

# Efficacy of *Moringa oleifera* Inclusion on Organoleptic and Mineral Qualities of Homemade Complementary Food from Blend of Malted Maize, Soybean, and Groundnut .

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## Abstract

This study determined the efficacy of *Moringa oleifera* inclusion on Organoleptic and mineral qualities of home-made supplementary food from blends of malted corn, soya bean and groundnut respectively. The results of sensory evaluation revealed that significant difference was observed at 5% confidence level ( $p < 0.05$ ) in colour (6.25-1.59), flavor (5.70-1.87) and overall acceptability (6.05-1.23). The control sample (sample A) made without addition of Moringa leaf had the highest rating in terms of taste, flavor, texture, mouth feel and is the most generally acceptable, this may be due to unfamiliar Moringa leaf taste perceived in other samples. The mineral analysis values of calcium, zinc, iron and iodine contents ranged from 18.29 to 33.41 mg/100g, 0.17 to 0.26 mg/100g, 1.86 to 2.30 mg/100g and 0.01 to 0.03 mg/100g respectively. The mineral analysis showed that the complementary food samples contained significant amount of zinc, iron, iodine and calcium needed by the body of infant and children for their wellbeing with the increase in substitution level of Moringa leaf. The study concludes that inclusion of Moringa leaf in supplementary formula for infants is a means of fortifying and or improving the nutritional values of supplementary foods in order to fulfill the nutritional Preconditions of youngster.

**Keywords:** Supplementary foods, *Moringa oleifera* leaf powder, sensory, mineral composition

## Introduction

Lack of adequate nourishment and micro nutrient deficiency are ruining the lives of children in sub-Saharan Africa, Nigeria in particular even after years of independence (WHO, 1998). Undernourished youngsters are frequently the product of diverse nutritional inadequacy. Technique to guarantee aversion of Undernourishment is by providing nourishing supplementary formula to youngster especially the under five year old (Onoja&Obizoba, 2009). Supplementary

formulas are nourishing foods aside breast milk given to youngsters (6 -24 months) through the time of supplementary feeding (WHO 2014). The development of youngsters for the first two years is swift and breast milk alone will not sufficiently provide nutrition for the child where the space keeps changing with the advancing age of the youngsters. (Abeshu, Lelisa&Geleta, 2016). In Nigeria, Complementary formulas are mainly made from staples within the vicinity (Akinola *et al.*, 2014). Young children are basically catered for with porridges that are not nutrient dense, as such protein inadequacy in the food is usual and it is mainly connected to inadequacies in food calorie and nourishing substances resulting to malnutrition with its concurrent well- being implications. Yusufu, Egbunu, Egwujeh, Opega and Adikwu, (2013). Sometimes, the porridge may be too watery or too bulky, leading to decrease in nutrient consumption (Yusufu *et al.*, 2013). Poor feeding at the time of complementary feeding results in unhealthful state and infant being susceptible to death as well as delayed mental development (Makinde&Ladipo, 2012).

The critical time that a child develops under nutrition corresponds with the age of initiation of supplementary foods, which are mostly not nutritious. There is need to feed the youngsters with supplementary foods that are nutritious, adequate, and palatable. Homemade complementary formula in the third world nations are of minute nutriment and depicts minute protein and high-calorie, since they are typically made from cereals. The protein constituent of cereals frequently used is of low attribute, short of vital amino acids which are essential for the development of youngsters. For instance, corn porridge or *koko* has been intertwined in the cause of malnourishment in youngsters through the supplementary era (Solomon, 2005). This nutrient insufficiency can be averted through different methods, part of which is enrichment or fortification with *Moringa olifera* leaf powder.

To produce nutrient sufficient and palatable supplementary food, it is significant to have food blends that meet the nutrient requirements of the youngsters. Therefore, in order to avert youngsters malnutrition and its accompanied health predicaments, supplementary foods made from corn, soya bean, groundnut and *Moringa oleifera* leaf powder which can greatly increase their mineral attribute and nourishing constituent, with small or no hike in the cost price hence necessitates this study.

## **Materials and Methods**

The maize grain, soybean and groundnut used in this study were bought at Sayedero market, in Ilaro, Ogun State, while the *Moringa oleifera* leaves were plucked from a nearby home garden in Oke –Ela Ilaro. The maize grain and soybean were first sorted out to remove foreign bodies and impurities, after which it was cleaned in portable water and packed in sterile polythene bag and later taken to the Food Processing Laboratory of The Federal Polytechnic Ilaro, for further processing prior to analyses.

