PROXIMATE ANALYSIS OF SOME SELECTED INFANT FORMULA SOLD IN MAKURDI METROPOLIS

Abstract

Infant formula is a synthetic version of mother's milk and belongs to a class of food materials known as dairy substitutes. This study was designed to evaluate the proximate composition in some selected infant formula sold in Makurdi metropolis. Six (6) different brands of infant formula samples were purchased from the major markets, Wadata market and North bank market Makurdi Benue State, North Central Nigeria. The six different brands comprises of three (3) infant milk formulae and three (3) infant cereal formulae. Samples on some Selected Infant Formulae were analysed in the laboratory for proximate composition and the data were subjected to Analysis of Variance to rank the significant differences in means. There were significant different ($P<0.05$) across the selected infant formulae sample for moisture, ash, crude protein, crude fate, crude fibre and carbohydrates. The result shows that FRISOGOLD significantly ($P<0.05$) has the highest moisture content (11.60%) with cowbell having the lowest (2.45%) while the ash content of cowbell was found to be the highest compared to other formulae. In conclusion, the commercial baby food samples (MYBOY, NAN and cowbell) have low moisture content which suggest an asset as this prolongs the shelf life and also inhibits microbial activity on these products thereby preventing spoilage.

INTRODUCTION

Infant formula is a synthetic version of mother's milk and belongs to a class of food materials known as dairy substitutes. Milk and its products are foodstuffs that have various forms of usage in nature. It contains more than twenty different trace elements including copper, zinc, manganese and iron which are cofactors in many enzymes and participates in many physiological functions in mammals [10]. The overview on infant formula reported that breast milk is the best food for infants, as it prevents Diarrhoea and other infant diseases. It should be the sole source of food for the first six (6) months, and only when breast feeding is not sufficient or if the mother is taking a drug that could harm the baby, should infant formula be administered [12].

According to [13] infant formula has almost all the major nutrients as the diet that will enhance the growth of the child and more so that these infant formulae are designed to provide the required nutrients as recommended diet intake (RDI) of minerals for infants and toddlers. Infant formula as food supplements has a part to play in the diets of infants that is very important. In the sense that, they supply to the body minerals and vitamins which is required in a larger quantity. Since they are primarily derived from animals or plants, they are therefore mostly milk, soya or cereal-based. They almost have all the nutrient requirements that are in breast milk, although it is difficult to produce a formula equal in all respects to breast milk [17].

There are different brands of infant formulae manufactured and mostly used worldwide; therefore the availability depends on the demand of the people. They include Milk based formulae – Cowbell infant formula, SMA gold infant milk, NAN infant milk, My Boy infant milk, Lactogen, Frisolac Gold, Nutriben etc and Cereal based formulae – Cerelac of different ages like 6 months, 8 months, 12 months (Maize, milk & Rice), Friso Gold (wheat base and rice base), Nutrend, Thrive (pediacain), Nutriben (8 cereals and 4 fruits).

The World Health Organization and Food Agriculture Organization have issued some guidelines to produce infant formula commercially, thereby controlling its production. However, reports have shown that various nutritional inadequacies have been cited in some infant formulae. But when infant formula is formulated in accordance with applicable Codex Alimentarius standards, it is nutritionally adequate and safe to be a complementary food and a suitable breast milk substitute. [15] reported that baby food composition varied according to region and economic status. More than 70% of lactating mothers do not breast feed their infants exclusively for the recommended periods of six months [15]. As a result infants are subjected to intake of formula milk. The US Foods and Drugs Administration in 2002 stated that infant formula milk was not a sterile product [8]. Therefore, this study was designed to evaluate the composition in some selected infant formula sold in Makurdi metropolis.

Materials and Methods

The study area is Otukpo town in Otukpo Local Government Area and located along latitude $7^{o}13^{o}57^{o}$N and longitude $8^{o}05^{o}26^{o}$E of Benue State. It is bounded to the North by Apa Local Government, the East by Obi Local Government, and the South by Ohimini Local Government, all of Benue State. The town is strategically located at the intersection of the eastern railway line and the only trunks "A" road linking the Northern parts of the country to the Eastern parts. The town has double maxima rainfall: the major one is around April – July and the minor between September – October. The dry dusty harmattan wind blow from the North between November and December. Depending upon a particular year, there are variations of rain output, thus from no rains, isolated rains or fair to heavy rains. The area is underlain by the Agwu shales, a unit of cretaceous sedimentary formation of the Benue valley. The sedimentary rock consists of lateritic soils, clays and shales with occasional thin lenses of sand stone. Besides, the area is endowed with thick forests. The cultural life of the

people in Otukpo is linked to farming, trading, small scale soap-making and palm oil industries.

