CHEMICAL COMPOSITION AND SENSORY EVALUATION OF CANDIES FROM TIGER NUT AND COCONUT MILK BLENDS

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Abstract
Tiger nut tubers were sorted, washed, soaked for 8 hours, ground a mixed with water, sieved using a muslin cloth and packaged in airtight container. Coconut was broken into pieces and coconut meat was pried out from the shell. The washed coconut meat was placed in a blender, mixed with water, sieved with muslin cloth and packaged in airtight container. Candy was produced from blends of tiger nut and coconut milk. Tiger nut milk and coconut milk were blended in ratio of 100:0, 70:30, 50:50, 30:70 and 0:100 designated as JKL, MND, ABC, GHI and DEF respectively. Sample PQR (100% cow milk) served as control. Proximate composition and sensory evaluation of candies were determined. Protein content ranged from 6.48 to 7.35%, fat content from 26.55 to 29.27%, ash content from 1.48 to 1.83% and fibre from 1.26 to 1.44%. Iron and potassium contents were significantly ($p<0.05$) higher in the ABC (50% tiger nut milk : coconut milk) than other sample. The value of vitamin A and calcium contents ranged from 0.87 to 2.67mg/100g and 270.54 to 591.18mg/100g respectively. Sample GHI (30% tiger nut milk and 70% coconut milk) was most accepted by the panelists in term of colour (7.2), flavor (7.1), taste (7.8), texture (7.1) and overall acceptability (7.9). Therefore acceptable and nutritious candies can be produced from tiger nut tubers and coconuts milk.

Key words: candies, coconut, tiger nut tuber, milk, acceptability

Received: 09.08.2018 Reviewed: 01.11.2018 Accepted: 15.11.2018

1. INTRODUCTION

Candy refers to confectionary or sweet which describes a spectrum of sweet goods and takes on different meanings from one country to the other. Candies are also defined as a highly cooked coloured and flavoured sugar mass formed into desired shapes. Candy is made by dissolving sugar in water or milk to form syrup which is boiled until it reaches the desired concentration or starts to caramelize. The type of candy depends on the ingredient and how long the mixture is boiled (Onwuka, 2014). It is often flavoured or coloured, and sometimes contains fruit and nuts among others. The utilization of animal milk in candy production results in their unavailability in most African markets and the high price of purchase. Imitation milk from plants such as tiger nut milk, coconut milk, soybean and others can be investigated in the production of confectionaries especially candy.

Tiger nut (*Cyperus esculentus*) is commonly known as earth almond, tiger nut, chufa, yellow nuts sedge and zulunut. It is known in Nigeria as Aya in Hausa, ofio in Yoruba and Akihausa in Igbo. There are three varieties of tiger nut (black, brown and yellow) are readily available in the market. Tiger nuts are rich in crude lipids and carbohydrates contents and their fairly good essential amino acid composition makes them a valuable source of food for man (Temple *et al.*, 1996). They are also rich in minerals like phosphorous and potassium, vitamin E and C, thus suitable for diabetic (Diannel, 2004). The nuts are valued for their nutritious starch contents, dietary fibre and carbohydrates. The tiger nut has reported to be used in the treatment of flatulence, indigestion, diarrhea, dysentery and excessive thirst. Tiger nut milk has been found to produce allergy (Belewu and Abodunrin, 2008).

The coconut (*Cocos nucifer*a L.) is an important fruit tree in the tropical regions. Fruit can be made into a variety of food and beverages such as coconut milk (Onweluzor and Nwakalor, 2009). Coconut milk is the word used to describe the liquid obtained from mechanical press of the coconut meat usually with added water. Milk can be used in

confectionaries, bakeries, biscuits and ice cream industries worldwide to enhance flavour and taste of various products (Persley, 1992).Coconut juice was found to be rich in calcium (800 mg%) while the protein and fat contents were 50 and 65 g% respectively. Nieuwentus and Nieuwelink (2002) reported that coconut milk is very rich in minerals and vitamin content while saturated fat was 10 % total energy. Coconut milk fat improves digestion and bowel function, support tissue repair and immune system functions, help protect the body from breast, colon and other cancers, improve the cholesterol ratio, reduce the risk of heart disease and increase the metabolic rate of body fat, among other benefits (Tijani *et al.*, 2017)

Traditionally, candies are made from cow milk but there is little or no information to various sources of imitation milk such as soy bean, coconut and tiger nut. Therefore, there is need to evaluate the potentials of these plants so as to increase their utilization in the market for candy. Tiger nut and coconut are consumed as snacks and beverages but due to low awareness on the nutritive and health benefits of these plant crops there is need for increased awareness of their benefits in candy making. This research work seeks to evaluate proximate and consumer's acceptability of a candies from blends of tiger nut and coconut milk.

