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NUTRITIONAL IMPACT OF LOCALLY FORMULATED FOOD ON MALNOURISHED CHILDREN IN KANO, NIGERIA

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ABSTRACT

Locally harvested crops contain essential nutrients that if they are utilized properly can provide necessary requirements for body building. The cost, availability and affordability of current standard Ready to use Therapeutic Food (RUTF) are the major obstacles to scaling up community-based management of acute malnutrition, an important child survival strategy. Identifying a cheaper alternative is a global public health priority. This research was carried out to study the effect of consumption of food formulated from locally available stuff on serum lipid profile, mid upper arm circumference (MUAC) and weight of malnourished children of Hasiya Bayero pediatric Hospital Kano State, Nigeria. The food was formulated using Sorghum (*Sorghum arundinaceum*), Date (*Phoenix dactylifera*), Groundnut (*Arachis hypogaea*), Soybean (*Glycine max*) and Moringa leaf (*Moringa oleifera*). The formulated food (300g) was given to males (10) and females (10) malnourished inpatient children (aged between 6 to 59 months) per day and consumed for a period of 2 weeks. Serum total cholesterol (T. CHOL), triacylglycerol (TRIG), high density lipoprotein (HDL), and low-density lipoprotein (LDL) were determined before (baseline) and 2 weeks after feeding with the study food. Mid upper arm circumference (MUAC) and weight of the volunteers were also measured. Results of the study showed an increase in weight, MUAC and mean serum lipid profile parameters after consumption of the study food was recorded. Mean serum T. CHOL, TRIG, HDL, and LDL levels were significantly higher ($p<0.05$) in female malnourished children than their males' counterparts before and after consumption of the study food. Thus, the study food had a positive effect on serum lipid status, weight and mid upper arm circumference (MUAC) of malnourished children.

Keywords: Food formulation, local ingredients, lipid status, malnourished children

INTRODUCTION

Malnutrition is a condition that occurs when people consistently do not consume or absorb the right amounts and types of food, as well as essential nutrients. Globally, it contributes to nearly half of all child deaths that is more than 3 million children each year (Robert, 2013). The main indicator of childhood malnutrition is stunting when children are too short for

their age. Stunted children have poor physical growth and brain development, preventing them from thriving and living up to their full potential. With over 11 million stunted children, Nigeria is facing a crisis of malnutrition and ranks second behind India among all countries with the highest number of stunted children (UNICEF, 2013).

Major causes of malnutrition in Nigeria were poor diet, disease/infection, poverty, Ignorance, economic and political insecurity, conflict and lack of resources. The treatment and prevention of severe acute malnutrition (SAM) via the Community Management of Acute Malnutrition programme (CMAM) is one of the interventions by world health organization (WHO) that has a positive impact on treating malnutrition in northern Nigeria. The program comprises four major components; community involvement, outpatient care, inpatient care, and services addressing the immediate and underlying causes of under nutrition such as supplementary feeding and food security programs. It provides take home ready to use therapeutic food (RUTF) as well as appropriate medical treatment on outpatient basis (Farouk, 2016). The RUTF is a fortified energy dense food intended to cover all nutritional needs during recovery from SAM (Akomo *et al*., 2019).

Major obstacles that may lead to increase in number of the mortality cases among the patients include, distance to a CMAM facility (most of the rural people cannot have an easier access to the program centers were this causes an increase in mortality rate among Nigerians), the patients drug/RUTF stock outs, lack of transport and support from husbands (some of whom forbade their wives' attendance or did not / could not provide transport money), Lack of knowledge on the symptoms of the disease until it become unbearable, and negligence behavior by some parents. The product (RUTF), which is based on peanut butter mixed with dried skimmed milk, vitamins and minerals, can be consumed directly by the child and provides sufficient nutrient intake for complete recovery. It can be stored for three to four months without refrigeration, even at tropical temperatures (UNICEF, 2013).

Majority of the RUTF is currently manufactured and imported from developed countries to developing countries including Nigeria, while using our local resources possibilities exist to create sustained improved nutrition for children. In order to lower the cost of nutritional feed production in the country, the use of locally cultivated crop should adequately be employed (Farouk, 2016). Therefore, this research was aimed at studying the effect of consumption of food formulated from locally available stuff on serum lipid profile and mid upper arm circumference (MUAC) of malnourished children.

MATERIALS AND METHODS

The study was conducted at Hasiya Bayero Pediatric Hospital Kano (a specialized service hospital), Kano state-Nigeria. An ethical approval was sought from the ethical committee of Ministry of health Kano, before the commencement of the study. The research was carried out in accordance with the declaration of Helsinki concerning the ethical principles for medical research involving human subjects.