Sample collection

Six (6) different brands of infant formula samples were purchased from the major markets, Wadata market and North bank market Makurdi Benue State, North Central Nigeria. The six different brands comprises of three (3) infant milk formulae and three (3) infant cereal formulae.

The manufacturer's date, expiring dates and NAFDAC numbers are subsumed in Table 1

Table 1: manufacturer's date, expiring dates and NAFDAC numbers of different milk brand

Milk Brand	manufacturer's date, expiring dates	NAFDAC numbers
Nan	02 2014, 29 02 2016	01 – 0096
My boy	04 2014, 04 2017	01 – 0901
Cowbell	05 11 2014, 05 11 2016	01 – 0558
Cerelac	11 2014, 05 2016	01 – 8379
Nutrend	03 2014, 09	01 – 0672
Friso gold	03 09 201423 08 2016	01 – 7770

[4]

Proximate Analysis of the Selected Infant Formulae

Determination of Moisture Content

The method described by [2] was adopted. A clean crucible was dried to a constant weight in an air oven at 110^0C, cooled in a desiccator and weighed (W_1). Two gram (2g) of the sample was accurately weighed into the previously labeled crucible and reweighed (W_2). The

crucible containing the sample was dried in an oven to a constant weight (W_3). The percentage moisture content was calculated thus:

$$\%\ Moisture\ Content\ = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \text{----------(1)}$$

Determination of Ash Content

The [1] method was used. The porcelain crucible was dried in an oven at 100^0c for 10 minutes, cooled in a desiccators and weighed (W_1).Two grams of the sample was placed into the previously weighed porcelain crucible and reweighed (W_2). It was first ignited and then transferred into a furnace, which was then set at 550^0C. The sample was left in the furnace for eight hours to ensure proper ashing. The crucible containing the ash was then removed cooled in the desiccators and weighed (W_3). The percentage ash content was calculated as:

$$\%\ Ash\ content\ = \frac{W_3 - w_1}{W_2 - W_1} \times 100 \text{ ----------(2)}$$

Determination of crude lipid content

The lipid content was determined as in the [1]. A clean, dried 500ml round bottom flasks, containing few anti-bumping granules was weighed (w_1) and 300ml of petroleum ether (40-60^0C) for the extraction was poured into the flask with soxhlet extraction unit. The extractor thimble containing twenty grams was fixed into the soxhlet extraction unit. The round bottom flask and a condenser were connected to the soxhlet extractor, and cold water circulation was put on. The heating mantle was switched on and the heating rate adjusted until the solvent was refluxing at steady rate. Extraction was carried out for six hours. The solvent was recovered and the oil was dried in the oven at 70^0C for one hour. The round bottom flask and the oil were cooled and weighed (W_2).The lipid content was calculated thus:

$$\%\ crude\ lipid\ content\ = \frac{w_2 - w_1}{w_t\ of\ sample} \times 100 \text{----------(3)}$$

Determination of crude fibre

The method described by [1] was used. Two grams of the sample was weighed out into a round bottom flask, 100 cm^3 of 0.25 M sulphuric acid solution was added and the mixture boiled under reflux for 30 minutes. The hot solution was quickly filtered under suction. The insoluble matter was washed several times with hot water until it was acid free. It was quantitatively transferred into the flask and 100 cm^3 of 0.31M sodium hydroxide solution was added and the mixture boiled again under reflux for 30 minutes and quickly filtered under suction. The insoluble residue was washed with boiling water until it was base free. It was dried to constant weight in the oven at 100^0 C, cooled in desiccators and weighed (C_1).

The weighed sample (C_1) was then incinerated in a muffle furnace at 550°C for 2 hours, cooled in the desiccators and reweighed (C_2).

Calculation

The loss in weight on incineration = $C_1 - C_2$. The calculation was carried out thus:

$$\%\ crude\ fibre\ = \frac{W_3 - W_1}{W_2 - W_1} \times 100 \text{----------(4)}$$

Determination of Nitrogen and Crude Protein

Protein Digestion:

The method of [2] was used. Exactly 1.5 grams of defatted sample in an ashless filter paper was dropped into 300 cm^3 kjeldahl flask. 25 cm^3 conc. H_2SO_4 and 3 g of digesting mixed catalyst (weighed separately into an ashless filter paper) was dropped into the kjeldahl flask. The flask was then transferred to the kjeldahl digestion apparatus. The sample was digested

until a clear green color was obtained. The digest was cooled and diluted with 100 cm^3 with distilled water.