2. MATERIALS AND METHODS

Procurement of raw materials

Tiger nut tubers, coconut granulate sugar glucose and limes were purchased from Eke Ekwulobia in Aguta L.G.A, Anambra State.

Preparation of tiger nut milk

Tiger nut tubers were sorted manually to remove undesirable material, washed with clean tap water for soil removal, blanched by boiling in 0.2% solution of sodium bicarbonate. This is to inactivate inherent enzymes and eliminate the nutty flavor which may be objectionable odour to some consumers. The tiger nut tubers were soaked for 8 hours in clean tap water then ground in a ratio of one litre of water each 300gram of tiger nut and mixture was left to macerate for 10min. The mixture was pressed and filtered using a muslin cloth. The milk obtained was stored in air tight container and kept in refrigerator for further use.

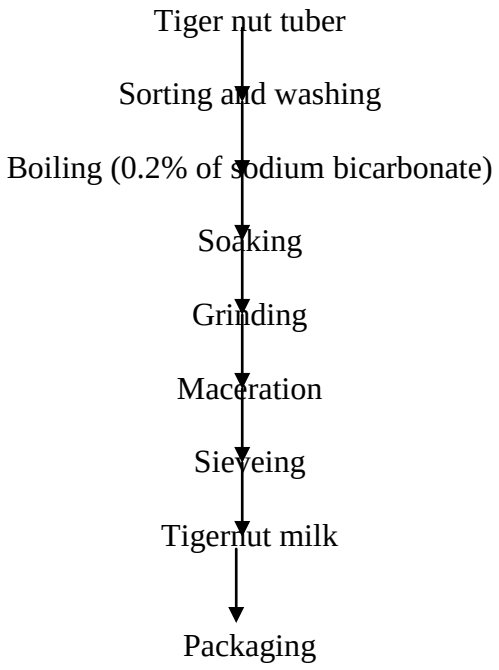

Fig. 1. Flow chart for production of tiger nut milk

Preparation of Coconut Milk

The matured fresh coconut was dehusked, cracked open into halves and removed with sharp knife. The split nuts were de-shelled to separate the coconut meat. The brown skin was removed from the coconut meat with razor blade. The coconut meat was washed and ground using electric blender with water, then sieved with muslin cloth and strained to obtain coconut milk. The coconut milk was packaged in air tight container and refrigerate for further use.

Formulation of Milk Blends

Tiger nut and coconut milk were blended in the ratio of 100:0, 70:30, 50:50, and 0:100. These were used to produce candy, 100 % cow milk served as control sample.

Production of candy

The method described by Sunny-Roberts (2007) was adopted, modified and used in the production of non-crystalline milk candy. Approximately100g of sugar, 30g of glucose syrup, 8g of lime juice and specific ratio of milk blend from tiger nuts and coconut meat 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 then temperature of the mixture reaches 120^oC and this lasted for 60 minutes. The mixture was allowed to cool to about 45^oC. The mixture was then poured into suitable molds to form candy. The resulting candies (plates 4 and 5) 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 Composition Analysis

The moisture, protein, fat, ash and crude fibre contents of the flour samples were carried out according to the methods of AOAC (2010) in triplicates. The carbohydrate was determined by difference.

Determination of vitamin A

Vitamin A was determined by method of the Association of Vitamin Chemists Kirk and Sawyer (1998).

