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Proximate Composition of Homemade Complementary Formula from Blend of Malted Maize, Soybean, and Groundnut in castled with M*oringa oleifera* Leave Powder

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Abstract

This study determined the proximate composition of homemade supplementary food formula from malted corn, soya bean and groundnut incastled with Moringa oleifera leaf powder. The corn, grain, soya bean and groundnut were purchased from a local market, Sayedero in Ilaro, Ogun State, while the Moringa oleifera leaves were plucked from a nearby home garden. The proximate analysis values of moisture, protein, fat, fibre, ash and carbohydrate content ranked from 6.73 to 9.23%, 6.67 to 17.2%, 2.70 to 4.54%, 5.73 to 9.22%, 2.15 to 4.07% and 55.75 to 76.03% respectively. The research has revealed that nourishing 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. Result also revealed that the complimentary food samples contained a significant amount of protein, fibre, ash, and the carbohydrate needed by the body of infants and children for their wellbeing. 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 to fulfil the nutritional Preconditions of youngster

Keywords, supplementary Foods, Moringa oleifera leaf powder, proximate composition

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1. Introduction

Lack of adequate nourishment and micronutrient 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 from 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 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 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 in malnutrition with its concurrent well-being implications. Yusufu, Egbunu, Egwujeh, Opega, & Adikwu, (2013). Sometimes, the porridge may be too watery or too bulky, leading to a decrease

in nutrient consumption (Yusufu *et al.*, 2013). Poor feeding at the time of complementary feeding results in an unhealthful state and infant being susceptible to death as well as delayed mental development (Makinde & Ladipo, 2012).
The critical time that a child develops undernutrition corresponds with the age of initiation of supplementary foods, which are mostly not nutritious. There is a 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 the 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 sustenance blends or diversification of sustenance that meet the nutrient requirements of the youngsters. Therefore, to avert youngster's malnutrition and its accompanied health predicaments, supplementary foods made from corn, soya bean, groundnut and *Moringa oleifera* leaf powder can greatly increase their protein attribute and nourishing constituent, with small or no hike in the cost price hence necessitates this study.

2. Materials and Methods

The maize grain, soybean and groundnut used in this study were purchased from Sayedero market, in Ilaro, Ogun State, while the Moringa oleifera leaves were plucked from a nearby home garden. 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, The Federal Polytechnic Ilaro, for further processing before proximate analysis.

Sample Preparation

Production of Soybean Flour

About one (1kg) soybean grain was sorted out to remove foreign bodies and impurities. The sorted beans were washed, steeped n water for 3hours, peeled and boiled for 15 minutes, oven-dried at 80^0C for 24hours and baked until golden brown for 30minutes. The procedure of Omueti, Otegbayo , Jaiyeola, &Afolabi, (2009) was espoused for the production of soya bean flour with slight moderation. The roasted grist was oven-dried at 60^0C for some minutes, pulverized and sifts to a fine powder. The powder was wrapped up with sterile polyethylene bags for further investigation.

Production of maize Flour

Maize flour was prepared with a slight modification of the method described by Abasiekong, Akobundu, & Oti, (2010). One (1kg) of corn grain which has been sorted out to remove foreign bodies and impurities discarded was soaked in 3.5 litres of potable water in a container and stored at normal temperature (29 ± 2^0C) for a day with a removing of water every 6 hours to avert souring. The grist was washed severally and put on a damped jute bag,

cover with a polyethylene bag and leave for 24h to quicken germination. The grist was quietly spread on the jute bag and allowed to sprout at room temperature (29±2^{0}C) and relative humidity of 95% for 120hours. Meanwhile, the grist was wet at intervals of 10hours to fast-track sprouting. The non-sprouted grist was removed. The germinated grist was spread out on trays and dried in a cabinet dryer (Model HR 6200, UK) at 60^{0}C for 20hours with occasional stirring of the grits at intervals of 30 min to ensure even drying. The dried malted grits were blown to take away the rots and sprouts. The corn malts 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 powder was made using a moderation of the procedure reported by Gernah and Sengev (2011). *Moringa* leaves were rinsed in potable water containing 5% Sodium chloride. *Moringa* leaves were dried indoor at ambient condition for four (4) days, pulverized and sifts to a fine powder with a fine sieve (500µm). The resulting flour was packaged and stored in airtight receptacle at ambient temperature.

