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Chemical Analysis of the Nutritional Composition of Formulated Complementary Foods

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Abstract: The study investigates the nutritional quality of complementary foods produced from some local food crops. The raw materials include wheat, soybeans and carrot. Wheat soybeans and carrot were prepared in the ratio 60:30:10 (WSC blend), and 50:30:20 (WSD blend). While wheat and soybeans only in 60:40onl WS blend. The chemical composition and nutritional qualities of the food sample were determined using standard methods. The data obtained was subjected to ANOVA. Crude protein, fat, moisture, calcium, magnesium, iron is significantly higher in WSD blend at (p<0.05). WSC blends has higher amount of sodium, potassium. Potassium and sodium shows significant different at p<0.05.

Keywords: Complementary Foods, Formulated, Immunological factors, Nutrition.

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1. Introduction

Scientifically, it has been proved that breast milk is the perfect food for the infants during the first six months of life. It contains all the nutrients and immunological factors, infants require maintaining optimal health and growth. However, at the age of six months and above, birth weight is expected to have doubled, breast milk is no longer sufficient to meet the nutritional needs of the growing infants. Nutritious complementary foods are therefore introduced also known as weaning foods which typically cover the period from six to twenty-four months of age *(UNICEF, 2003)*.

Childhood under nutrition remains a major health problem in resource- poor setting. Approximately one-third of children less than five years of age in developing countries are stunted (low height -for-age), and large proportions are also deficient in one or more micronutrients. Recent data shows that just over half of 6-9months old are breastfed and given complementary foods and only 39 per cent of 20-30 month olds are provided with continued breastfeeding (*UNICEF, 2003).* It is well recognized that the period from birth to two years of age is the critical window for the promotion of optimal growth, health, and development. Insufficient quantities and inadequatequality of complementary foods, poor child-feeding practices and high rates of infection have a detrimental impact on health and growth in these important years. Even with optimum breastfeeding children will become stunted if they do not receive sufficient quantities of quality complementary foods after six months of age (UNICEF, 2003). An estimated six per cent or six hundred thousand under-five deaths can be prevented by ensuring optimal complementary feeding.

Improved feeding of children under two years of age is particularly important because they experience rapid growth and development, are vulnerable to illness and there is evidence that feeding practices are poor in most developing countries. Continued breastfeeding beyond six months should be accompanied by consumption of nutritionally adequate, safe and appropriate complementary food that help meet nutritional requirements when breast milk is no longer sufficient. From 6-12month, breastfeeding- if implemented optimally should continue to provide half or more of the child's nutritional needs, and from 12-24 months, at least one- third of their nutritional needs. In addition to nutrition, breastfeeding continues to provide protection to the child needs. In addition to nutrition, breastfeeding continues to provide protection to the child against many illnesses und provides closeness and contact that helps psychological development. Appropriate complementary foods can be readily consumed and digested by the young child from six months onward and provides nutrients- energy, protein, fats and vitamins and minerals- to help meet the growing child's needs in addition to breast milk (WHO, 2012).

Complementary feeding is to increase the nutritional adequacy of complementary foods. Different strategies may be required for different population (e.g. rural vs. urban populations, the very poor, populations affected by emergencies), however among all these groups, locally available foods should be exploited when possible.

Secondly, vulnerable segments of the population (i.e. non-breastfed children, children from very poor household and children with HIV, malnutrition, or living under emergency condition etc.) need to be identified. These groups may require targeted food aid, multi-micronutrient or lipid-based nutrient supplements. Food can be targeted in different ways, for example to the poorest families in a community, or to all families in the poorest communities in a targeted area, or to a household with children with evidence of growth faltering (WHO, 2012).

Learning ability, economics productivity, immune response, stunted growth, chronic infection, poor performance in school and lower adult wages and reproductive outcomes, this is why nutritional adequate complementary foods from locally available food crops is necessary. The aim of this study was to investigate the proximate and elemental compositions of formulated complementary food

2. Material and Methods

Materials

Soya beans (Glycine Max), Wheat and Carrot were used for the study. The soya beans, wheat, and carrot were purchased from Oje market Ede in Osun State, Nigeria.