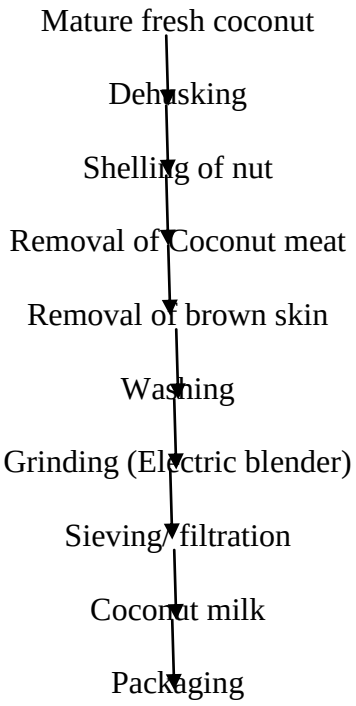

Fig. 2. Flow chart for production of coconut milk

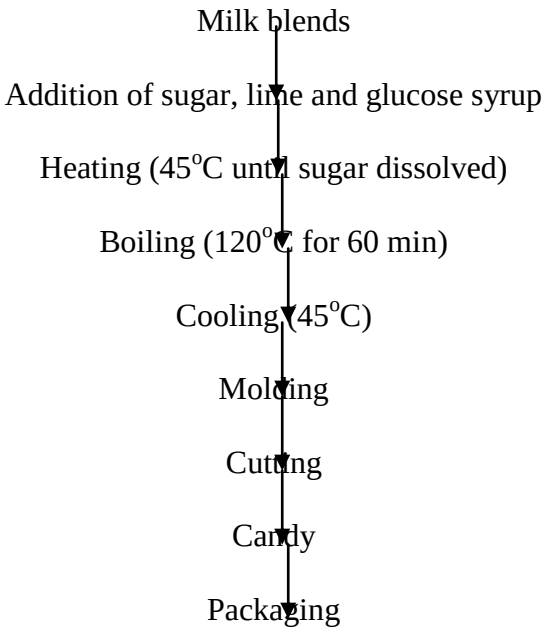

Fig. 3. Flow chart for production of candy

Table 1. Proximate Composition of Candy from Tiger nut and Coconut Milk Blends

Samples			Moisturecontent (%)	Protein content (%)	Fat content (%)	Ash content (%)	Fibre (%)	Carbohydrates (%)
P	Q	R	$3.97^{b} \pm 0.01$	$6.67^{b} \pm 0.01$	$27.37^{d} \pm 0.02$	$1.83^{a} \pm 0.01$	$1.43^{a} \pm 0.01$	$58.78^{e} \pm 0.04$
J	K	L	$1.28^{e} \pm 0.01$	$5.67^{f} \pm 0.02$	$28.45^{b} \pm 0.01$	$1.63^{d} \pm 0.01$	$1.32^{c} \pm 0.01$	$61.67^{b} \pm 0.01$
M	N	D	$1.36^{d} \pm 0.01$	$6.48^{d} \pm 0.01$	$26.55^{f} \pm 0.01$	$1.75^{b} \pm 0.01$	$1.26^{e} \pm 0.01$	$62.61^{a} \pm 0.01$
A	B	C	$1.24^{f} \pm 0.01$	$7.35^{a} \pm 0.01$	$27.58^{c} \pm 0.01$	$1.68^{e} \pm 0.01$	$1.36^{b} \pm 0.01$	$60.79^{d} \pm 0.01$
G	H	I	$4.26^{a} \pm 0.01$	$6.28^{e} \pm 0.02$	$29.27^{a} \pm 0.02$	$1.48^{f} \pm 0.01$	$1.44^{a} \pm 0.01$	$57.30^{f} \pm 0.01$
D	E	F	$2.66^{c} \pm 0.01$	$6.58^{c} \pm 0.01$	$26.97^{e} \pm 0.01$	$1.56^{e} \pm 0.01$	$1.28^{d} \pm 0.01$	$60.97^{c} \pm 0.01$

Values are means ± standard deviation. Mean followed by the same column with the same superscripts are not significantly different ($p<0.05$). PQR= 100% cow milk, JKL= 100% tiger nut milk, MND= 70% tiger nutmilk: 30% coconut milk, ABC = 50% tiger nutmilk: 50% coconut milk,GHI= 30% tiger nutmilk: 70% coconut milk, DEF = 100% coconut milk.

Mineral Contents Analysis

Potassium and calcium contents of the samples were determined using Flame photometer. Iron contents of the candy samples were determined using Atomic Absorption Spectrophotometer.

Sensory Evaluation

A ten member panel was trained on sensory attributes for the evaluation of candies produced from blends of tiger nut and coconut milk using a 9-ponit Hedonic scale (where 9= extremely like and 1= dislike extremely). The samples were scored for colour, flavor, taste, mouth feel and overall acceptability.

Statistical Analysis

Data obtained from proximate composition analysis, mineral analysis, vitamin A analysis and sensory evaluations were subjected to Analysis of Variance (ANOVA) using the statistical package for Social Sciences (SPSS) Version 17.0 (SSPS, 1995). Duncan's Multiple Range Test (DMRT) was used to compare the

treatment mean. Statistical significance was accepted at ($p<0.05$).