Informed Consent

A written informed consent for inclusion into the study was obtained from the parents/guardians of the children before participation in the study, furthermore, they were made aware that all the information obtained will be treated confidential and would be used for research purpose only.

Samples Collection

The component of the formulated food used in this include; Soybeans, Sorghum, Groundnut, Date palm and Moringa leaves. The Samples were purchased from Rimi market in Kano State. The fresh samples were carefully selected and labeled properly in a polythene bags and then taken to the Botany Department of Biological Sciences, Bayero University Kano for confirmation. Blood samples were collected by well-trained personnel by antecubital or metacarpal venipuncture into plain well labeled tubes for serum collection. The samples were used for laboratory analysis of the parameters required for the research.

Diet Preparation

After collection and careful selection, the samples were washed in fresh water to remove dust, dirt, possible parasites or their eggs. They were then dried under shade; soybean and groundnut were heated slightly at about 50^0C in order to de-moisturized, the seeds of the date palm were removed and the flesh was used after shed dried. Afterwards, all samples i.e. Soybeans (30%), Sorghum (17.5%), Groundnut (17%), Date palm (13%) and Moringa leaves (2.5%) were mixed and then pulverized it into powder using grinding machine. The powder was air dried for two to three days and stored in fresh plastic containers. Energy content and acceptability of the formulated food by Children were determined (Gadanya, 2019). The formulated food which contained 22.59% protein, 30.86% fat and 30.20% carbohydrate was then used to prepare the pap that was used to feed the malnourished children. The food was prepared to a porridge-like consistency twice daily, under supervision of the hospital management and the Kitchener, at the Hospital's kitchen and packed into food flask and distributed to the patients.

Experimental Design

Ten male and ten female malnourished inpatient children, aged 6-59month were recruited for the research. Their blood samples were collected before the commencement of the feeding and after receiving the locally prepared food for a period of two weeks. Anthropometric parameters (Mid upper arm circumspect (MUAC) and Weight) were also measured before and after the treatment. Serum HDL-Cholesterol, LDL-Cholesterol, Triglycerides (TRIG) and Total Cholesterol were determined. Mean serum lipid values were compared between the base line and after treatment with the formulated food

Determination of Serum Total Cholesterol

Total cholesterol was determined using the Liebermann Burchard reaction (Kenny, 1952). To appropriately labelled test tubes for samples, standard and blank, 2.5ml of acetic acid/acetic anhydride mixture was added, and 0.1ml of serum, standard and distilled water were added to the test tubes

respectively. They were then mixed and allowed to stand for 5minutes in cold water. Then concentrated sulphuric acid was added and mixed immediately and incubated further in cold water for 10minutes. Absorbance was taken at 570nm against blank.

The concentration was calculated as:

CX=AT/AS X CS

Where

AT= Absorbance of test

AS= Absorbance of standard

CS= Concentration of standard

CX= Concentration of test

Determination of Serum Triacylglycerol

Triacylglycerol was determined using the extraction method (Trinder, 1969).

To appropriately labelled test tubes, 0.5ml each of serum, water and standard ware added. Then 2ml of heptane, 3.5ml of isopropanol and 1ml of 0.08N sulphuric acid were added, mixed for 20seconds, and left to stand for five minutes. Heptane upper layer was carefully transferred to a clean tube. To a test tube, 0.2ml of this extract was added, then 2ml of isopropanol and 1 drop of 6.25M KOH were also added. The mixture was mixed well and heated for ten minutes in a heating block at 70^0C. They were then removed, and 0.2ml of periodate and 1ml of acetyl acetone ware added, mixed well and heated again at 70^0C. They were removed, absorbance was taken against the blank at 425nm. The concentration was calculated as:

CX=AT/AS X CS

Where

AT= Absorbance of test

AS= Absorbance of standard

CS= Concentration of standard

CX= Concentration of test

Determination of Serum High Density Lipoprotien (HDL)

The HDL was determined according to the method described by Heny, 1974. To appropriately labelled test tubes: samples, standard and blank, 0.1ml of serum, HDL standard solution and distilled water were added to the test tubes respectively. R1 reagent (2.5ml) was added, mixed immediately and incubated at room temperature for 10minutes. R2 reagent was then added and incubated further for 20minutes and absorbance was taken at 500nm against blank. The concentration was calculated as:

CX=AT/AS X C_S

Where

AT= Absorbance of test

AS= Absorbance of standard

CS= Concentration of standard

CX= Concentration of test

Determination of Serum Low Density Lipoprotien (LDL)

Serum low density lipoprotein (LDL) level was estimated using Friedwald *et al*., (1972)

formula:

LDL= Total Cholesterol – HDL – TG/5

Statistical Analysis

Results were expressed as mean + standard deviation and analyzed using student's t-test with the statistical package for social sciences (SPSS) Version 16.0. A p value < 0.05 was considered significant.