Production of Groundnut flour

Groundnut powder was made using the procedure reported described by Gernah, Ariahu and Ingbian (2012), groundnut was cleaned in potable water and air-dried for some hours. The groundnut was grilled in an oven at 7^{0}C for 30 minutes 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 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 was 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 benchmark 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 powder. The diets were neatly wrapped and stored in 500 ml plastic containers with fitting lids at normal condition.

3. Results

Table 1: Proximate Composition of Complementary Foods Samples Produced

Samples	Moisture (%)	Fat (%)	Ash (%)	Fibre (%)	Protein (%)	Carbohydrate (%)
A	6.73±0.47^b	2.70±0.04^b	2.15±0.03^b	5.73±0.07^a	6.67±0.07^b	76.03±0.24^a
B	9.29±0.87^a	2.76±0.06^b	2.30±0.05^b	5.98±0.07^a	10.4±0.07^a	69.28±0.60^a
C	8.15±0.21^a	4.20±0.03^a	3.92±0.03^a	9.23±0.03^a	14.3±0.02^a	60.23±0.07^a

D	9.23±0.40[a]	4.54±0.03[a]	4.07±0.06[a]	9.22±0.05[a]	17.2±0.05[a]	55.75±0.19[b]

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

KEY,

Sample A (Benchmark)	60% maize, 30% soybean and 10% peanut
Sample B	50% maize, 30% soybean, 15% peanut and 5% *Moringa* leave powder
Sample C	45% maize, 25% soybean, 20% peanut and 10% *Moringa* leave powder
Sample D	40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder

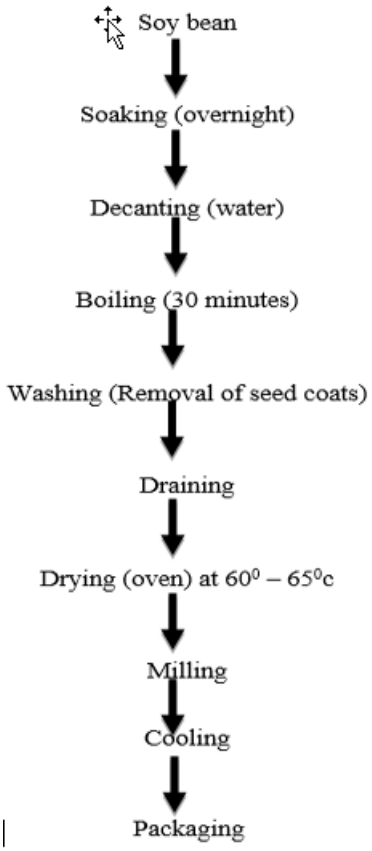

Figure 1, Flowchart for the Production of Soybean Flour (Omueti, Otegbayo, Jaiyeola, &Afolabi (2009)

Figure 2, Flowchart for the Production of Malted Maize Flour (Abasiekong, Akobundu, & Oti, (2010)

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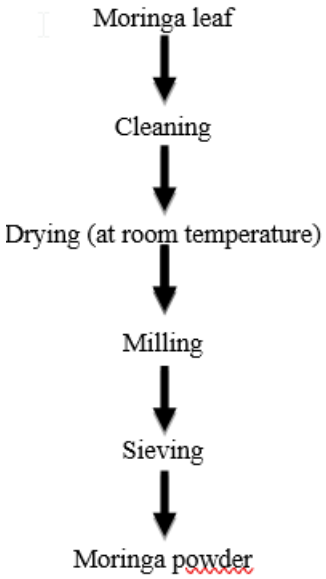

Figure 3, Flowchart for the Production of Moringa leaf powder.