3. RESULTS AND DISCUSSIONS

The proximate composition of candies tiger nut and coconut blends is presented in Table 1. There were significant ($p<0.05$) differences in moisture contents of the candy samples. The value (4.26%) of 100% tiger nut candy observed in this present study was slightly higher than the value (3.02%) of 100% tiger nut candy reported by Obasi and Ugwu (2015) and was lower than the value reported by Sunny-Robert (2007) in coconut candy. The difference in the values could be attributed to the composition of the candies. Low moisture contents may be due to most chemical and biological processes that cause spoilage and deterioration of food which are water dependent (Sunny-Robert, 2007). There were a significant ($p<0.05$) differences in protein contents among the samples. The protein contents ranged from 5.67 to 7.35 %. Sample ABC (50% tiger nut milk: 50% coconut milk) had the highest value (7.35%), while sample JKL (100% tiger nut milk) had the lowest value of protein. The variation in the result is probably due to the method of extraction employed (Oyenuga and Fetuga, 1975). This could also be as a result of ratios of the milk blends as the quantity of tiger nut milk was higher the protein contents reduced.

Significant ($p<0.05$) differences were observed in the fat contents of all the samples. Sample GHI (30% tiger nut milk: 70% coconut milk) had the highest value (29.27 %), while sample MND (70% tiger nut milk: 30% coconut milk) had the lowest values (26.55%) of fat contents. This could be attributed to the different sources of milk used in production. Fat contents of coconut candy obtained in this present study were lower than the value (26.55%) reported in coconut candy by Sunny- Roberts (2007). The decrease in the fat contents of the candies is advantageous for the keeping quality of the candies as chances of rancidity would be greatly reduced (Sunny- Roberts *et al.*, 2004).

There were significantly ($p<0.05$) differences in the ash contents among the candy samples. The ash contents ranged from1.48 to 1.83 %. Sample PQR (50% tiger nut milk: 50% coconut milk) had the highest values (1.83 %) while sample GHI (100% tiger nut) had the lowest value (1.18%). Similar result was reported by Obasi and Ugwu (2015) in ash contents of 100% tiger nut candy. Ash content represents total mineral contents of food for nutritional evaluation. The range of the fibre content of the candy samples was from the values 1.26 to 1.44%. Sample GHI (30% tiger nut milk: 70% coconut milk) had the highest value (1.44%) while sample MND (70% tiger nut milk: 30% coconut milk) had the lowest value (1.26%). As the percentage tiger nut milk increased the fibre contents decreased.

Carbohydrates ranged from 58.75 to 62.61 %. Significant ($p<0.05$) differences were observed in the carbohydrates contents of all the candy samples. The range reported in this study was lower than the range (90.55 to 91.73%) reported by Obasi and Ugwu (2015) in the candies produced from tiger nut and melon milk.

Table 2: Vitamin A and mineral composition of candy from Tiger nut and Coconut Milk Blends

Samples			Vitamin A (mg/100g)	Calcium (mg/100g)	Potassium (mg/100g)	Iron (mg/100g)
P	Q	R	$2.67^{a} \pm 2.88$	$591.18^{a} \pm 10.00$	$25.00^{b} \pm 1.00$	$0.75^{a} \pm 0.01$
J	K	L	$0.87^{a} \pm 0.01$	$551.18^{b} \pm 10.00$	$24.00^{b} \pm 1.00$	$0.76^{a} \pm 0.10$
M	N	D	$1.05^{a} \pm 0.01$	$420.84^{e} \pm 10.00$	$20.00^{b} \pm 10.00$	$0.75^{a} \pm 0.01$
A	B	C	$1.02^{a} \pm 0.01$	$509.00^{c} \pm 1.00$	$35.00^{a} \pm 1.00.$	$0.85^{a} \pm 0.10$
G	H	I	$1.05^{a} \pm 0.01$	$458.91^{d} \pm 10.00$	$21.50^{b} \pm 010$	$0.75^{a} \pm 0.01$
D	E	F	$1.04^{a} \pm 0.01$	$270.54^{f} \pm 10.00$	$10.00^{c} \pm 1.00$	$0.75^{a} \pm 0.01$

Values are means ± standard deviation. Mean followed by the same column with the same superscripts are not significantly different ($p<0.05$). PQR= 100% cow milk, JKL= 100% tiger nut milk, MND= 70% tiger nut milk: 30% coconut milk, ABC = 50% tiger nut milk: 50% coconut milk, GHI= 30% tiger nut milk: 70% coconut milk, DEF = 100% coconut milk.

