International Journal of Home Economics, Hospitality and Allied Research, 2(1): 103-118.
DOI: https://doi.org/10.57012/ijhhr.v2n1.008
Received: February 16, 2023
Revised: June 14, 2023
Accepted: July 13, 2023
Published: July 28, 2023

Original Research Report

Effects of Natural Sweeteners on the Nutrient Composition and Organoleptic Attributes of Tigernut-Coconut Drinks

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Abstract: The study determined the effects of natural sweeteners (date fruit and black plum) on nutrient compositions and organoleptic attributes of tigernut-coconut drinks. Two research questions and hypotheses guided the study. The population of the study was 60. Ingredients used for the drink preparation were gotten from Ogige market, Nsukka. Nine-point hedonic scale was used as an instrument for data collection. Data obtained were analyzed using mean and standard deviation for the research questions, while ANOVA was used to test the hypothesis at 0.05 level of significance. Findings of the study indicated that the moisture content of the drink samples ranged from 88.68% to 90.60%, ash content ranged from 0.10% to 0.16%, crude fibre content was from 2.4% to 3.4%, fats and oil content was from 2.0% to 2.4%, protein content ranged from 0.10% to 4.2%. Carbohydrate content ranged from 0.10% to 3.58%. The organoleptic attributes of the drink samples showed that the sample containing date fruit as a sweetener had the highest rate of general acceptability. Among the recommendations made was that local food producers should utilize date fruit and black plum as natural sweeteners in the production of drinks. Also, the natural sweeteners (date fruit and black plum) can be processed, stored separately and used as homemade sweeteners for different cereals and drinks by homemakers.

Keywords: Black-plum, Date-fruit, Drinks, Natural Sweeteners, Tigernut

1. Introduction

Drink is any liquid substance intended for human consumption for hydration, sustenance and energy. According to Eke-Ejiofor and Beleya (2018), drinks are liquids specially prepared for human consumption. Drinks can be homemade or commercially prepared in factories. Eze and Njoku (2018) noted that the three main classifications of drinks are stimulating, refreshing and nourishing drinks. Stimulating drinks such as tea and coffee are consumed to stimulate mental and physical activities. Refreshing drinks such as water and juice are drinks consumed to make up for fluid loss in the body. Nourishing drinks are consumed to provide nutrients to the body. This study focused on nourishing drinks prepared from tigernuts and coconuts.

Tigernut can be described as the only known tuberous crop that produces underground storage organs containing significant amount of all three storage reserves of sucrose, starch and oil, as compared to other crops belonging to roots and tubers that usually accumulate high amount of starch o sugars in their roots tissues (Manek et al., 2012). Tigernuts is eaten in various forms such as raw, roasted, dried, baked, milled to be used as flour or processed to extract the milky juice known as tigernut milk. Eke-Ejiofor and Beleya (2018) noted that tigernut is a rich source of nutrition especially for people in rural communities. On the other hand, coconut milk is the fluid extracted from the white fleshy part of coconut. It is highly nutritious as it contains high amount of fiber, vitamins, minerals and fatty acids. Coconut Research Center (2004) reported that coconut milk is rich in fibre, carbohydrate, vitamins, and minerals particularly magnesium, calcium and phosphorus. Coconut milk and tigernut milk can be mixed to get a healthy drink. The taste of the tigernut-coconut drink can be enhanced with sweeteners.

Sweeteners are food additives used to improve taste of food products. According to Puneet et al. (2016), sweeteners are substances used or intended to use, either to impact a sweet taste to food products or as a tabletop sweetener. Sweeteners enhance food taste and flavour while adding fewer or no calories to food product. Saraiva et al. (2020) noted that sweeteners can be broadly classified into two namely: artificial and natural sweeteners. Artificial sweeteners are chemical compounds that have little or no nutritional value. They are synthesized compounds that have high-intensities of sweetness and commonly used in the production of baked food products, carbonated drinks, dairy products and in pharmaceuticals to coat bitter tablets and syrups.

Natural sweeteners are naturally occurring taste enhancers for food products. Saraiva et al.

