

RESOLVING HIDDEN HUNGER AMONG SCHOOL CHILDREN THROUGH SOY ENRICHED BISCUIT: A FOCUS ON IBARAPA CENTRAL, OYO STATE, NIGERIA

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Abstract

Multiple micronutrient (MMN) deficiencies often occur simultaneously as a result of a poor-quality diet. The objective of the study is to enrich biscuits (the most identified consumed snack) for improved micronutrient availability. Method of data collection involved sampling frame comprised of eight schools selected from the four local educational zones of Ibarapa Central Local Government Area, Oyo state using systematic sampling technique wherein the first and seventh schools on the list provided by the LGEA were chosen. This study involved an experimental study consisting of: formulation and development of biscuits, which were prepared with wheat-soy flour in the ratios of 100:0 (control), 90:10, 80:20, 70:30 for products labeled A, B, C and D, respectively 20g of each product was packed for proximate and micronutrients analysis, to determine the nutrient content of the biscuits. Findings show that Product C (80:20) of the developed biscuits was nutritious meeting the 20% Reference Nutrient Intake (RNI) for snack in most nutrients. There was substantial improvements over the non-enriched biscuit i.e. control, which includes increment in nutrient composition of product C in comparison to control as highlighted below: (protein) 67.7%, (fat) 12.7%, (energy) 0.6%, (calcium) 185%, (iodine) 224.1%; (vitamins A, B₁, C and D) 269.5%, 82%, 129.2% and 705%. It was concluded that the developed product meets the requirements for arresting hidden hunger and is recommended for commercial production.

Key words: Micronutrient; Hidden hunger; School children; Enriched biscuits; Deficiency

Introduction

The twin problems of hunger and malnutrition have continued to impair health, survival and quality of life of children (Buhl, 2010; UNICEF/Tremeau, 2019). Under-nutrition, a form of malnutrition occurs with lack of some or all nutritional elements necessary for human health. The grim statistics of childhood deaths show that death due to hunger related causes occur every six seconds. Under-nutrition is one of the leading causes of childhood morbidity and mortality in many developing countries.(Ayogu, *et al.*, 2018) Evidence of high levels of nutritional deprivation in school children has spurred increasing global interest in their nutrition and health (Ndukwu, *et al.*, 2013). Nutrition is very essential for the cognitive functioning of school children as nutrients are needed directly as the building block of the brain structures as well as the synthesis and function of neurotransmitters. Indirectly, it enhances cognitive development, sound health and energy metabolism (Gomez-Pinilla, 2008). Improvement in the health of a school child makes the child more explorative, active and prompts the caretaker to interact with the child more often and enhances cognitive development indirectly. Improved health status in older children

resulted in positive impact on school attendance and better social interaction with other children which in turn enhanced their cognitive development and performance. Development such as well-being, motivation concentration and intelligence also improves when there is improvement in the general aspect of psychology.

The nutritional status of school children has great effect on their academic performance. Classroom achievement depends on the current diet as hunger results in inattentiveness and distraction. More impacting and subtle is “hidden hunger” which besets many school children. Hidden hunger is known as micronutrient deficiencies having devastating consequences on people, especially children. Micronutrient deficiency can lead to mental impairment, poor health, low productivity and even death (International Food Policy Research Institute, 2014). A meta-analysis on the effect of iron supplementation in children, demonstrated that effects on cognition were more pronounced in children who had iron deficiency (anemia) at the start of the intervention compared to non-deficient children. Therefore, it may be hypothesized that micronutrient interventions may be more effective in improving

cognition in malnourished populations in developing countries than in well-nourished children in developed nations.

Multiple micronutrient (MMN) deficiencies often occur simultaneously as a result of a poor-quality diet. In developing countries, low dietary intakes of animal-source foods can lead to MMN deficiencies. Parasitic infections or diarrhea can also lead to MMN deficiencies due to limited absorption or utilization of nutrients. In developed countries, the overall quality of the diet of school children and adolescents is inadequate in large parts of the population. Families with low socioeconomic status often cannot afford balanced diets; have less access to micronutrient-rich foods (fruits, vegetables, meat, fish, and dairy). In addition, school children may develop a more independent eating pattern which may include more out-of-home food consumption without supervision, which is likely to result in increased intake of foods of low nutritional value, such as soft drinks and salty snacks in place of micronutrient-rich foods.

Fortification of commonly consumed foods is one of nutritional intervention employed to improve micronutrient status. Biscuits are rich source of nutrients produced off-site, easily packed, stored, and transported. These are served as breakfast especially in full-day schools, in which case are given early in the day to alleviate short-term hunger. Biscuits are cheaper and easier to distribute than meals, and often aim to act as an incentive for increased school access, but are less substantial and financial cost to families are lower. Biscuits work in the same way as in-school meals, alleviating short-term hunger and micronutrient deficiencies, and improved learning. These types of food are used in emergency or crisis contexts for rapid scale-up or in situations of poor school infrastructure and storage facilities with little preparation time and facilities.

