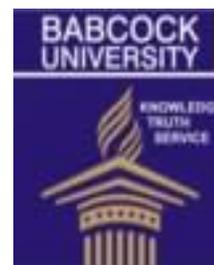




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Nutrient and sensory evaluation of sorghum ogi fortified with moringa leaf powder

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Abstract

The work aimed at investigating the effect of fortification of ogi with Moringa leaf powder on the nutritive value and sensory properties and to provide nutritive food for people in Nigeria. Moringa leaf powder and Sorghum ogi powder were prepared in different percent formulations, and nutrient and sensory evaluation was carried out. The data were analyzed using Statistical Analysis System (SAS) package. The results showed that with increasing addition level of moringa leaf powder, there was a significant ($p > 0.05$) increase in crude fat, crude fiber, dietary fiber, mineral contents (Na, K, Ca, P, Fe, Cu and Zn) and selected vitamins (A, B1, B2, B3, B6 and C). While the moisture content and carbohydrate reduced, t Brai J.N here was no significant difference in the percent crude protein. There was a decrease in the swelling capacity of the ogi sample with an increase in added moringa powder. The sensory evaluation of percent sorghum ogi A and the fortified ogi samples B, C and D gave B and C (5% and 10%) as the most acceptable ogi sample among the fortified ogi, while A (100% sorghum ogi) ranked best. The concluding results showed that the sorghum/moringa ogi samples with 10% moringa fortification had the second highest nutrient composition with the highest acceptable sensory attributes among the B, C and D fortified samples.

Keywords: Nutrient; Sensory properties; Sorghum; Moringa

Introduction

Moringa Oleifera is a type of vegetable plant shrub (Roloff *et al* 2009) – italicize the *et al.*, it is native to Indian Subcontinent and has become naturalized in the tropical and subtropical areas around the world (Fahey, 2005), it is also known to be very useful (Khalafalla *et. al.*, 2010) as food and medication. Moringa is considered to be one of the most nutrient-rich plant (Ayotunde *et.al.* 2011, Nadeem *et. al.*, 2012, Anwar *et.al.* 2007)

Sorghum is a very important crop that serves as human dietary staple for more than 500 million people in Africa and Asia (ICRISAT 2015). It is well suited to the semi- arid and sub- tropical climate conditions of Africa (Doggett 1988).

Ogi is a fermented cereal pudding from West Africa typically made from Maize, Sorghum or Millet, it is one of the most popular and widely used local pudding that is eaten by infants (Nago *et .al.*,1998), children, adolescents and adults. In Nigeria and other parts of West Africa, 90% of the infants are introduced to complementary foods after 6 months of breast feeding. (Faber, 2001), and ogi is used for this purpose. Ogi is also consumed by breast feeding mothers to stimulate the production of milk as well as given to sick and recovering patients due to its soft consistency. During the period when infants are fed with complementary foods, the children are said to be highly vulnerable to malnutrition, so there is need to provide them with semi solid foods that provide adequate nutrients for a growing infant (FAO/WHO, 1998).

Ogi is mostly prepared using traditional methods (Marero *et. al.*, 1989), as a result, there is a great loss of nutrients(Brown *et. al.*, 1998, Aminigo and Akingbala, 2004, Akobundu and Hoskins, 1982). The loss of nutrients during the processing of ogi led to lots of attempts to fortify ogi (Osungbaro *et. al.*, 2000, Sanni *et. el.* 2001) so as to improve their nutrient composition.

This work aimed at evaluating the effect of fortification of sorghum ogi with moringa leaf powder on its nutrient composition and sensory properties.

Material and methods

Materials

The food commodities; sorghum, and moringa were purchased from garage market Ikorodu, Lagos, Nigeria.

Methods

Preparation of sorghum ogi

The ogi was prepared using Akingbala *et al* (1981) method which was done with a slight modification. The sorghum was cleaned thoroughly and after which, the broken kernels and other foreign particles were sorted out. Then the sorghum grains were washed,

soaked in a bucket and allowed to steep for 72 hours at room temperature (27 °C). The steep water was not changed for three days. After the third day, the steep water was thrown away and the grains were wet milled using a grinding machine. The milled slurry was then wet sieved using a muslin cloth to remove bran, hull and germ. The ogi slurry was then collected in a muslin cloth and hand squeezed to remove excess water leaving behind a semi wet ogi after which it was dried at 80°C for 8 hrs in the oven in order to obtain dry ogi powder.