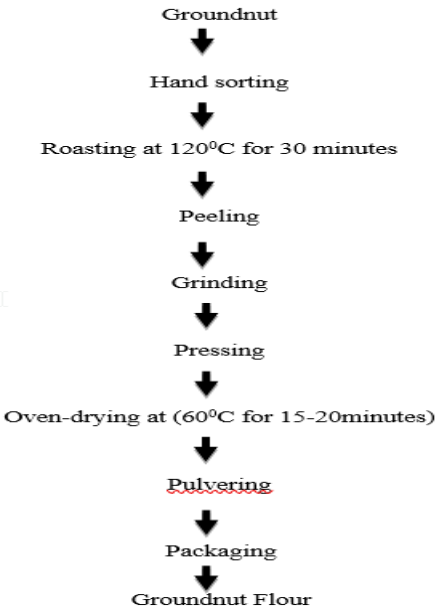

Figure 4, Flowchart for the Production of Groundnut Flour (Gernah, Ariahu and Ingbian (2012)

4. Discussion

This study determined the proximate composition of complementary foods derived from malted maize, soybeans and groundnut incastled with *Moringa oleifera* leaf powder as indicated in Table1. A significant difference was observed in protein, ash, moisture and carbohydrate constituent of the samples. Moisture constituent of food samples ranked from 6.73to 9.29%. The control sample (60% maize, 30% soybean and 10% peanut) had the highest moisture content while, sample D (40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder) had the lowest moisture content. Moisture content indicates the presence of water in many foods. The rise in moisture constituent of the samples can lead to a decrease in energy and nutrient densities of complementary formula. The result of the moisture content derived in this study concords with a moisture content of complementary formula made from corn, soya bean and *Moringa* leaves reported by Gebrezgi (2018) with the moisture content ranging from 6.71 to 8.90%. The moisture content of the grinded formula is within the boundary of FAO/WHO suggested value (<10%), which increased from 6.73% in the benchmark (sample A or control) to 9.23% in Sample D (40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder). Moisture indicates terms of the viscosity and microbial attribute of food (Makinde &Ladipo, 2012). A supplementary formula should be spared of impurities that might predispose youngsters to infection. Olaoye, Onilude & Idowu (2006) noted that reduced moisture constituent in food tends to avert complementary formula from microbial impurities and to extend shelf life.

Protein constituent of the complementary foods ranked from 6.67to 17.2%. Sample D made from 40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder had the highest protein content while, sample A (60% maize, 30% soybean and 10% peanut) had the least protein content. There was a significant hike in protein constituent with accelerating level of *Moringa* leaf powder from 6.67 % in benchmark to 17.2% in sample D. This results from the addition effect brought about by the high protein constituent of *Moringa* leaf powder. Abraham, Joseph & Dick (2013) noted that *Moringa* leaf flour can hike the protein constituent in bread made from wheat flour, soya bean flour and *Moringa olifera* leaf flour. The protein constituent of formulated samples corroborates the protein content of 6.59 to 16.93% reported by Nwosu,Nmam,Ibeziako & Maduforo (2014) in their study. The protein content in sample D is in line with the recommendations of FAO/WHO (16.7%).

Proteins are important components that aid the body to make up new tissues. They are vital at the time of growth, pregnancy and when recuperating from wounds. It is therefore advocated that youngsters eat about 16 g of protein daily Shiriki, Igyor and Gernah (2015). A 100 g meal of the formulated food will therefore meet over 100% of children protein requirements.