Statement of the problem; Most school children consume inadequate diet, i.e. usually skip meals, either as a result of ignorance, poverty, emotional disturbance due to maladjustment, trying to meet other needs of higher priority, or unavailability of food. Studies carried out had shown that diets of school children are inadequate in calories, proteins, vitamins and minerals (Sultan, 2014; Katungwe *et al.*, 2015). Thus, their growth rate is poor, having low body weight and height which affect their performance, ability to concentrate, grasping capacity and learning ability. In addition, inadequate food intake leads to under nutrition among school children (Buhl 2010, Bundy *et al.*, 2009, West *et al.*, 2006). International Food Policy Research Institute (2014) observed that

hidden hunger afflicts more than 2 billion individuals, i.e. one in three people, globally. The impacts of hidden hunger can be devastating, much worse on child health and survival resulting in serious physical and cognitive consequences.

School children find pleasure in consuming snacks during school hours at break time. This could augment their nutritional supply, irrespective of the motive for consumption. High protein snacks are the tastiest way to keep on giving longer lasting energy than the usual carbohydrate-heavy options. Bundy, *et al.*, (2009), explained that snacks can be served early in the day to alleviate short-term hunger. These snacks are cheaper and easier to distribute than meals and often act as incentive for increased school access and are less substantial and their financial cost to families is lower. Biscuit is among the most consumed baked wheat product. Although they are low in protein, fibre, vitamins and minerals, but with wide acceptability among all age groups because it is easy to digest, compact in size and can be preserved for a long time (Daina, *et al.*, 1973).

More attention in research as to be focused on nutritional needs of early childhood with the belief that they are more vulnerable but an intervention among school children could supplement efforts of the preschool years, to reduce the effect of malnutrition. The consumption of healthy snacks can help the supplementation of energy and nutrient requirements, (but more importantly micronutrients) and therefore contribute positively to growth and development. The efforts of researchers in other climes are not directly applicable as efforts are focused on controlling over-nutrition or obesity while Nigeria's school children are mostly under nourished. This work is concerned with resolving hidden hunger (micronutrient deficiencies) among school children through soy enriched biscuit: a focus on Ibarapa Central, Oyo State. Nigeria.

Research Questions: The following questions were raised to pivot the study:

- i. What is the most frequently consumed snack that could be fortified for an intervention?
- ii. How can the identified snack be fortified to provide needed micronutrients?
- iii. What are the micronutrient values of the newly developed product?

Objectives of the study: The general objective of this study is to fortify a popular snack for the improvement of micronutrient available to school children. Specific objectives include, to:

- i. determine the most frequently consumed snack
- ii. enrich the identified snack for improved micronutrient availability
- iii. Evaluate the micronutrient contents of fortified snack.

Justification for the study

Under nutrition hinders physical and intellectual development of school age children, the consumption of snack will supply energy and nutrients needed to improve ability in class which in turn facilitates learning. It prevents psychosocial dysfunction caused by hunger in children i.e. aggression and anxiety. It also improves nutrition and health status that aids learning. The provision of snack for school children in rural areas is an attempt made by this study to reduce the problem of malnutrition and under nutrition in school children in the country.

The use of local food sources in the development of a nutrient-dense snack promotes the consumption of cheap local foods. This study focused on the nutritional needs of school children to draw attention of researchers to the effectiveness of fortified snacks in elongating nutritional stability beyond infancy.

Conceptual and theoretical clarifications

A micronutrient deficiency is a public health problem which affects more than 2 billion people or one in three people globally. It accounts for about 7% of the global disease burden and at a global cost of \$180 billion every year. Young children and women of reproductive age are the most affected with about 1.1million out of 3.1 million child death occurring as a result of under nutrition (Murphy, 2013). The causes include poor diet, diets based on staple crops i.e.

maize, wheat, rice, and cassava, micronutrient needs not met during pregnancy and lactation, Lack of Vitamin A and zinc affect child health and survival by weakening the immune system, zinc deficiency impairs growth and leads to stunting in children; iodine and iron deficiencies prevent children from reaching their physical and intellectual potential. Micronutrient deficiencies impair physical growth and learning in children and limits productivity in adults. These in the long run perpetuate poverty and greater susceptibility to disease. It was agreed by the health community that a diverse and nutrient-rich diet is key to fighting micronutrient deficiencies (Chung, 2016). Bundy, *et al.* (2009), observed that school-age children are particularly vulnerable to under-nutrition as the priority in nutrition interventions is often to prevent malnutrition during fetal development and the first years of life. Infants and children grow rapidly; they are therefore vulnerable to nutrient deficiencies, in particular brain growth. Therefore the timing of nutrition intervention should be considered because some brain functions develop early in life and nutritional deficits during this period may irreversibly impair brain development and later cognitive functioning. Nutrition is very essential for the cognitive functioning of school children as nutrients are needed directly as the building block of the brain structures as well as the synthesis and function of neurotransmitters. Indirectly, it enhances cognitive development, sound health and energy metabolism (Gomez-Pinilla, 2008).