Methods

Preparation of material

Five kilograms of wheat grains were cleaned and winnowed to remove stones and dirty particles. It was now washed with water and steeped for (6-12) hours. The soaked wheat was then spread on tray and cover with a dark cloth and kept in the dark room for 3day to germinate.Water was sprinkled on it daily to keep it moist. This germination process produces the enzymes that break down the starch into sugar and shorter length (Kordylas, 1990). The sprouted grains were dried in an oven (model No. UNISCOPE SM9053, Surgical friend medical, England) at 55°C. The malted grains were then milled to obtain wheat flour (1 mm mesh screen).

The soya beans was cleaned and winnowed to remove dirty particle and debris. The soya beans were blanched by pouring into boiling water and were left for 10 minutes. It was drained and poured into a cold water to remove the testa, it was dry in an oven at 55°C it was now grinded to obtain the soy flour.

The carrot was purchase in Oshogbo was cleaned and washed with clean water, it was now grated into smaller fragment it was now dried in the oven at 50^0C after drying it was blended to obtain the carrot flour.

Formulation of the Complementary Food

The blended sample; Wheat, Soya beans and Carrot flour was formulated in 60:30:10 w/w (WSC blend), 50:30:10 w/w (WSD blend) and 60:40:0 w/w (WS blend)

Chemical analysis

The proximate and mineral analysis of the blend was analyzed according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 18^{th} EDITION, 2005). All analysis was carried out in triplicate. Among the physic-chemical parameters determined were: Crude protein, Crude fat, Moisture content, Ash, Crude fibre, available carbohydrate was calculated by difference (100-%/protein+% fat%+crude fiber+% Ash+% moisture content). Food energy was calculated using Atwater factor (4 x protein, 4 x carbohydrate and 9 x fat).

Calcium Potassium, Sodium, copper, and phosphorus was done using Spectrophotometric Method (AOAC,975.16) Magnesium (Mg), Manganese (Mn), Iron (Fe), Zinc(Zn) was carried out using Buck 200, Atomic Absorption Spectrophotometer AOAC, 975.23)

Data Analysis

The calculated value of the formulated complementary food, which will be consumed in a day the infant, was compared with the average daily nutrient requirement for infant. Mean and standard deviation was calculated for all the value.

3. Result and Discussion

Result

Protein varied from 25±0.24% - 22.38± 0.15)%. 1.28± 0.05- 2.60±0.30% for fat. Crude fiber (16.30±0.05% -1.73±0.03) Moisture content high in the three blend signifying that is not dried enough. Ash content ranges from (0.90±0.08-2.99± 0.14).WSD has the highest β- carotene content (65.50± 0.78) µg/ 100 because it contains more carrot (20g). Carbohydrate varied from 42.09- 62.34% Protein, fat, fiber, Ash, moisture, shows significant differences at ($p > 0.05$).

Table 2 shows comparism of the mineral (nutrient) content of the formulated complementary food needed by an infant and compared with the commercial sold Nestle Cerelac and the Recommended Daily Allowance (RDA). All the formulated complementary food is in line with the recommended daily allowance and commercial sold weaning food (Cerelac). However, the complementary food did not meet the calcium and sodium requirement for an infant and fall below the Cerelac product. The loss might as a result of food processing.

Table 1: Mean Value (± S.D) For Proximate Compostion of the Formulated Blends

Sample	%Crude protein	% Crude fat	% Crude fibre	% Moisture	% Ash	CHO%
WSC	24.69 ±0. 30[b]	1.28± 0.05[b]	16.30± 0.05[a]	10.62±1.0[b]	2.99±0.14[a]	44.12[b]
WSD	25±0.24[a]	1.29± 0.05[a]	16.29± 0.06[a]	13.03±0.5[a]	2.29±0.03[b]	42.09[c]
WS	22.38±0.15[c]	2.60±0.03[c]	1.73±0.03[b]	10.05±0.1[b]	0.90±0.80[c]	62.34[a]
Cerelac	15.0	9.00	2.95	2.50	2.60	67.95

WSC blend; 60:30:10, WSD blend; 50:30:20, WS blend; 60:40, values are means of 6 replicate