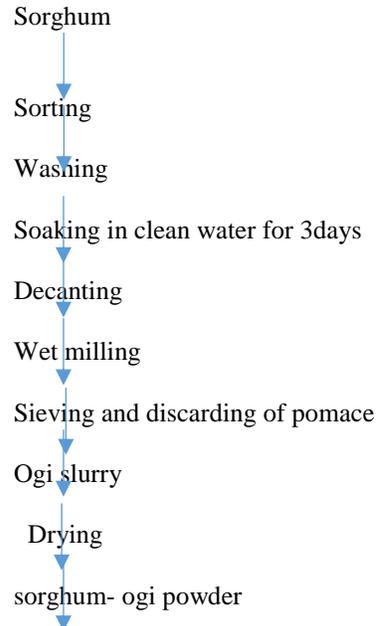


Figure 1- processing of sorghum ogi powder.

Preparation of moringa powder

Freshly plucked Moringa leaves were cleaned (rinsed) and dried at room temperature for 3 days. They were then blended, allowed to cool and then packaged in cellophane bags until used.

Preparation of moringa-sorghum ogi powder

Moringa-sorghum ogi powder were produced by blending sorghum ogi powder and moringa powder in the following different formulations i.e.

Sample A: 100% sorghum ogi powder and 0% moringa powder

Sample B: 95% sorghum ogi powder and 5% moringa powder

Sample C: 90% sorghum ogi powder and 10% moringa powder

Sample D: 85% sorghum ogi powder and 15% moringa powder.

Determination of proximate composition

The different formulations of sorghum ogi powder fortified with moringa powder samples were analyzed for moisture, ash, crude fibre, crude protein, crude fat, carbohydrate, gross energy, dietary fibre and selected vitamins and minerals. The Samples were analyzed chemically according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 18TH EDITION, 2005). All analysis were carried out in duplicate.

Sensory evaluation

Ogi was prepared by making the flour into slurry by heating on fire with constant stirring until a thick paste will be formed. The total weight of sample used was 100g. The sample were weighed in to 4 different portions.

Sample 1: 100g of ogi powder and 0g of moringa powder

Sample 2: 95g of ogi powder and 5g of moringa powder

Sample 3: 90g of ogi powder and 10g of moringa powder

Sample 4: 85g of ogi powder and 15g of moringa powder

Sensory evaluation of the composite ogi samples was carried out by a panel of 10 people comprising of the students and staff of Babcock University. The 9 point hedonic scale, the attributes investigated for includes of the color, aroma, taste, appearance, texture, mouthfeel, flavor, and overall acceptability.

Statistical analysis

Statistical analysis of all data was done with the Statistical Analysis Systems (SAS) package (version 9.2 of SAS institute Inc). All the data were analyzed using Docan with Statistically significant differences ($p < 0.05$).

Results

Table1-Proximate composition of sorghum ogi powder fortified with moringa leaf powder

PARAMETERS%	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
MOISTURE	10.990 ^a	10.507 ^b	10.350 ^c	10.207 ^d
CRUDE PROTEIN	9.4800 ^a	10.333 ^a	10.630 ^a	10.983 ^a
CRUDE FAT	2.710 ^d	2.8033 ^c	3.0133 ^b	3.180 ^a
CRUDE FIBRE	2.083 ^d	2.203 ^c	2.550 ^b	2.693 ^a
ASH	1.966 ^d	2.350 ^c	2.683 ^b	2.947 ^a
CARBONHYDRATE	72.77 ^a	72.08 ^b	70.77 ^c	69.99 ^d
G.E(Kcl/g)	3.344 ^d	3.384 ^c	3.450 ^b	3.482 ^a
Dietary fibre	6.807 ^d	8.090 ^c	8.817 ^b	9.127 ^a

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

Sample A: 100% sorghum ogi powder and 0% moringa powder

Sample B: 95% sorghum ogi powder and 5% moringa powder

Sample C: 90% sorghum ogi powder and 10% moringa powder

Sample D: 85% sorghum ogi powder and 15% moringa powder

Table 2 - Mineral content of the sorghum ogi powder fortified with moringa leaf powder

PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
%Na	0.0150 ^d	0.0310 ^c	0.0587 ^b	0.0710 ^a
%K	0.350 ^d	0.379 ^c	0.405 ^b	0.420 ^a
%Ca	0.032 ^d	0.045 ^c	0.078 ^b	0.091 ^a
%P	0.290 ^d	0.304 ^c	0.330 ^b	0.345 ^a
%Mg	0.082 ^b	0.129 ^{ab}	0.169 ^a	0.187 ^a
Fe(mg/kg)	45.067 ^d	46.500 ^c	48.267 ^b	50.067 ^a
Cu(mg/kg)	4.700 ^d	5.500 ^c	6.567 ^b	7.467 ^a
Zn(mg/kg)	21.400 ^d	23.467 ^c	24.867 ^b	26.100 ^a

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

Sample A: 100% sorghum ogi powder and 0% moringa powder

Sample B: 95% sorghum ogi powder and 5% moringa powder

Sample C: 90% sorghum ogi powder and 10% moringa powder

Sample D: 85% sorghum ogi powder and 15% moringa powder

Table 3- Vitamin content of sorghum powder fortified with moringa leaf powder

PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
VITA(μ g/100g)	234.633 ^d	236.233 ^c	238.367 ^b	247.400 ^a
VIT B6(mg/100g)	0.486 ^d	0.610 ^c	0.693 ^b	0.830 ^a
VIT B3(mg/100g)	4.547 ^d	4.767 ^c	5.017 ^b	5.663 ^a
VIT B1(mg/100g)	0.310 ^d	0.550 ^c	0.647 ^b	0.807 ^a
VIT B2(mg/100g)	0.130 ^d	0.210 ^c	0.353 ^b	0.447 ^a
VITAMIN C (mg/100g)	0.011 ^d	1.850 ^c	2.040 ^b	2.180 ^a

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

Sample A: 100% sorghum ogi powder and 0% moringa powder

Sample B: 95% sorghum ogi powder and 5% moringa powder

Sample C: 90% sorghum ogi powder and 10% moringa powder

Sample D: 85% sorghum ogi powder and 15% moringa powder

Table- 4 Swelling capacity of sorghum powder fortified with moringa leaf powder

PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
SWELLING CAPACITY	13.690 ^a	13.513 ^b	13.207 ^c	13.017 ^d

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

Sample A: 100% sorghum ogi powder and 0% moringa powder

Sample B: 95% sorghum ogi powder and 5% moringa powder

Sample C: 90% sorghum ogi powder and 10% moringa powder

Sample D: 85% sorghum ogi powder and 15% moringa powder

Table -5 Sensory evaluation of sorghum ogi fortified with moringa leaf powder

PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
APPEAL	8.20 ^a	7.70 ^a	6.60 ^b	5.50 ^c
COLOUR	8.60 ^a	8.00 ^a	6.70 ^b	6.00 ^b
APPERANCE	8.40 ^a	8.00 ^a	6.20 ^b	5.6 ^b
TEXTURE	8.20 ^a	7.70 ^{ab}	7.20 ^{bc}	6.60 ^c
MOUTHFEEL	8.30 ^a	7.90 ^{ab}	7.20 ^{bc}	7.00 ^c
AROMA	8.20 ^a	7.80 ^a	6.30 ^b	6.10 ^b
TASTE	8.10 ^a	7.60 ^a	6.60 ^a	6.10 ^b
OVER-all ACCEPTABILITY	8.40 ^a	6.70 ^b	6.50 ^b	5.80 ^c

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

Table 1 shows the proximate composition of the samples. Sample A with 0% moringa had the highest level of moisture, while sample D with 15% moringa had the lowest moisture content and this difference was significant ($p < 0.05$) The moisture content of the sample decreases with an increase in the level of *Moringa Oleifera* powder. The table also shows that there was no significant difference in the level of crude protein content in the samples. There was also an increase in the composition of crude fat, with sample D having the highest and sample A having the lowest at 5 percent level of probability. There was an increase in the level of crude fibre which ranged from 2.083 – 2.693 with sample D having the highest significant value. There was also a reduction in the carbohydrate level with sample D having the lowest amount. The percentage carbohydrate for the samples ranged between 69.99% and 72.77% and they were significantly different ($p < 0.05$). The proximate composition of the samples revealed that the non-supplemented sample had the lowest values ash

content and it was significant ($p < 0.05$). There was an increase in the gross energy level with sample D having the highest value and sample A having the lowest and they were significant. There was also a significant difference in the dietary fibre with sample D having the highest value and sample A having the lowest value and they were significant.