Distillation of the Digest:

20 cm^3 of the diluted digest was measured into a 500 cm^3 kjeldahl flask containing anti-bumping chips and 40 cm^3 of 40 % NaOH was slowly added by the side of the flask. A 250 cm^3 conical flask containing a mixture of 50 cm^3 of 2 % boric acid and 4 drops of mixed indicator was used to trap the ammonia liberated. The conical flask and the kjeldahl flask were then placed on the kjeldahl distillation apparatus, with the tubes inserted into the conical flask and the kjeldahl flask. The flask was heated to distill out NH_3 evolved. The distillate was collected into the boric acid solution. From the point when the boric acid turned green, 10 minutes were allowed for complete distillation of the ammonia present in the digest. The distillate was then titrated with 0.1M HCl.

Calculation:

$$\% N = \frac{14 \times M \times V_t \times T_v}{Weight\ of\ test\ sample(mg) \times V_a} \times 100$$

$$\% Crude\ protein = \% Nitrogen\ (N_2) \times 6.38 \qquad [1]$$

Where M = Actual molarity of acid

T_v = Titre value of HCl used

V_t = Total Volume of diluted digest

V_a = Aliquot volume distilled

Determination of Carbohydrate

The total carbohydrate content was determined by difference. The sum of the percentage moisture, ash, crude lipid, crude protein and crude fibre was subtracted from 100 [1].

% Total carbohydrate $= 100 -$ (% moisture $+$ % ash content $+$ crude fat $+$ % crude protein $+$ % crude fi).

Statistical analyses

The results obtained in this study were subjected to analysis of variance (ANOVA) using Statistical Package for Social Science. For multiple comparisons of means across different infant formulae brand, ANOVA was used. In all the case p-values less than 95% confidence level ($\alpha = 0.05$) were considered significantly different using Tukey test.

RESULTS

Proximate Analysis of Selected Infant Formulae

Samples on some Selected Infant Formulae were analysed in the laboratory for proximate composition and the data were subjected to Analysis of Variance to rank the significant differences in means. Result of the proximate composition of selected infant food products is presented in Table 2. There were significant different ($P<0.05$) across the selected infant formulae sample for moisture, ash, crude protein, crude fate, crude fibre and carbohydrates. The result shows that FRISOGOLD significantly ($P<0.05$) has the highest moisture content (11.60%) with cowbell having the lowest (2.45%) while the ash content of cowbell was found to be the highest compared to other formulae. The protein content of My Boy and cowbell recorded the significantly ($P<0.05$) the highest (15.48%) and that of FRISOGOLD (11.91%) was lowest. NAN has the highest crude fat content and CERELAC and FRISOGOLD with the lowest (5.8%). The crude fibre of NUTREND was the highest with (1.65%) and no amount of crude fiber was detected in NAN, MY BOY and COWBELL. FRISOGOLD has the highest carbohydrate content of (70.34%) with Cowbell having the lowest of (47.12%).

Table 2: Proximate Analysis of the Selected Infant Formulae.

SAMPLE	%Moisture Content	% Ash Content	% Crude Protein	% Crude Fat	% Crude Fibre	% Carbohydrates
NUTRENED	7.37±0.0 [c]	2.15±0.02 [b]	14.29±0.01 [c]	4.60±0.02 [d]	1.65±0.02 [a]	69.96±0.02[c]
NAN	3.55±0.01 [e]	0.75±0.01 [f]	14.00±0.02 [d]	28.8±0.02 [a]	0.00±0.00 [d]	52.90±0.03[e]
COWBELL	2.47±0.02[f]	7.05±0.01 [a]	15.48±0.01 [a]	27.9±0.01 [b]	0.00±0.00 [d]	47.13±0.01[f]
CERELAC	8.16±0.07 [b]	1.95±0.02 [c]	14.89±0.02 [b]	4.50±0.03 [d]	0.40±0.01 [c]	70.13±0.02[b]
MY BOY	4.90±0.14 [d]	1.30±0.03 [d]	15.48±0.01 [a]	23.2±0.02 [c]	0.00±0.00 [d]	55.24±0.02[d]
FRISO	11.7±0.07 [a]	1.15±0.02 [e]	11.91±0.03 [e]	4.50±0.01 [d]	0.50±0.02 [b]	70.36±0.03[a]
P value	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*

[abc]Means with different superscripts on the same column are significantly different (P<0.05)