### **Sample Preparation**

#### **Production of Soybean Flour**

About 1kg of soybean grains were sorted and cleaned to remove foreign materials. The sorted beans were washed, steeped in water for 3h, peeled and boiled for 15 min, oven-dried at 80°C for 24h and baked until golden brown for 30min. The procedure of Omueti, Otegbayo, Jaiyeola, and Afolabi, (2009) were espoused for producing the soya bean flour with slight moderation. The roasted grist was oven dried at 60°C for some minutes, pulverized and sifts to fine powder. The powder was wrapped up with sterile polyethylene bags for further investigation.

#### **Production of maize flour**

Maize flour was prepared with method described by Abasiekong, Akobundu, & Oti, (2010). 1kg of corn grains were soaked in 3.5 l of portable water in a container and stored at normal temperature (29±2°C) for a 24 h, changing the water at 6 h interval to avert souring. The corn were washed severally and put on a damped jute bag, cover with a polyethylene bag and leave for 24h to quicken germination. The grists were quietly spread on the jute bag and allowed to sprout at room temperature (29±2°C) and relative humidity of 95% for 120hours. Meanwhile, the grist's were wet at intervals of 10hours to fast track sprouting. Non-sprouted grist's were removed. The germinated grist's were spread out on trays and dried in a cabinet dryer (Model HR 6200, UK) at 60°C for 20 hours with stirring of the grits from time to time at a space of 30 min to ensure even drying. The dried malted grits were separated from the rots and sprouts. The corns were pulverized in an attrition mill and sift through a 500 micron mesh sieve. Maize powder that was gotten was packed in an airtight container, tagged and kept until needed for further use.

### **Production of *Moringa oleifera* leaf powder**

*Moringa oleifera* leaf was processed into powder using the procedure described by Gernah and Sengev (2011). *Moringa* leaves were rinsed in potable water containing 5% Sodium chloride, and air-dried indoor at ambient condition for four days, pulverized and sifted to fine powder with a fine sieve (500µm). Resulting flour was packaged and stored in air tight receptacle at ambient temperature.

### **Production of Groundnut flour**

Groundnut flour was prepared using procedure reported described by Gernah, Ariaahu and Ingbian (2012). Groundnut seeds were cleaned and air dried for 24 hours. The groundnut was grilled in an oven at 170<sup>0</sup>C for 30 min and the peel was gotten rid of to get evenly brown roasted groundnuts. Groundnut powder was obtained by grinding the roasted groundnut in a 1.5L Solitaire mixer grinder (VTCL Heavy Duty 750 watts) into a smooth powder. The milled (product) was passed through hydraulic screw pressing and the oil was allowed to drain from the mill in order to get a powdering form of hot silky groundnut.

### **Food Product and Diet Formulation**

Corn, soya bean and groundnut flour were grinded in a proportion of 60:30:10. This proportion were brought to light based on their protein constituent through material balancing (Smith, 2003) to give 16 g protein/100g food as suggested by the protein advisory group for infant diets, as reported by Solomon (2005). The formulations were homogenized using a VTCL heavy duty grinder and portioned into four parts each. While bench mark A (60:30:10) was used unfortified, Sample B (50:30:15:5), Sample C (45:25:20:10) and Sample D (40:20:25:15) were enriched with 5% (125 g), 10% (250g) and 15% (375g) of *Moringa oleifera* leaf powder. The diets were neatly wrapped and kept in 500 ml plastic containers with fitting lids at normal condition.

### **Organoleptic Analysis**

The organoleptic assessment of the samples were carried out using twenty (20) semi-trained panelist comprising (students from the Departments of Food Technology and, Nutrition and Dietetics, Federal Polytechnic Ilaro) as described by (Ihekoronye&Ngoddy, 1985). They assessed the organoleptic qualities based on taste, colour, texture, flavor, mouth feel and overall

acceptability using a nine point hedonic scale where 1 represents “extremely dislike” and 9 “extremely like. During the organoleptic assessment, panelists rinsed their mouth with water to clear the palate after each sample was evaluated.

## **Mineral Analysis**

### **Procedure for digestion**

1.00g of ground materials was weighed (oven dry at 60<sup>0</sup>C) into a 125ml Erlenmeyer flask which have been washed beforehand with acid and distilled water. 4ml of perchloric acid, 25ml conc. HNO<sub>3</sub> and 2ml conc. H<sub>2</sub>SO<sub>4</sub> was added under a fume hood. The contents were mixed and heated gently at low to medium heat on a hot plate under Perchloric acid fume hood until dense white fumes appear. The content was finally heated strongly (medium to high heat) for half a minute, it was allowed to cooled, and afterwards 40-50ml distilled water was added. It was then boiled for half a minute on the same plate at medium heat. The solution was cooled and filtered completely into a 100ml Pyrex volumetric flask.