Table 2 shows the minerals content of the samples. The mineral content was significantly ($p < 0.05$) increased with increase in moringa powder; the increase was recorded in each of the minerals such as in Na (0.015-0.071), K (0.350 - 0.420%), Ca (0.032-0.091%), P (0.290-0.345%), Fe (45.067-50.067mg/kg), Cu (4.700-7.467mg/kg) and Zn (21.400-26.100mg/kg), with sample A having the lowest amount and sample D having the highest amount.

Table 3 shows the result of the composition of some selected vitamins. The vitamin contents were significantly ($p < 0.05$) increased with increase in moringa powder, the increase were recorded in each of

the vitamins. Vitamin A (234.633 – 247.400 µg/100g), Vitamin B6 (0.486-0.830mg/100g), Vitamin B3 (4.547-5.663mg/100g), Vitamin B1 (0.310-0.807mg/100g), Vitamin B2 (0.130-0.447mg/100g) and Vitamin C (0.011-2.180mg/100g).

The swelling capacity of the samples as presented in Table 4. There was a decrease in swelling capacity with increased addition of moringa leaves powder. The values for the swelling capacity ranged from 13.690g/g to 13.017 and the values are significantly different ($p < 0.05$). The sample ogi that has no moringa leaf powder substitution had the highest value while the ogi samples substituted with moringa leaf had lower values.

The sensory evaluation of the samples were presented in Table 5. There was no significant difference in appeal between Sample A and sample B but there was a reduction in the appeal in samples C and sample D. There was no significant difference in color between Sample A and sample B and there was no significant difference between sample C and D. There was no significant difference in Appearance between Sample A and sample B and there was no significant difference between sample C and D. There was no significant difference in Aroma between Sample A and sample B and there was no significant difference between sample C and D. There was no significant difference in taste between Sample A, B and C, while there was a significant difference in sample D.

The overall acceptability shows that sample A had the highest level of acceptability, there was no significant difference between sample B and C while sample D had the lowest level of overall acceptability.

Discussion

The moisture content of the sample decreased with an increase in the level of Moringa oleifera powder. This indicates that addition of Moringa oleifera powder gives the gruel a good keeping quality, considering that spoilage microbes thrive better in the presence of adequate moisture which was reported by Damodaran and Parkin (2008). Upon the addition of Moringa oleifera powder, the fat content was observed to be comparable with a research done by Demaeyer (1976), who recommended a low fat content diet (2-4%) for weaning food. This is because the high fat content of a food sample can affect its shelf life. Fat can undergo oxidative deterioration which leads to rancidification and spoilage, thereby reducing the shelf life of the food sample. Hence, a food with high fat content is prone to spoilage than one with low fat content. The carbohydrate content decreased with increase in level of Moringa oleifera leaf powder, in agreement with the observation made by Mbata *et al.* (2009), where the addition of plant to cereal-based traditional foods resulted in carbohydrate content reduction. The increase in mineral and vitamin contents of the

samples as a result of increase in the level of Moringa oleifera was attributed to the Moringa oleifera powder which have been found to be rich in potassium and calcium (Jideani and Diedericks, 2014), other minerals and vitamins. Studies have revealed the leaves to combat malnutrition, especially among infants and nursing mothers (Nadeem *et al.*, 2012). The results from this study indicated a reduction in swelling capacity with increase in moringa leaves powder which also agrees with the research by Akinrele (1970). The sensory Evaluation showed that samples B and C had the closest level but next level to acceptability of sample A. (0%), in terms of acceptability. But Sample C had higher level of nutrient composition. This could mean that the sensory and the nutritional attributes could be combined to obtain nutritional and acceptable ogi samples Egunlety *et al* (2002).

Conclusion and recommendation

The research showed that addition of 10% moringa oleifera leaf powder to ogi led to an increase in nutrients content (minerals and vitamins) and sensory acceptability of sorghum ogi. The fortification of sorghum ogi with 10% of moringa oleifera leaf powder is thus recommended.