DISCUSSION

The difference among proximate analysis of the infant formulae brand can be attributed to the different sources of raw materials processed to manufacture the different brands [16].The highest value recorded by FRISOGOLD for moisture content was higher than those reported in literature for baby food samples 3.7- 4.9% [9], 3.75- 9.32% [6] and 3.0- 4.60% [20], respectively. The lowest moisture content of 2.45% was found in Cowbell. The moisture content values from FRISOGOLD, CERELAC and Nutrend are all within the standard value

of 5-10% recommended by the Standard Organization of Nigeria [14]. The low moisture of MYBOY, NAN and cowbell could be of advantage since it has been noted that low moisture content remains an asset to shelf life and preservation of food nutrients whereas a higher moisture content could lead to spoilage through increase in microbial action [17].The very low moisture contents suggest that 'when properly packaged and stored even under ambient conditions, these samples would have long shelf life. Samples NAN, CERELAC, FRISOGOLD, NUTREND and MYBOY were all within the maximum standard value of 2.0% [14] except for samples cowbell which were higher than the standard range. In similar studies, values of ash content ranged in millet/soybeans based baby foods from 1.70-2.30% [6] and cereal based baby foods ranged from 2.06 to 2.60% [9]. These were slightly higher than the values obtained in this studies with the exception of cowbell but not far from the maximum recommended standard value [14]. The low ash content in this study might be attributed to the effect of fortification and loss of organic matter during processing. The crude protein values obtained was lower than the values of 15.9- 16.9% from other studies [6] but fell within the range of 10.5- 15.0% [9] and 14.4-18.2% [20].The crude protein values of this work was within the range when compared to other works and also falls within the minimum range of 14-17% recommended by [14]. Protein is important for babies in their growth, so increase in the protein content of this food is needed to optimise nutritional values derived from their intake. It is very important that a child gets enough protein in their daily diet. They are the building blocks of body tissue and can also serve as a fuel source [5]. Protein can be found in all cells of the body and is the major structural component of all cells in the body, especially muscle. They are complex combinations of smaller chemical compounds called amino acids which are used as precursors to nucleic acid, co-enzymes, hormones, immune response, cellular repair, and other molecules essential for life. Additionally, protein is needed to form blood cells. Protein is needed by everyone to maintain and repair the body,

and it is especially important for babies and young children because protein supports growth and development. Protein is important for babies because walking requires protein to power muscles, and brain cells need this nutrient to learn speech and language skills. Healthy 1- to 3-year-olds need 0.55 grams of protein per pound daily, which means the average child should get 16 grams of protein each day [18, 19].The low protein content observed for FRISOGOLD calls for improvement on these foods by increasing the amount of protein or use of protein supplements or pairing them with other suitable protein source. The crude fibre content in the different brands of infant baby foods was less than 1.65%. These values are lower to the values reported for soy/millet based baby foods 3.30- 5.0% [6]. However they do not compare with other reported values for cereal based baby foods 9.29- 10.8% [9] which is higher and exceeds the standard maximum value of 5% based on [14] recommendations. The low fibre content in this study may be due to the fact that dehulled raw materials were used in the formulation. Low fibre influences nutrient availability positively while high fibre lowers plasma cholesterol levels [14]. NAN, Cowbell and My Boy were not detected, this is due to milk dissolution properties and might not needed in the food of infants below six months. The values for crude lipid content in the selected baby foods are ranged from 4.50% in CERELAC and FRISOGOLD through 28.8% in NAN. The values reported for NUTREND, CERELAC and COWBELL, however, do not compare to higher values of 7.0-9.0% [13] and 15.6% -17.7% [9] but lower than the values observed for CERELAC, FRISOGOLD and NAN in this study. The recommended standard value for crude lipid fat content for commercial baby foods is a maximum of 10.0% [14] and values obtained for NUTREND, CERELAC and COWBELL from this work do not exceed the recommended standard value. However an appropriate inclusion of essential fatty acids in infants and children's diet is vital, because it does not only increase energy density and ensure proper neural development, but also serves as a transport vehicle for fat soluble vitamins [4].The carbohydrate content of

FRISOGOLD, NUTREND and CERELAC baby food samples evaluated in this work were all above the recommended standard values of 60% minimum. However, these values are higher than that of crude protein and also when compared to values from reported literature 67.5-68.75% [6]; 67.95-68.40% [9].The recommended standard value for carbohydrate content is a minimum of 60% [14] and values from this work suggest that the samples of FRISOGOLD, NUTREND and CERELAC baby foods evaluated contains a sufficient amount of carbohydrate. Carbohydrates are important in infant and children's diet as it provides energy. [4] recommended that foods fed to infants and children should be energy dense ones. This, according to the recommendation is necessary because adequate energy fuels child's metabolism, support growth, keeps their brain and nervous system working and maintains overall health whereas low energy foods tend to limit total energy intake and the utilization of other nutrients and functions as mentioned above [18].

