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Quality Characteristics of Candies Produced From Tigernut Milk and Soymilk Blends

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Abstract— The side effect of lactose intolerance on the health of humans has been reported on consumption of dairy milk, and imitation (or substitute) milk from plants such as legume has been found to curb it. In this experiment, the physicochemical and sensory evaluation of candies developed from different blends of tigernut milk and soybean milk were investigated. Results showed that the candies had a significance difference ($p<0.05$) in acceptability of sensory attributes such as; appearance, taste, flavor, mouth feel and overall acceptability. The formulated candies samples compared favourably with the control sample PQR (100% liquid milk).The candies had vitamin C composition ranging from 2.60mg/kg – 16.24mg/kg, while vitamin A ranged from 67.04mg/kg – 164.11mg/kg. Protein and minerals like sodium, calcium, magnesium and potassium were significantly increased ($p<0.05$) in sample GHI (70% tigernut milk and 30% soymilk) in the candy. The moisture and ash content of sample PQR (100% liquid milk) were significantly increased ($p<0.05$). The fiber content were significantly increased in sample PQR (100% liquid milk) candy. Carbohydrate content was significantly increased in sample ABC (50% tigernut milk and 50% soymilk) candy. It can be concluded that the results obtained revealed the possibility of using tigernut milk and soymilk as raw materials in food industries.

Keywords— Candies, tigernut milk ,soybean milk, physicochemical and sensory evaluation

I. INTRODUCTION

Candy is defined as a highly cooked, coloured and flavoured sugar mass formed into desired shapes. A more or less solid article of confectionary made by boiling sugar or molasses to the desired consistency, and then crystallizing, moulding, or working in the required shape. Technically, milk or chocolate can be added to sugar mixture in candy processing depending on the variety. The utilization of animal milk in candy production results in their unavailability in most African markets and to their high price of purchase. Tigernut (*Cyperus esculentus l.*) tuber is also another plant crop that its milk can be utilized in candy production. Tigernut (*Cyperus esculentus L.*) is an underutilized crop (family) and was found to be a cosmopolitan perennial crop of the same genus as the papyrus plant. Other names of the plant are earth almond as well as yellow nut grass [6; 2]. The nut was found to be rich in myristic acid, oleic acid, linoleic acid [3].

It is known in Nigeria as Aya in Hausa, Ofio in Yoruba and Akihausa in Igbo where three varieties (black, brown and yellow) are found. Among these, only two varieties; yellow and brown are readily available in the market. Tigernut can be eaten raw, roasted, dried, baked or be made into a refreshing beverages called tigernut milk. Tigernut milk is a very nutritive and energetic drink, both for young and old. It is tremendously high in starch, glucose and proteins. Also rich in minerals like potassium, phosphorus, vitamin E and C. Tigernut milk contains a large amount of oleic acid and it is cardiac preventive. Tigernut milk has never been found to produce allergy.

Soy milk, sometimes called soy drink or soy-beverage, is a white emulsion which resembles cow milk (convectional milk) in both appearance and consistency. It is made from soybean (*Glycine max l.*) seed and is described as a stable emulsion of oil, water and protein. It is an inexpensive source of protein and calories for human consumption which compares favorably with diary milk and can be used as a vital and cheaper substitute for cow milk for solving malnutrition problems in developing countries like Nigeria.

Soy milk has therefore been advocated that cow milk production should be substituted with soymilk production, especially where the former is difficult and expensive. It has lower fat content than cow milk and contains no cholesterol. This is regarded as one of its positive benefits. The absence of lactose in soymilk also positions it as a solution to lactose intolerance for some consumers of dairy milk, especially infants with such biochemical challenges. It promotes growth in children who are allergic to cow milk and has been used in solving protein deficiency problems all over the world.

The main objective is to evaluate the quality characteristics of candy produced from tigernut milk and soymilk blend.

II. METHODOLOGY

The tigernut tubers (*Cyperus esculentus l.*) and soybean grains (*Glycine max l.*), granulated sugar, glucose syrup, and lime were purchased from Eke Ekwulobia market in Aguata L.G.A. of Anambra state, Nigeria. The soybean grains and tigernut tubers were sorted manually to remove undesirable materials, washed with clean tap water for soil removal, blanched at 60^0C for 5 seconds in order to inactivate inherent enzymes and reduce microbial load, then drained prior to utilization.

MILK BLEND FORMULATION

Tigernut milk and soybean milk were mixed at varying proportions, 90:10, 80:20, 70:30, 60:40 and 50:50 to obtain the raw material for candy production, with 100% liquid milk serving as the control sample. This was done using a blender operated at full speed for 2 minutes.

MILK CANDY PRODUCTION

The method described by [7] was adopted, modified and used in the production of non-crystalline milk candy. Approximately 100g of sugar, 30g of glucose syrup, 8g of lime juice and specific ratio of milk blend from tigernut milk and soybean milk were combined in a heavy sauce pan over medium heat (45^0C) and stirred until the sugar dissolved. A thermometer was inserted into the mixture as it was brought to boiling without stirring until the temperature of the mixture reaches 120^0C and this lasted for 60 minutes. The mixture was allowed to cool to about 45^0C. The mixture was then poured into suitable molds to form. The resulting candies were removed from the molds after 30 minutes, cut with a very sharp knife and was left to completely cool for 24 hours. The candies were wrapped in an aluminum foil and stored in an airtight container at room temperature prior to analysis. The same process was repeated for other samples with varying milk blends.