### **Mineral Determination**

Atomic absorption spectroscopy (AAS) was used for the mineral determination. Atomic absorption spectrophotometric (Perkin-elmal model 403, Norwalk, CT, USA) was used to determine the levels of calcium, iodine, zinc and iron in the samples after digestion with concentrated nitric acid as prescribed by Association of Official Analytical Chemists (AOAC, 2010).

### **Statistical analysis**

The data generated (n=3) were statistically analyzed and presented as means and standard deviation. Analysis of Variance (ANOVA) was used to test the level of significance. Duncan’s Multiple Range Test was used to compare and separate means. Significance was accepted at p<0.05.

## **Results**

**Table 1: Sensory Properties of Complementary Foods Samples Produced**

| Samples | Color                  | Taste                        | Flavor                 | Texture                      | Mouthfeel              | Overall acceptability  |
|---------|------------------------|------------------------------|------------------------|------------------------------|------------------------|------------------------|
| A       | 7.10±1.37 <sup>b</sup> | 6.15±1.23 <sup>a</sup>       | 6.20±1.32 <sup>a</sup> | 6.95±1.54 <sup>a</sup>       | 6.25±1.41 <sup>a</sup> | 7.25±1.29 <sup>b</sup> |
| B       | 6.25±1.59 <sup>a</sup> | <b>5.60±1.67<sup>a</sup></b> | 5.70±1.87 <sup>a</sup> | 6.05±1.32 <sup>a</sup>       | 5.75±1.68 <sup>a</sup> | 6.05±1.23 <sup>a</sup> |
| C       | 6.25±1.41 <sup>a</sup> | 5.80±1.70 <sup>a</sup>       | 5.70±1.89 <sup>a</sup> | 6.30±1.81 <sup>a</sup>       | 6.05±1.88 <sup>a</sup> | 6.20±1.44 <sup>a</sup> |
| D       | 5.60±1.82 <sup>a</sup> | <b>5.90±1.52<sup>a</sup></b> | 5.80±1.36 <sup>b</sup> | <b>6.00±1.81<sup>a</sup></b> | 5.55±1.79 <sup>a</sup> | 6.25±1.25 <sup>a</sup> |

Value of triplicate mean ± standard deviation determination with the significant different in (p<0.05). Samples with different superscripts within the same column were significantly different (p<0.05).

**Table 2: Mineral Composition of Complementary Foods Samples Produced**

| Samples | Calcium<br>(mg/100g)    | Zinc<br>(mg/100g)      | Iron<br>(mg/100g)      | Iodine<br>(mg/100g)    |
|---------|-------------------------|------------------------|------------------------|------------------------|
| A       | 18.29±0.03 <sup>a</sup> | 0.17±0.01 <sup>a</sup> | 1.86±0.01 <sup>a</sup> | 0.01±0.00 <sup>a</sup> |
| B       | 21.69±0.01 <sup>b</sup> | 0.19±0.00 <sup>a</sup> | 2.09±0.01 <sup>a</sup> | 0.02±0.00 <sup>a</sup> |
| C       | 26.34±0.01 <sup>a</sup> | 0.23±0.00 <sup>a</sup> | 2.12±0.00 <sup>a</sup> | 0.02±0.00 <sup>a</sup> |
| D       | 33.41±0.01 <sup>a</sup> | 0.26±0.00 <sup>a</sup> | 2.30±0.01 <sup>a</sup> | 0.03±0.00 <sup>a</sup> |

Value of triplicate mean ± standard deviation determination with the significant different in (p<0.05). Samples with different superscripts within the same column were significantly different (p<0.05).

KEY:

A Bench mark\_ 60% maize, 30% soybean and 10% peanut

B 50% maize, 30% soybean, 15% peanut and 5% *Moringa* leave powder

C 45% maize, 25% soybean, 20% peanut and 10% *Moringa* leave powder

D 40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder

## Discussion of Results

Table 1 depicts the result of sensory properties of the complementary foods. Color, taste, flavor, texture, mouth feel and overall acceptability were determined in the samples. It was observed that significant difference exists at 5% confidence level ( $p < 0.05$ ) in colour, flavour and overall acceptability across the sample.