CONCLUSIONS

The proximate composition and levels of trace metals in purposively six brands of infant milk formula aged 0-6 months sold in Nigeria were determined using Atomic absorption spectrophotometer techniques and they showed significant differences across different brands. Also, the commercial baby food samples (MYBOY, NAN and cowbell) have low moisture content which suggest an asset as this prolongs the shelf life and also inhibits microbial activity on these products thereby preventing spoilage. Commercial baby food good are good source of energy and other mineral elements but cannot be relied on as the sole source of complete nutrient intake needed daily by its consumers since they were all low in protein and fiber. These baby foods have to be paired with other protein of choice to get the full nutrient value expected.

REFERENCES

1. AOAC (1990).Official Methods of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, D.C. USA, pp. 200-210.
2. AOAC (2006). Official method of analysis (18th edition). Association of Official Analytical Chemist, Washington D.C. U.S.A.
3. FAO/WHO. (2011). Safety evaluation of certain food additives and contaminants: Prepared by the seventy-third meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). WHO Food Additives Series. 64: 381-497.
4. FAO/WHO.(1998). Preparation and Use of Food Based Dietary Guidelines.*Report ofJoint FAO/WHO Consultation. WHO Technical Report series 880,* Geneva.
5. Food and Nutrition Board. (2005). Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients). *The National Academic Press,Washington,* D.C.
6. Iombor ,T.T., Umoh, E.J. and Olakumi.E.(2009). Proximate Composition and Organoleptic Properties of Complementary Food Formulated from Millet, Soy beans.*Pakistan Journal of Nutrition, 8, 1676-1679.*
7. Joint FAO/WHO Expert Committee on Food Additives. Tolerable or acceptable daily intakes, other toxicological information and information on specifications. In: Summary Report of the Seventy-Fourth Meeting of JECFA. 2011: 3-9.
8. Lanphear, B., Dietrich, K., Auinger, P. and Christopher, C. (2008). Cognitive deficits associated with blood lead concentrations less than ten micrograms per deciliter in US children and adolescents. *Public Health Reports* 4: 87-96.
9. Mariam, S. (2005). Nutritive Value of Three Potential Complementary Foods Based on Cereals and Legumes. African Journal of Food and Nutrition Series 5(2): 1-14.
10. Mohammed A. A.Gasmalla, khadir E. khadir, Abubakar Musa,Waleed Aboshora and Wei Zhao. (2013). Evaluation of some physiochemical parameters of three commercial milk products: *Pakistan Journal of food science*. **23** (2):62-65.
11. Nwokolo E. 1996. Lima bean (Phaseolus lunatus). Legume and oilseeds In: Nutrition. E Nwokolo and J Smart (Eds.). London: Chapman and Hall. p:145-155.
12. Ojo, R.J.,and Olabode, O. S(2013)., Analysis of Heavy Metals and Hydrocyanic Acid in Selected Infant Formula in Abuja, Federal Capital Territory of Nigeria., Scholars Academic Journal of Biosciences.,1(6):318-325.
13. Oskarsson,A(1998)., Risk Assessment in Relation to Neonatal Metal Exposure, Anlyst, 123(1):19-23.
14. SON. (1988). Standard for Foods for Infants and Children: Infant Formula. NigerianIndustrial Standard, Nigeria.
15. Sullivan J.I. (2008). Cognitive development: Breast milk benefit Vs infant formula hazard. Archives of General Psychiatry. **65** (12): 1458-1459.
16. Tai, S., Shao, F., Chia, Y. and Wen, I. (2013). Investigation of the nitrate and nitrite content in milk and milk powder in Taiwan. *Journal of Food and Drugs Analysis* 21 (1): 73-79.

17. Temple, V.J., Badamosi, E.J., Ladeji, O. and Solomon, M. (1996).Proximate Chemical Composition of Three Locally Formulated Complementary Foods. *West African Journal of Biological Science*, 5, 134 – 143.
18. W.H.O. (2008). Strengthening action to improve feeding of infants And young children 6– 23 months of age in nutrition and child health Programmes. *Report of Proceedings,* Geneva, Switzerland.
19. W.H.O. (2009). *Infant and young child feeding. Model chapter for textbooks for medical students and allied health professionals. Geneva, Switzerland: WHO Press,* World Health Organization.
20. William, A., Masters, J. and Kuwornuand, D. S. (2011). Improving Child Nutrition throughQuality Certification of Infant Foods: Scoping Study for a Randomized Trial in Ghana.pp. 15-16.