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Table 2: Mean Value (±S.D) For Mineral Composition Of Formulated Blends

SAMPLES	Sodium mg/100	Potassium mg/100	Calcium Mg /100)g	Magnesium mg/100	Iron mg/100	Zinc mg/100	Copper mg/100
WSC	33.4±0.85[a]	1143±5.21[a]	87.22± 1.80[b]	302 ± 2.44[b]	11.93±0.5l[b]	6.7± 0.31[a]	0.45±0.05[b]
WSD	32.8 ± l.ll[b]	1137±4.85[b]	89.2 ± 0.41[a]	366 ±42.ll[a]	11.98± 0.24[a]	6.62±0.20[b]	0.36±0.l9[c]

WS	24.5 ± 0.69^{c}	1126 ±2.71^{b}	78.5±0.25^{b}	225±2.65^{C}	10.1±0.3^{C}	5.5 ± 0.25^{c}	0.68 ±0.05^{a}
Nestle Cerelace	220	700	420	-	10	7	-

WSC blend; 60:30;10. WSD blend; 50:30:20, WS blend; 60:40, Values are means of 6 replicate

Discussion

Protein is responsible for growth, regulation of body process and provides energy (Otitoola, 2008). The protein content of the three blends was significantly different at (p> 0.5). Protein content present in the three blends meets the Recommended Dietary Allowance for protein which is (13-14g). And also higher than the commercially sold Nestle Cerelac, which is 15.0%. The child has to consumer 8g of protein in a serving (30g) of the blend 2-3 times per day in order to meet the nutritional requirement due to the size of the child's stomach. So the formulated blend will meet the nutritional requirement of the children when consumed for body building and repair. This value obtained is similar to work done by (laswai and Kulwa, 2010) on nutrient content and acceptability of soybean based complementary to be and obtain protein to be 22.23%.

Fats have been found to be a source of protection of organs and bones from injury by serving as protective padding and insulated the body against cold (Otiloota, 2008). The fat value obtained is closed to the value obtain by (Theo bald et a1,2005). Who work on nutritional quality, storage stability ofcomposition food, and obtain fat to be (2.41 ± 0.31). The low fat content will help to prevent rancidity in the food. The Recommended Dietary Allowance for fat is (10-25g) so the blends do not meet the RDA standard for fats and commercial sold weaning food Nestle Cerelac (9.0g) so it has to supplement with crops rich in fats such as groundnut in order to meet the Childs needs. The children need to consume 9.86g of fat in a serving (30g) of the blends 2-3 times daily, in order to meet the nutritional requirement of the child.

Crude fiber is significantly higher in WSC blend (16.30±0.05%) and WSD blend (16. 29±0.06) at (p<0.05) due the presence of carrot in the blend, and carrot have been known to be a good rich dietary fiber and help to soften and increase the bulk of stools thereby reduce the problem of constipation in children (Morais et al., 1999). There is lower amount of crude fiber in WS blend (1.73±0.3%) due to absence of carrot. Crude fiber Shows significant different between the blend at (p>0.05). A similar value too was obtained by Anigo et al.,2010 (1.74± 0.02%). Who work on Nutrient composition of complementary food gruels. So the Childs needs 8g of fibre in a serving (30g) of the blend three times daily in order to meet the nutritional requirement of the child based on the size of the stomach.

US standard recommended 12% for long term storage. Low moisture content indicates low storage problem (Samuel, 2004). High moisture in food has been shown to encourage microbial growth (Temple et al., 1996). This observed value is close to the work done by (Laswai and Kulwa, 2010) on nutrient content and acceptability of soybeans based complementary food and obtain moisture to be (13.02%). This imply that the formulated blends especially the WSC blend and WS blend will keep for a long time without spoilage because of their low moisture content This is an important consideration in local feeding method in Nigeria because most mothers often prepare large quantities of dry infants' foods and keep in container' to avoid frequent processing in order to have spare time and energy for other domestic activities.