Also, the fat constituent of the supplementary formula ranked from 2.70 to 4.54%. Sample D had the greatest fat constituent while the benchmark had the least fat content. The fat content of the grinded formula is proportionately greater than the benchmark, though, the fat content of all the samples is beneath the stipulated dietary allowance by FAO/WHO (>6%). Dietary fat gives calorie, indispensable fatty acids act as fat-soluble vitamins carrier and sponsors delectability of food (Makinde & Ladipo, 2012). It was observed that only complementary food formulated with 40% maize, 20% soybean, 25% peanut and 15% *Moringa* leave powder falls within 4.5% to 10.99% fat in complementary formula made from grist, soya bean and *Moringa* leaves reported by Gebrezgi (2018). Abraham, et al., (2013), gave a larger fat constituent in his grist –soya bean-*Moringa* bread as the level of *Moringa* leaf flour build up in the mix. Fat is essential in the diet of youngsters as it gives greater calorie density and eases the assimilation of fat-soluble vitamins. It also gives indispensable fatty acids like omega-3 and omega-6 polyunsaturated fatty acids (PUFA'S) needed for proper neural development youngsters (Igyor, Yusufu&Senger, 2011).

However, crude fibre constituent ranged from 5.73 to 9.22%. Sample D had the greatest fibre constituent and the control sample (60% maize, 30% soybean and 10% peanut) had the least fibre constituent. The fibre content of the formulated supplementary formula hiked with the addition of *moringa* leaves flour. Nevertheless, crude fibre does not add nutriment to the body; it gives bulk in the diet without added calories to food and eases bowel movements thus averting many gastrointestinal diseases in man by keeping the digestive system healthy Shiriki*et al*., (2015). The fibre content in complementary foods reported in this study falls within the range of 2.96 to 11.12% of fibre content in complementary foods produced by Shiriki*et al*., (2015).

Notwithstanding, fibre is part of the non-vitality providing nutrients, it aids nitrogen utilization and assimilation of some nutriment (Michaelsen, Weaver, Branca& Robertson, 2000). The crude fibre of all the samples was in the approved limit for food of not more than 5g dietary fibre per 100g dry matter (FAO/WHO, 2014) and would add to the gastrointestinal tract and cardiovascular well-being. However, uttermost mindfulness should be given to supplementary formula made for youngsters since their body system is immature to process high fibre content. Fibre may influence the order of assimilation of diverse nutriments of importance in foods with low nutrients constituent (Asma, Babiker& El-Tinay, 2006).

The ash constituent of the complementary formula ranked from 2.15to 4.07% with sample D having the greatest ash constituent and sample A had the least ash constituent. The ash constituent of food is an indication of mineral constituents of the food (Fusuan, Fawale, Enwerem, Uche & Ayodele (2017). The ash constituent gotten in this research is greater than the value of ash constituent (0.56-2.00%) in supplementary formula made from fermented corn, soya bean and carrot flours reported by Barber, Obinna-Echem & Ogburia (2017). The greater the ash constituent the more the mineral content of the food.

However, the carbohydrate content ranged from 55.75to 76.03% with the benchmark sample having the greatest carbohydrate constituent and sample D had the least carbohydrate content. There was a significant reduction in carbohydrate content from 76.03% in the benchmark sample to 55.75% in sample D. As the level of *Moringa* leaf powder inclusion hiked, the carbohydrate constituent reduced. The margin was seen as a result of the low carbohydrate constituent in *Moringa* leaf flour. This finding is akin to discoveries by Shiriki *et al*., (2015), who reported a decline in carbohydrate constituent of the complementary formula samples with an increased substitution level of *Moringa* leaf to 38.50%. Carbohydrates give heat and calorie to all body processes. Inadequate carbohydrate consumption can make the body convert protein and body fat to manufacture needed vitality, thus causing exhaustion of body tissues (Gordon, 2009).

Elevated carbohydrate constituent of foods seen in the research is nutriment adequate as youngsters need strength to do their strenuous metabolic activities as growth continues (Ibironke, Fashakin & Ige, 2004).

5. Conclusion

The research has revealed 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. However, this study found out that complementary food sample made from 40% sprouted maize, 20% soybean, 25% peanut and 15% Moringa leave powder contains high proximate composition compared to the other samples.

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APPENDIX

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 Beans

Fig. 4 Pictorial diagram of Blended Moringa leaf