(2020) noted that natural sweeteners are taste enhancers extracted mainly from organic food products without any chemical modification during extraction, processing or production procedure. Some of the common natural sweeteners are maple syrup, honey, beetroots and black plum. Natural sweeteners of specific importance to this study are date fruits and black plum.

Dates can be consumed as fresh fruits. It is widely eaten in its raw form as food and snacks in many parts of the world, and used as sweeteners in the preparation of different drinks. Cleveland (2014) noted that the main component of date fruit is simple carbohydrate (mainly glucose and fructose), which may constitute about 70% of the content. On the other hand, Black Plum (*Vitex doniana*) belongs to the family of *Verbanaceae.* Black plum is a drupe with a sweet mesocarp. Black plum fruits are eaten as snacks either fresh or dried and it has a sweet taste with velvet-like texture. Adejumo et al. (2013) opined that syrup similar to honey can be extracted from black plum fruit and the sensory properties as well as physical results of the plum syrup showed that it can be substituted for other syrups as a nutritive sweetener. This study utilized freshly extracted date fruit and black plum as sweeteners for tigernut-coconut drinks.

In the area of the study, there are several drinks produced and commercially available for consumption. Typical examples of commercial drinks are soya milk, *zobo,* and *kunu* made from guinea corn (*dawa).* Preliminary investigation showed that most of the producers of commercial drinks in the study area use artificial sweeteners. Orutugu et al. (2015) reported that granulated sugar is a sweetener commonly used in the production of local beverages and drinks such as soya milk and *kunu*. This necessitated the need for the study on the production of tigernut-coconut drinks with natural sweeteners.

1.1. Statement of Problem

Different drinks are consumed by people to hydrate the body on daily basis. It is worrisome that most of the packaged drinks consumed by different categories of people are carbonated and sweetened with artificial chemicals and sweeteners. Most of the commercially available carbonated and soft drinks in the market today are sweetened with artificial sugar substitutes. Lucová et al. (2013) reported that artificial sweeteners are commercially used in the production of carbonated foods, baked food products, powdered drink mixtures, jams, jellies, dairy products and in pharmaceuticals to coat bitter tablets and syrups. Typical examples of artificial sweeteners used for enhancing taste of the drinks by producers include saccharine, cyclamates, aspartame, acesulfame,

neotame, among others. Saraiva et al. (2020) reported that artificial sweeteners such as saccharine, cyclamates and aspartame allegedly causes bladder and liver toxicity, foetus malformations, carcinogenicity among other dangers which has led to their ban in food processing in some countries including the United States of America and European Union.

Healthy drinks have become an issue of interest as consumer awareness is moving towards sugar-free and more natural drinks, considering that most soft drinks in the market contain high sugar. Consumers of recent are becoming more aware of the therapeutic and nutritional effects of food they eat. There is little documentation on the nutritional composition and use of date fruit and black plum as natural sweeteners in drink preparation despite their availability. The study therefore determined the effects of natural sweeteners (date fruit and black plum) on nutrient compositions and organoleptic attributes of tigernut-coconut drink samples.

1.2. Purpose of the Study

The general purpose of the study was to investigate the effects of natural sweeteners (date fruit and black plum) on nutrient compositions and organoleptic attributes of tigernut-coconut drinks. Specifically, the study:

a) formulated three drink samples of tigernut and coconut sweetened with either date fruit, black plum and granulated sugar (control).
b) determined the proximate compositions (moisture, ash, fats/oils, fibre, protein and carbohydrate) of the three drink samples.
c) determined the organoleptic attributes(consistency, taste, aroma, colour and general acceptability) of the three drink samples.

1.3.Research Questions

The study was guided by the following research questions:

a) What are the proximate compositions (moisture, ash, fats/oils, fibre, protein and carbohydrate) of the three drink samples?
b) What are the organoleptic attributes (consistency, taste, aroma, colour and general acceptability) of the three drink samples?

1.4.Hypothesis

The following null hypotheses were formulated and tested at 0.05 level of significance:

H_{O1}: There is no significant difference in the mean proximate compositions (moisture, ash, fats/oils, fibre, protein and carbohydrate) of the three drink samples.