Ash content shows the amount of inorganic element present in a food. Ash is high in WSC blends (2.99± 0.14%) this can be attributed to presence of carrot and soybeans compare to WS blend (0.90± 08%). WSC value in close in work done by (Modu et al., 2009) (2.30±l.27) who work on evaluation and nutritional value of composite meal. The formulated blends have essential mineral present in it, and will meet thenutritional requirement of the infants. Itisalso close to recommended value for ash Which is < 3. Ash show significant differences at p>0.05. The ash value obtained is close to the commercial sold Nestle Cerelac (2.60%). Carbohydrate provide the body with energy which is a ready source of energy Carbohydrate is high in the three blend and also close to recommended value for Carbohydrate (64±4). Which when consumed provide the needed energy for the children. The value is close to work carried out by Compaore et al.,2011, 63.95±0.04. The value obtained for carbohydrate is also close to one obtained for the commercially sold Nestle Cerelac (67.95%).

Elemental Composition

Sodium show significant different in the three blends, which is essential to maintain fluid balance and bone balance. This value obtained for protein fall below the RDA standard which is 120, the loss in nutrient might be to process involved in food processes Which have to fortified (by adding table salt) in order to meet the children need or complements with milk and cheese.

Potassium is significantly higher in the three and is above the RDA recommendation which is 500. So the blend is able to meet thechild's nutritional needs by maintaining the body fluids balance of the child when consumed. Which is higher than the one obtained by (Solomon, 2005) to be 500, and higher than the commercial sold cerelac (700mg/100g). Potassium shows significant difference at $p<0.05$.

Calcium is vital component for teeth and strong bone.). Calcium value obtained fall below the RDA for calcium which is 400, It is also below the one obtained by the commercial sold cerelac. (420mg/l 00g) This loss might be as a result of the processes involved in food production. So which means the blends have to be fortified/complement with milk product so as to meet the Childs nutritional needs. This value is higher than the one obtain by (Solomon, 2005) who work on nutritive value of three complementary blends (67.2±00 mg/100g)

Magnesium is significantly higher in the formulated food and is above the recommended allowance for children 40mg is able to meet the nutritional needs when consumed. The value obtain is also in line with by the work done by Anigo et al.,2010.

For trace element; the formulated food has high amount of iron.The value for the three blends fall within the RDA recommendation (6.0) When consumed help to deliver oxygen to body tissues, which will help to improve the intellectual performance and regulate the body temperature and prevent nutritional anemia. This is similar to the one obtained for the commercial sold Cerelac (10.1mg/l00g). The value obtained is more than the one obtained by Modu et al., 2009 (8.05±0.42).

Zinc is adequate in the formulated food, when consume is able to promote neurological activity and memory which help lo boost the memory of the child. The value for zinc is similar to the one obtained by Ijarotimi and Keshinro, 2012. (5.5±0.0) the value obtained for zinc fall within the RDA which is (5.0). The value is also close to commercial sold cerelac 7 mg/l00g.

Copper helps in the formation of hemoglobin. It is significant high in WS blend (680±0.05mg/l 00g) when compared to WSC blend (450±0.05 mg/l00g) and WSD (360±0.19 mg/l00g) $p<0.05$.A Similar result was obtained by Theobald et al., 2005 (470 ± 0.00), who work on nutritional quality and storage ability of composite foods. The commendation for Copper is 150µg /day, and the value obtained fall within the RDA, so the blend is able to meet the nutritional requirement for the children.

5. CONCLUSION

The results from this study suggest that proper reformulation and fortification of these local diets can provide nutritious foods that are suitable not only for weaning, but also as rehabilitation diet to malnourished children that can be more cost effective. This is believed to be a practical food-based approach aimed at combating the problem of malnutrition among infants and children in Nigeria and other developing countries. These formulated blends meet the child nutritional needs because all the raw material used in food composition are locally available and does not require special skill for the preparation.

The present analytical results showed the Formulated as a good source of protein and energy contents that could contribute calories to human and help to combat the problem of malnutrition in convalescent children.

5.1 RECOMMENDATION

The formulated complementary food is recommended for children and adults because of its high nutritional content. Mothers should be enlightening about the crops that is available, and should be aware in the risk involved on consumption n on only starch food/gruels.

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