003). Statistically significant differences ( $p < 0.05$ ) in all data were determined by General Linear Model procedure (GLM) while Least



**Figure 1.** Flow diagram of production of Ogi powder  
Source: Akingbala et al. (1981).

**Table 1.** Proximate composition of *Moringa* fortified yellow-Maize-ogi.

Samples	Moisture Content	Crude Protein	Crude fat	Crude fibre	Ash	CHO
A	9.13a	9.23a	3.56a	2.33c	1.70c	74.04a
B	8.63b	13.03b	3.70ab	2.93b	2.50b	69.20b
C	8.77b	18.00c	3.87a	3.57a	3.30a	62.50c

Means with the same alphabet in the same column are not significantly ( $p < 0.05$ ) different from each other.

A – 100% yellow maize-ogi,

B – 90% yellow maize-ogi and 10% moringa leaves powder

C - 85% yellow maize-ogi and 15% moringa leaves powder

Significant Difference (LSD) was used to separate the means.

is as presented in Table 1. The sample with 15% moringa leave substitution had the highest protein content (18.00 %) while the sample with no moringa substitution had the lowest (9.13 %). The proximate composition of the

## RESULT

The proximate composition of the powdered ogi samples fortified ogi samples revealed an increase in the nutritional content. This is similar to the reports from studies in which ogi was supplemented with other substances such as okra seed meal, soybean (Aminigo

**Table 2.** Mineral composition of moringa fortified yellow maize -ogi samples.

Sample	Calcium	Magnesium	Iron	Potassium	Zinc	Copper
A	136.6c	31.67c	5.23c	33.33c	0.20c	0.27c
B	3.85b	80.00b	8.37b	173.33b	0.50b	0.50b
C	466.0a	123.00a	14.77a	215.00a	0.73a	0.60a

Means with the same alphabet in the same column are not significantly ( $p < 0.05$ ) different from each other.

A – 100% yellow maize-ogi,

B – 90% yellow maize-ogi and 10% moringa leaves powder

C - 85% yellow maize-ogi and 15% moringa leaves powder.

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

Sample	Beta-Carotene content ( $\mu\text{g}/100\text{g}$ )
A	141.67a
B	858.33b
C	1126.67c

Means with the same alphabet in the same column are not significantly ( $p < 0.05$ ) different from each other

A – 100% yellow maize-ogi,

B – 90% yellow maize-ogi and 10% moringa leaves powder

C - 85% yellow maize-ogi and 15% moringa leaves powder.

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

Sample	Swelling capacity
A	33.33a
B	24.00b
C	10.00c

Means with the same alphabet in the same column are not significantly ( $p < 0.05$ ) different from each other

A – 100% yellow maize-ogi,

B – 90% yellow maize-ogi and 10% moringa leaves powder.

C - 85% yellow maize-ogi and 15% moringa leaves powder.

and Akingbala, 2004; Akinrele *et al.*, 1971; Adesokan *et al.*, 2011). The increase is higher compared to other researchers; Ajanaku *et al.* (2012) who obtained about 258% percentage increase in sorghum-ogi sample but with 100% level of substitution with groundnut seed. Aminigo and Akingbala (2004) also obtained about 122 and 106% increase in protein content with 20% substitution with defatted and roasted okra seed meals. There was increase in the crude fibre and ash content with increase in the level of moringa substitution. This is a reflection of the composition of moringa leaves, it is reported to have about 13.2% ash content and 8.51% crude fibre (Melesse, 2011). The percentage carbohydrate for the samples ranged between 62.50% and 74.04%.

The result of the analysis of selected minerals is as presented in Table 2. An increase in mineral content with

increase in moringa leaves powder substitution addition was recorded in all the mineral content tested. There was increase in the calcium content from 136 mg/100 g to 466 mg/100 g, iron content from 5.23 mg/100 g to 14.77 mg/100 g, the magnesium increased from 31.67 to 123.00 mg/100 g, the potassium 33.33 to 215.00 mg/100 g, Zinc from 0.23 to 0.73 mg/100 g and copper from 0.27 to 0.60 mg/100 g. There was increase in the beta-carotene content with increase in the level of moringa leaf substitution as shown in Table 3. The beta-carotene is very important for sight and general immunity of the body. The swelling capacity of the ogi samples is as presented in Table 4. There was a decrease in swelling capacity with increase in moringa leaves powder substitution. The values for the swelling capacity ranged from 10.00 % - 33.33 %. The results from this study showed that there was a reduction in swelling capacity with increase in mor-

**Table 5.** Evaluation of the sensory properties of moringa fortified yellow maize- ogi samples.

Samples	Colour	Taste	Mouth feel	Appeal	Flavour	General acceptability
A	8.40a	8.10a	7.60a	8.00a	6.80a	8.40a
B	6.40b	5.60a	5.80b	5.30b	5.40ab	6.20b
C	5.50c	5.20b	5.70b	4.50b	5.70ab	5.10b

Means with the same alphabet in the same column are not significantly ( $p < 0.05$ ) different from each other

A – 100% yellow maize-ogi,

B – 90% yellow maize-ogi and 10% moringa leaves powder

C - 85% yellow maize-ogi and 15% moringa leaves powder

moringa leaves powder addition and this means that more of the ogi can be consumed in terms of quantity.

The result of the sensory evaluation of the ogi samples is as shown in Table 5. The result showed that the sample substituted with 10% moringa leaf did not have any

significant ( $p < 0.05$ ) difference in taste with the unfortified ogi samples. This indicates that the sample with 10% substitution had a close rating with the unfortified samples.

## CONCLUSION

This research work reflected the effects of moringa leaf substitution on the nutritional value of the yellow-ogi samples. There was increase in the protein content, ash content and crude fibre. The samples substituted with 15% moringa leaf powder recorded a good nutritional content while the yellow-ogi sample substituted with 10%

moringa leaf did not have a significant ( $p < 0.05$ ) difference in taste. This reveals that fortification of yellow maize ogi with *moringa oleifera* leaf is possible and this will also enhance the nutritional status of the populace especially the children and adult who consume ogi as breakfast foods.

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