Table 2 shows the vitamin A and mineral composition of candy from blends of tiger nut and coconut milk. The vitamin A content of candy samples were not significantly ($p>0.05$) difference from each other. Sample PQR (100% cow milk) had the highest (2.67mg/100g) value of vitamin A while sample JKL (100% tiger nut milk) had the lowest (0.87 mg/100g). The range of values (0.87 to 2.67%) of vitamin A obtained in this present study was higher than the range of values (0.00 to 0.07%) reported by Obasi and Ugwu (2015). This shows that candies from tiger nut milk are poor sources of vitamin A. This was in agreement with the report of Obasi and Ugwu (2015).

The calcium contents of candies produced from tiger nut ranged from 270.54 to 591.18 mg/100g. There were significant ($P<0.05$) difference among the sample in calcium contents. The value of calcium contents obtained here was much higher than the report of Obasi and Ugwu (2015) in candy from melon and tiger nut milk. This is an indication that the consumption of candy from coconut and tiger nut milk builds healthy/strong bones and teeth and also assists in blood clotting.

Significant ($p<0.05$) differences were observed in potassium contents of candies. Sample ABC (50% tiger nut milk: 50% coconut milk) had the highest contents (35.00mg/100g) potassium contents while sample DEF (100% coconut milk) had the lowest values (10.10 mg/100g). The presence of potassium in candy is necessary to reduce high blood pressure diseases. Potassium is also essential for the normal functioning of nerves and muscle and in maintains the acid-base balance of the body (Tolonen, 1990).

There was no significant ($P > 0.05$) difference in iron contents of candies. The iron contents ranged from 0.75 to 0.85 mg/100g. The iron content is good constituent of hemoglobin and its presence is important in the process of blood formation.

Sensory evaluation of candy produced from the blends of tiger nut and coconut milk are shown in Table 3. There were significant ($p<0.05$) differences in all the sensory attributes among the samples. Sample GHI (30% tiger nut milk : 70% coconut milk) had the highest mean scores in terms of colour, flavor, taste, mouth feel and overall acceptability, followed by the sample ABC (50% tiger nut milk : 50% coconut milk) and sample PQR (100% cow milk) had lowest mean scores in terms of colour, mouth feel and overall acceptability.

Therefore candy produced with 70% coconut milk: 30% tiger nut milk was most preferred to other candy samples by the panelists. The eye appealing and highly accepted candies can be produced from the tiger nut and coconut milk.

4. CONCLUSION

Candy was produced from blends of tiger nut and coconut milk. The result revealed that sample ABC (50% tiger nut milk: 50% coconut milk) and sample GHI (70% tigernut milk: 30% coconut milk) had highest values in protein contents, ash contents and fat contents. Sample ABC was significantly higher in the potassium and iron contents than other candies.

Table 3. Sensory Evaluation of Candy from blends of Tiger nut and Coconut milk

Sample			Colour	Flavour	Taste	Mouth feel	Overall Acceptability
P	Q	R	$5.70^{c}\pm0.10$	$6.30^{c}\pm0.10$	$5.60^{bc}\pm0.10$	$4.50^{c}\pm0.10$	$5.40^{f}\pm0.10$
J	K	L	$6.70^{b}\pm0.10$	$5.50^{d}\pm0.10$	$5.40^{bc}\pm0.10$	$6.30^{b}\pm0.10$	$6.10^{d}\pm0.10$
M	N	D	$5.70^{c}\pm0.10$	$5.60^{d}\pm0.10$	$5.90^{c}\pm0.10$	$5.30^{d}\pm0.10$	$6.30^{c}\pm0.10$
A	B	C	$6.70^{b}\pm0.10$	$6.90^{b}\pm0.10$	$7.20^{a}\pm0.10$	$7.20^{a}\pm0.10$	$7.50^{b}\pm0.10$
G	H	I	$7.20^{a}\pm0.10$	$7.10^{a}\pm0.10$	$7.80^{a}\pm0.10$	$7.10^{a}\pm0.10$	$7.90^{a}\pm0.10$
D	E	F	$5.80^{c}\pm0.10$	$5.60^{d}\pm0.10$	$5.00^{a}\pm0.10$	$6.10^{c}\pm0.10$	$5.60^{e}\pm0.10$

Values are means ± standard deviation. Mean followed by the same column with the same superscript are not significantly different ($p<0.05$). PQR= 100% cow milk, JKL= 100% tiger nut milk, MND= 70% tiger nutmilk: 30% coconut milk, ABC = 50% tiger nutmilk: 50% coconut milk, GHI = 30% tiger nutmilk: 70% coconut milk, DEF = 100% coconut milk.

Candy from these types of milk had comparable nutritional values with the candy which was made of animal milk. Sensory evaluation result revealed that candy produced with 70% tiger nut milk : 30% coconut milk was more acceptable when compared with the control sample.

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