In terms of all the sensory properties, complementary food sample made with 60% maize, 30% soybean and 10% peanut (A) had the highest rating in terms of color taste, flavor, texture and mouth feel of the complementary food samples., while D (40% maize, 20% soybean, 25% peanut and 15% *Moringa* leaf powder) had the least color rating. Addition of *Moringa* leaf flour changes the color of the composite blend samples. Colour characteristics are a major criterion that impacts the quality of the formulated complementary products. According to Ikpeme, Osuchukwu & Oshieel (2010) colour is an essential hallmark in judging appropriate baked cookies that not only mirror the suitable raw materials used for the preparation but also provides information about the formulation and characteristic of the product. Meanwhile, sample B (50% maize, 30% soybean, 15% peanut and 5% *Moringa* leaf powder) had the least rating in taste and flavor while least rating in terms of texture and mouth feel was observed in D (40% maize, 20% soybean, 25% peanut and 15% *Moringa* leaf powder). Increase in substitution of *Moringa leaf* flour caused variations in organoleptic evaluation rating. Findings obtained in this study was in agreement with findings of Gebrezgi (2019) who also reported that inclusion of *Moringa* leaf flour caused reduction in organoleptic parameters but increase in nutritional content. This could be attributed to the fact that moringa have an unusual taste which people are not familiar with.

Also, results obtained in this study was in tandem with findings of Onoja, Akubor, Gernar and Chinmma (2014), who also reported that complementary food formulated from local staples (sorghum, soybean, plantain, Roselle calyces and *Moringa oleifera*) had low color rating which was attributed to incorporation of *Moringa oleifera* leaf powder which gave the product a greenish color which the mothers were not familiar with. In terms of the overall acceptability of the complementary foods produced, sample made from 60% maize, 30% soybean and 10% peanut without *moringa* leaf had the highest rating and is the most generally acceptable. Therefore, it can be deduced that general acceptability of sample A is due to non-inclusion of moringa leaf powder. This results corroborate with study by Onoja *et al.*, (2014) and Gebrezgi

(2019) who reported least rating in organoleptic properties of supplementary foods with the inclusion of *moringa oleifera* leaf and Roselle calyces (*Hibiscus sabdariffa*).

Table 2 Shows the mineral constituent of the supplementary food samples. Result showed that the calcium content of the supplementary food samples ranked from 18.29 to 33.41 mg/100g. The calcium constituent gotten in this study is higher than the calcium constituent (15.01-25.10mg/100g) of supplementary food made from malted millet, plantain and soybean flour blends presented by Bolarinwa, Olajide, Oke, Olaniyan and Grace (2016). Calcium is essential for ideal growth and development of infants and youngster. In addition, the zinc constituent of the formulations varied among the samples. It ranged from 0.17 to 0.26mg/100g. The zinc composition of the supplementary food obtained in this study is lower than that of maize-tiger nut fortified weaning food with the value of 0.59 to 1.05 mg/100g reported by Wakil & Ola (2018) Zinc performs a vital function in cell division, protein formation and growth (Rolfes, Pinna & Whitney, 2009).

The iron constituent of the food formulations ranked from 1.86 to 2.30 mg/100g. Iron is important for the formation of blood cells and prevention of anemia in infants and youngster. More so, the iodine constituent of the supplementary food samples ranked from 0.01 to 0.03 mg/100g. The iodine content presented in this study is lower than iodine in complementary food made from sorghum, soybean, plantain, reported by Onoja, Akubor, Gernar & Chinmma (2014) with the value of 0.51-1.02 mg/100g.

## **Conclusion**

The research has clearly revealed that the inclusion of *Moringa oleifera* leaf powder brought about rise in mineral properties of the formulated food samples, as complementary food sample made from 40% sprouted maize, 20% soybean, 25% peanut and 15% Moringa leave powder contains high minerals constituent compared to the other samples. The rise in mineral constituent of the samples confirms the beneficial efficacy of enrichment (Lutter & Rivera, 2003). However, this research concludes that nutriment adequate homemade supplementary formula can be made from malted maize, soybean and groundnut with the fortification of Moringa leaf powder for low income households to feed infants and young children. This study recommends that animal protein such as Crayfish or other animal product be incorporated to qualify the food blend as more nutrient-dense suitable foods.

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## APPENDIX 1

### PICTORIAL DIAGRAM OF BLENDED COMPLEMENTARY FOOD



Fig. 1: Pictorial Diagram of Blended Groundnut



Fig. 2 Pictorial diagram of Blended Maize



Fig.3 Pictorial diagram of blended soy bean  
leaf



Fig.4 Pictorial diagram of blended moringa