RESULTS

From the result of this study (table 1), mean serum lipid status, total cholesterol (T.CHOL), triacylglycerol (TRIG), high density lipoprotein (HDL), and low density lipoprotein (LDL) of both males and females malnourished children shows an increase (but was not statistically significant $P<0.05$) after consumption of the formulated food.

Table 1: Serum lipid profile of male and female malnourished children (aged 6-59 month) before and after administration of study food.

Parameters	Concentration before consumption of formulated food (mg/dl)		Concentration after consumption of formulated food (mg/dl)	
	Males n=10	Females n=10	Males n=10	Females n=10
T. CHOL	85.413 ± 27.124[a]	103.69 ± 22.701[a]	95.229 ± 31.042[b]	116.33 ± 26.430[b]
TRIG	57.819 ± 26.033[a]	59.330 ± 7.368[a]	61.869 ± 25.519[b]	66.590 ± 13.470[b]
HDL	38.559 ± 5.325[a]	39.214 ± 6.682[a]	42.380 ± 4.251[b]	42.402 ± 5.393[b]
LDL	35.290 ± 28.832[a]	52.608 ± 25.652[a]	40.475 ± 31.542[b]	60.610 ± 27.996[b]

Results are presented as mean ± standard deviation. Values bearing similar superscript across the same row are significantly different at $p<0.05$. n = number of malnourished children in each group.

Results of mid upper arm circumference (MUAC) and weight of the male and female volunteers recorded (tables 2 and 3) shows that there was an increment in MUAC and Weight of the volunteers when comparison was made between the baseline and after receiving the formulated food for the period of two weeks.

Table 2: Weight of male and female malnourished children ((aged 6-59 month) before and after consuming the study food

Before consuming formulated food (kg)		After consuming formulated food (kg)	
Males n=10	Females n=10	Males n=10	Females n=10
6.3	8	7	9.2
7	6	7.8	7.3
6.5	5.7	7.2	5.9
4	6.8	4.3	7
5.7	6.5	7.2	7.1
3.2	7	4.3	7.8
6.5	2.1	7.6	3.5
6	5.3	7.4	6.1
5	7.2	6.2	7.9
7.5	5	8	6.2

Table 3: Mid upper arm circumference (muac) of male and female malnourished children (aged 6-59 month) before and after consuming the formulated food.

Before consuming formulated food (cm)		After consuming formulated food (cm)	
Males n=10	Females n=10	Males n=10	Females n=10
10.5	13	10.8	13.4
12.5	10.5	13.1	11.2
12	8.5	12	9
9.6	11	9.8	11.5
10	10	10.5	11
7.8	11	8.1	11
10.8	8.5	11.1	9
12	11	12.4	11.3
10	11	10.2	11.2
12	11	12.2	12.8

DISCUSSION

In this study, the observed increase in mean serum lipid status, total cholesterol (T.CHOL), triacylglycerol (TRIG), high density lipoprotein (HDL), and low density lipoprotein (LDL) of both males and females malnourished children after consumption of the formulated food (table 1), could be attributed with the nutrient content of the formulated food (22.59% protein, 30.86% fat and 30.20% carbohydrate). It was reported by Akuyam *et al*., 2008 that, there was a significant reduction in serum lipid concentrations in children with protein energy malnutrition (PEM). This report can be supported by this study as the lipid status parameters concentration shows an increment after consumption of the formulated food by the volunteers for a period of two weeks. The increase was not statistically significant ($p<0.05$) probably due to limited time of treatment. Females malnourished children were found to have significantly higher ($p<0.05$) mean serum lipid profile parameters than males malnourished children.

An increment in MUAC and Weight of the volunteers observed when comparison was made between the baseline and after receiving the formulated food for the period of two weeks shows that, the food when consumed by both male and female malnourished children for some period of time can help them to regain their weight and bring normalcy to the anthropometric parameters. This could be associated with the findings of a previous study which showed that the study food was highly acceptable to children, and was found to increase serum protein profile of malnourished (Gadanya *et al*., 2019).

CONCLUSION

This study shows that, consumption of the study food formulated from locally available stuff had a positive effect on serum lipid status, weight and mid upper arm circumference (MUAC) of the malnourished children that consumed the food for a period of two weeks.

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