References

- Akobundu E.N.T, Hoskins F.H (1982). Protein losses in traditional agidi paste. *J. Food Sci.* 47:1728-1729.
- Akingbala, J.O., Rooney L.W, Faubion, J.M (1981) A Laboratory Procedure for the preparation of ogi, A Nigerian Fermented Food <https://doi.org/10.1111/j.1365-2621.1981.tb.04212.x>
- Akinrele I. A. (1970), Fermentation studies on maize during the preparation of a traditional Africa starch-cake. *Journal of the Science of Food and Agriculture/volume 21, Issue 12*
- Aminigo ER, Akingbala JO (2004). Nutritive composition of ogi fortified with okra seed meal. *Journal of Applied Sci Environ Mgt* 8: 23-28.
- Anwar, F., Latif, S., Asharaf O.T., and Gilani A. H. (2007). Moringa *Oleifera*: A food plant with multiple medicinal uses. *Phytotherapy Research.* 21:17-25
- A.O.A.C, (2005), Official methods of analysis 18th ed. Washington: Association of Official Analytical Chemist
- Ayotunde, E. O., Fagbenro, O. A. & Adebanyo O. T. (2011). Toxicity of aqueous extract of *Moringa oleifera* seed powder to Nile tilapia (*Oreochromis niloticus*) fingerlings. *Int. Res. J. Agric. Sci.* 1:142–150.

- Damodaran, S., Parkin, K.L. (2008): *Fennema's food chemistry*, CRC press Boca Raton, FL.
- Demaeyer, E. (1976): Processed weaning foods. Nutrition in Preventive Medicine. Geneva, World Health Organisation, 389-405.
- Doggett, H. (1988), Sorghum, 2nd Edition. Longman Scientific and Technical, Essex, UK.
- Egounlety M, Aworh O. C, Akingbala JO, Houben JH, Nago MC (2002). Nutritional and sensory evaluation of tempe-fortified maize-based weaning foods. *Int J Food Sci Nutr* 53: 15-27.
- Faber, M., V.B. Jogessar and A.J.S. Benade, 2001. Nutritional status and dietary intakes of children aged 2-5 years and their caregivers in a rural South African community. *Int. J. Food Sci. Nutr.*, 52: 401-411.
- Fahey, J.W. (2005). Moringa Oleifera: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. *Trees for Life Journal*, 1:5.
- FAO/WHO. (1998). Carbohydrates in Human Nutrition. In: *International Report of a Joint Expert Consultation*. Rome: FAO/WHO.
- ICRISAT (Accessed: 31-7-2015) Sorghum (Sorghumbicolor L. Moench). *International Crop Research Institute for the Semi-Arid Tropics*.
- Jideani, V.A., Diedericks, C.F. (2014): Nutritional, Therapeutic, and Prophylactic Properties of *Vigna subterranea* and *Moringa oleifera*. <http://dx.doi.org/10.5772/57338>
- Khalafalla, M. M., E. Abdellatif, H. M. Dafalla, A. A. Nassrallah, K. M. Aboul-Enein, D. A. Lightfoot, (2010). Active principle from *Moringa oleifera* Lam leaves effective against two leukemias and a hepatocarcinoma. *Afr. J. Biotechnol.* 9:8467–8471.
- Marero, L.M, Pagumo, E.M, Aguinaldo, A.R, Homma S (1989). Nutritional characteristics of weaning foods prepared from germinated cereals and legumes. *Journal of Food Science*. 53 (5):1399-1402.
- Mbata, T., Ikenebomeh, M.J., Alaneme, J. (2009): Studies on the microbiological, nutrient composition and antinutritional contents of fermented maize flour fortified with bambara groundnut (*Vigna subterranean* L), *African Journal of Food Science* 3, 165-171.
- Nadeem M, Javid A, Abdullah M, Arif AM, Mahmood T (2012) Improving nutritional value of butter milk by blending with dry leaves of moringa oleifera. *Pak J Nutr* 11: 714-718.
- Nago, M.C., J.D. Hounhouigan, N. Akissoe, E. Zanou and C. Mestres, 1998. Characterization of Beninese traditional Ogi, a fermented Sorghum slurry: physicochemical and microbiological aspects. *Int. J. Food Sci. Technol.*, 33: 307-315.
- Osungbaro TO, Esuoso YA, Esuoso KO (2000). Nutritional and textural qualities of soy-ogi, (soy-maize porridge) and agidi, (fermented soy-ogi meal). *La Rivista Italiana Delle Sostanze Grasse*. Vol. LXXVII.
- Roloff, A., Weisgerber H., Lang, U., and Stimm, B. (2009). *Moringa oleifera*. *Weinheim*: 978-3.
- Sanni, A.I., Asiedu, M and Ayernor, G.S. (2001). Influence of processing conditions on the nutritive value of Ogi-Baba, a Nigerian fermented sorghum gruel. *Plant Food. Hum. Nutr.* 56(3): 217-223.