PROXIMATE ANALYSIS

Proximate composition (moisture content, protein, fat, crude fibre and ash content) of the milk candy samples were determined in duplicates using [1] method.

SENSORY EVALUATION

The method described by[4] was used. The nine (9) point Hedonic scale was used and the quality attributes such as appearance, taste, flavour, mouth-feel and general acceptability of the candies were tested by 10 panelist randomly selected from the lecturers and students of Food Science and Technology, Federal Polytechnic, Oko.

STATISTICAL ANALYSIS

The data obtained were subjected to analysis of variance of a completely randomized design using SPSS procedure version 21 for personal computers [9], while treatment means were separated using Duncan multiple range test at 95% confidence level.

III. RESULTS AND DISCUSSION

The results of the proximate composition of tigernut milk, soymilk and the candies are shown in Table 1. The moisture content values recorded for milk candy samples ranged from 50.61% - 53.85%. The fat content of the candies ranged from 0.66% - 8.22%. There was a significant difference ($p<0.05$) among the samples. Sample 80:20 (80% tigernut milk and 20% soymilk) has the lowest fat content value (0.60%) while sample 70:30 (70% tigernut milk and 30% soymilk) had the highest fat content value (8.22%). This could be attributed to the different source of milk used for the production. The decrease in the fat content of the candies is an advantage for the keeping quality of the candies as chances of rancidity would be greatly reduced [8].The range of the protein content of the candy samples was from 3.07% - 8.20%. From the result, sample 70:30 (70% tigernut milk and 30% soymilk) had the lowest protein value (3.07%), while sample 100% (100% liquid milk) candy had the highest value (8.20%) content. Ash represents the total mineral content of a food material and thus serves as a viable tool for nutritional evaluation, [5]. The ash content of the candies ranged from 0.20% - 3.60%. Sample 100% (100% liquid milk) candy had the highest ash content value (3.60%), while sample 70:30 (70% tigernut milk and 30% soymilk) candy had the lowest ash content value (0.20%). There was a significant difference ($p<0.05$) among the samples.

From the result, the carbohydrate content of all the samples was very high and ranged from 21.52% - 37.04%. Sample 50:50 (50% tigernut milk and 50% soymilk) had the highest carbohydrate value (37.04%), while 100% (100% liquid milk) candy had the lowest carbohydrate (21.52%) content. This increase in the carbohydrate content of candy sample could be as a result of the ingredients added to the candies considering the fact that candy is sugar based product.

The fibre content of the candy ranged from 0.5% - 3.79%. Sample 50:50 (50% tigernut milk and 50% soymilk) had the lowest fibre content (0.73%), while sample 100% (100% liquid milk) candy had the highest fibre content. There was a significant difference ($p<0.05$) among the samples.

Sensory evaluation of the candy samples

The formulated candies compared favourably with the control sample in the different sensory attributes evaluated. Therefore, tigernut milk and soymilk can be applied successfully in the making of candy which had comparable nutritional values with candy made from liquid milk. This means that the production of such candies on a large scale would be a wise way of utilizing these crops. It would also provide an opportunity of purchasing these products at affordable prices, which will in turn make the beneficial nutrients present in the crops available to the consumer through the candies, especially African children.

IV. CONCLUSION AND FUTURE SCOPE

Apart from animals such as cow, milk can be extracted from other sources such as plant crops, precisely tigernut tubers and soybean grains. Milk from these plant crops is

found to have desirable, acceptable, and relevant physiochemical properties. The results obtained revealed the possibility of using tigernut milk and soymilk as raw materials in food industries. Therefore, it has been applied successfully in the making of candy which had comparable nutritional values with candy made from cow milk. This means that the production of such candies in a large scale would be a good way of utilizing these crops. It would also provide an opportunity of purchasing these products at affordable prices which will in turn make the beneficial nutrients present in the crops available to the consumers through the candies, especially African children.

Table 1: Proximate composition of tigernut milk, soymilk and the candies

Samples	Moisture content %	Ash content %	Protein content %	Fat content %	Fibre content %	Carbohydrate content %
ABC	53.01^{a}±.46	0.24^{c}±.05	7.19^{b}±.16	1.04^{e}±.02	0.73^{bc}±.15	37.04^{a}±.02
DEF	53.85^{a}±.53	0.42^{b}±.03	4.10^{e}±.10	3.31^{d}±.06	0.50^{c}±.05	33.00^{a}±5.30
GHI	51.65^{b}±1.06	0.20^{c}±.05	3.07^{f}±.11	8.22^{a}±.15	0.62^{bc}±.16	31.67^{a}±2.57
JKL	53.58^{a}±.71	0.32^{bc}±.03	4.83^{d}±.67	0.66^{e}±.29	0.77^{bc}±.11	32.48^{a}±4.70
MNO	50.61^{b}±.44	0.25^{c}±.05	6.51^{c}±.13	5.20^{c}±.72	0.85^{b}±.10	32.75^{a}±2.25
PQR	53.85^{a}±.32	3.60^{a}±.20	8.20^{a}±.20	6.80^{b}±.31	3.79^{a}±.33	21.52^{b}±1.10

Mean in the same column with different superscript are significantly different ($p<0.05$)
Key: ABC- 50:50, DEF- 60:40, GHI- 70:30, JKL- 80:20, MNO- 90:10, PQR- 100%

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