Consistently including high levels of micronutrients in the diet of children is crucial to their optimal growth, development, normal learning and cognitive functions.

Materials and methods

Ibarapa Central Local Government Area of Oyo State in South-Western Nigeria has its headquarters at Igbo-Ora. There are two main towns in Ibarapa Central Local Government namely Igboora and Idere consisting of ten wards. It has an area of 480 km² and a population of 116,809. This part of the State was selected for study to represent the rural and semi-urban population of Oyo State. The Local Government Area is predominantly agrarian.

This study involved the following;

- a. The formulation and development of the snack.
- b. Determination of the nutrient content of the developed product (snack)

Nutrient-dense biscuits were produced using rubbing-in method. The biscuits were prepared from the blend of full fat soy flour at 0, 10, 20 and 30% substituted for refined wheat flour that is 100, 90, 80, 70% refined wheat flour. The process for production of nutrient-dense Snack (biscuits) consisted of rubbing-in 150 ml vegetable oil into 1000g of flour with 0.05g salt, 35.16g baking powder, 25g sugar, 20g cocoa powder. All dried ingredients were mixed together, vegetable oil was rubbed into the flour and six eggs beaten well with 200ml water were added. All ingredients were weighed accurately using weighing balance and mixed, kneaded and rolled out into uniform sheet 1/2cm thickness and cut into round shapes with a properly shaped cutter. They were later arranged on greased trays and baked at 170 - 180°C.

- c. The procedure for the production of the new product, biscuit, is laid out in a flow diagram in Fig. 3.1

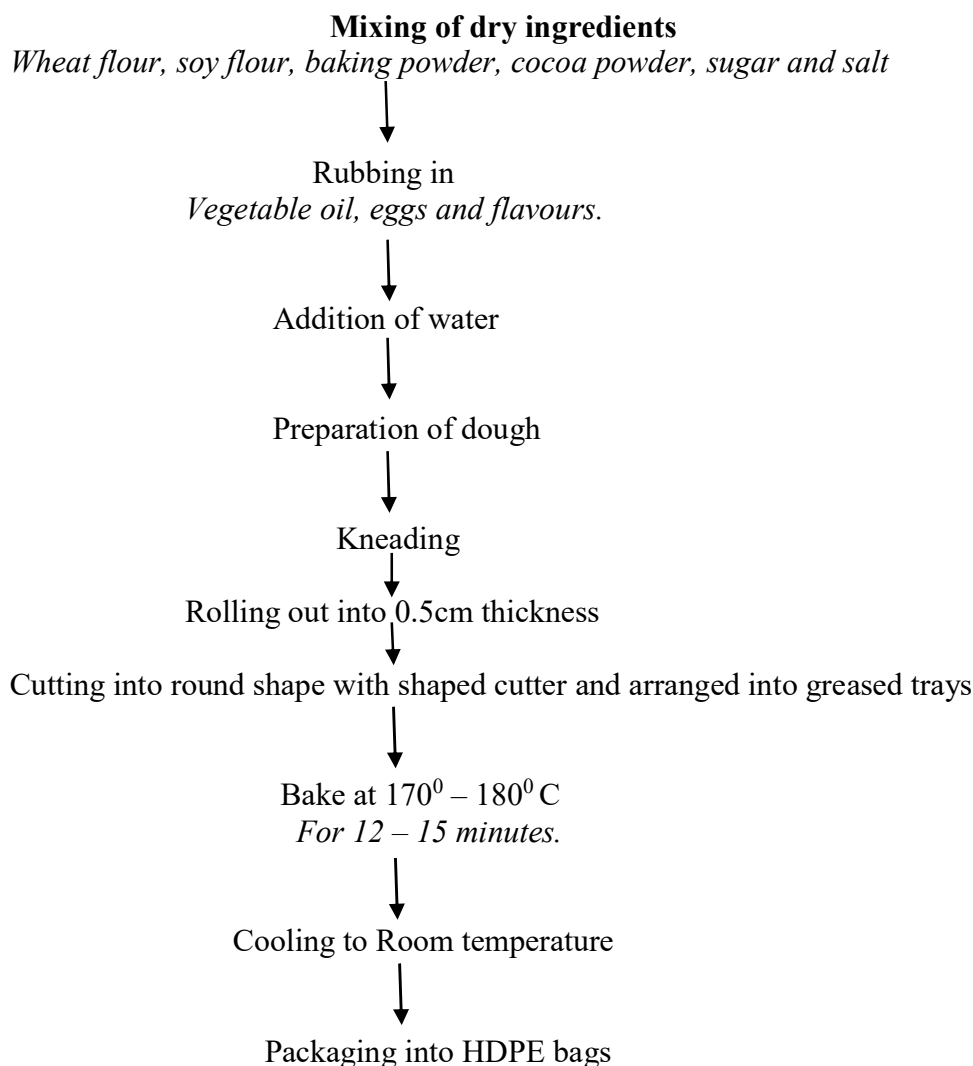


Fig.1 Flow diagram for biscuit preparation

Chemical analysis and results

Determination of nutrient content of the product

After the snacks preparation, four samples of 20g each were packed for chemical analysis to determine the nutrient content of the snack.

- Proximate Analysis: Samples A, B C D were analyzed chemically according to the official methods of analysis (A.O.A.C, 1990) It was carried out in triplicate and micronutrient analysis in duplicate.
- In determining the micronutrient composition of the samples, the materials were subjected to tests as follows:

Vitamins were divided into water soluble and fat soluble vitamins and analyzed using chromatographic

Table 1 Chemical Analysis

Nutrient Content	Sample A 0 % Soy	Sample B 10%Soy	Sample C 20%Soy	Sample D 30%Soy
Moisture	3.18	3.26	4.28	3.20

method i.e. High Performance Liquid Chromatography (HPLC).

Minerals: Minerals are of two categories (i) Main elements, and (ii) Trace elements, which were analyzed using Spectrometry.

The developed products were in four samples- one served as the control (A) which had only basic components of biscuits while the other three had the enrichments in varying degrees. Sample B had 10% soy flour, Sample C had 20% of soy flour and Sample D had 30% of Soy flour. All samples (A, B, C and D) were subjected to chemical analysis for both proximate and micronutrient properties as shown in Table 1.

Protein	10.95	14.52	18.36	20.08
Fat	14.46	14.81	16.30	14.62
Crude Fibre	0.28	0.41	1.19	0.60
Ash	2.77	3.12	3.28	3.29
Carbohydrate	68.61	64.30	57.78	58.81
Energy	448.54	448.55	451.26	447.14
Calcium	10.93	17.43	31.15	28.65
Iron	4.65	3.7	3.95	3.18
Zinc	1.33	0.17	0.88	1.67
Phosphorus	115.28	46.93	213.95	236.85
Iodine	7.37	33.49	23.90	11.97
Vitamin A	13.20	18.33	48.78	27.99
Vitamin B₁	0.45	9.25	4.16	2.40
Vitamin B₂	0.22	12.38	5.50	3.21
Vitamin B₆	0.34	7.26	3.21	1.83
Vitamin C	2.42	7.89	5.85	4.81
Vitamin D	0.22	1.56	1.74	1.97

Discussion

The nutrient content of the product was compared to the Reference Nutrient Intake (RNI) benchmarks and examined the extent to which the minimum nutrient requirements were met. These were considered in terms of the RNI for each age group and gender (where necessary). Energy, protein, iron, iodine, vitamin B components and vitamin C were well exceeded, while a shortfall was observed in calcium, zinc, vitamin A and vitamin D as shown in table 2.

When compared with non-enriched biscuit (the control), the developed product had shown substantial improvement over the nutrient contents. Table 3 shows improvements achieved over the control through enrichment of the biscuit. Calcium had an improvement of 185%, while the Vitamin B group gave various levels of improvements (B₁, 831%; B₂, 2447%; B₆, 845%), Vitamin A had 269% and Vitamin D, 705%. Shortfalls were observed in respect of Iron (-15%) and Zinc (-33.83%). Despite the shortfall, iron was significantly higher than the RNI but of concern is Zinc that had fallen short for both the control and RNI.

Conclusion and recommendations

It can be concluded that developed snack possessed chemical properties capable of resolving micronutrient deficiencies. The developed snack met the 20% Reference Nutrient Intake (RNI) for snack in most nutrients evaluated (protein, carbohydrate, energy, iron, iodine, vitamin B group). The developed biscuit substantially improved over the conventional biscuits and therefore could be commercialized. Further study is recommended to further fortify

biscuits to provide the micronutrients in shortfall of RNI.

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