H_{O2}: There is no significant difference in the mean organoleptic attributes (consistency, taste, aroma, colour and general acceptability) of the three drink samples.

2. Materials and Methods

2.1. Design of the Study

A mixed-method research design was used in this study, which included both Research and Development processes (R & D) and an experimental and descriptive survey approach. We used R&D to prepare and test the composite flour and stiff dough samples; laboratory experiments to determine the composition of the nutrients; and a survey research design to determine the organoleptic attributes of the flour.

2.1.1. Ethics Statement

The research ethics clearance was provided to the researchers by the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. All respondents' informed consent was received in writing.

2.2. Area of the Study

The study was carried out within the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka.

2.3. Population and Sample

The population for the study was 60 respondents (sensory evaluation panelists). This consisted of 49 undergraduates and post graduates students from the Department of Home Economics and Hospitality Management Education as well as 11 lecturers from Agricultural Education Department, Faculty of Vocational and Technical Education, University of Nigeria, Nsukka (UNN). No sampling was done since the population was a manageable size.

2.4. Instrument for Data Collection

A standard instrument (9-point hedonic scale) was utilized for data collection. Hence, there was no validation of the instrument. The materials used in the study included: dried tigernuts, fresh

coconuts, dried date fruit, black plum, ginger and granulated sugar, plate milling machine, scrappers, graters, sharp and dull knives for the coconut shelling, chopping board, 1mm pore size sieve and mesh, muslin cloth. All the materials were purchased from Ogige market in Nsukka, Enugu State.

2.5. Data Collection Technique and Study Procedure

The samples were prepared as described in the following processing techniques:

2.5.1. Processing of Tigernut: Dried tigernuts (3 kg) was processed by adapting the production methods by Habiba et al. (2017). The dried tigernuts were picked, washed and soaked in a bowl of clean water (about 1:3 tigernut to water ratio, at room temperature; 27 °C to 30 °C for about 24 hours). Then, it was washed and milled, mixed with water and filtered to obtain the milky juice extract (plain tigernut milk). This was used in preparing tigernut drink.

2.5.2. Processing of Coconut Milk: Coconut flesh (5 kg) was processed by adapting the production methods by Akusu and Emelike (2018). The coconut shell and brown skin were removed and the white coconut fleshed was washed thoroughly, cut into thin slices and milled into paste. The milled coconut flesh (about 3kg after removing shell) was placed in a bowl and 750ml of sterile warm water was added to extract the aromatic compounds. The extracts were then filtered with a sterilized muslin cloth to obtain a milky emulsion with a sweet coconut flavour.

2.5.3. Processing of Date Fruit: 1kg of date fruit was processed by adapting the production methods by Gamal et al. (2014). The date fruit were washed thoroughly and cut to separate the flesh from the seeds, then washed in distilled water for about 4 hours, then, milled using 700ml of water to smooth syrup. Thereafter, the syrup was boiled at 70°C for 2 hours. After heating, the slurry was filtered through a cheese cloth with a hand press then the filtrate was packaged properly and stored at room temperature until ready for use.

2.5.4. Processing of Black Plum: Black plum (1 kg) was processed by adapting the production methods by Abu (2007). The fresh and ripe fruits were washed thoroughly and the epicarp removed. The pulp was scraped from the stony endocarp and milled with about 100ml of water. The mixture was then filtered through a muslin cloth, the syrup obtained were packaged and stored at room temperature until ready to use.

2.5.5. Preparation of Ginger Extract: Ginger was washed and scrapped to remove nsuperficial skin, cut into small pieces of about 2 mm thickness and blended with water in the ratio of 2:2. The blend was filtered through muslin with 2, 4 and 8 folds according to the method outlined by (Emelike et al.,

2016). Ginger was added to the three samples of the tigernut-coconut drink for enhanced flavour.

The processing procedure for the preparation of Tigernut-Coconut drinks sweetened with date fruit, black plum and refined sugar (control group) is shown in Figure 1.

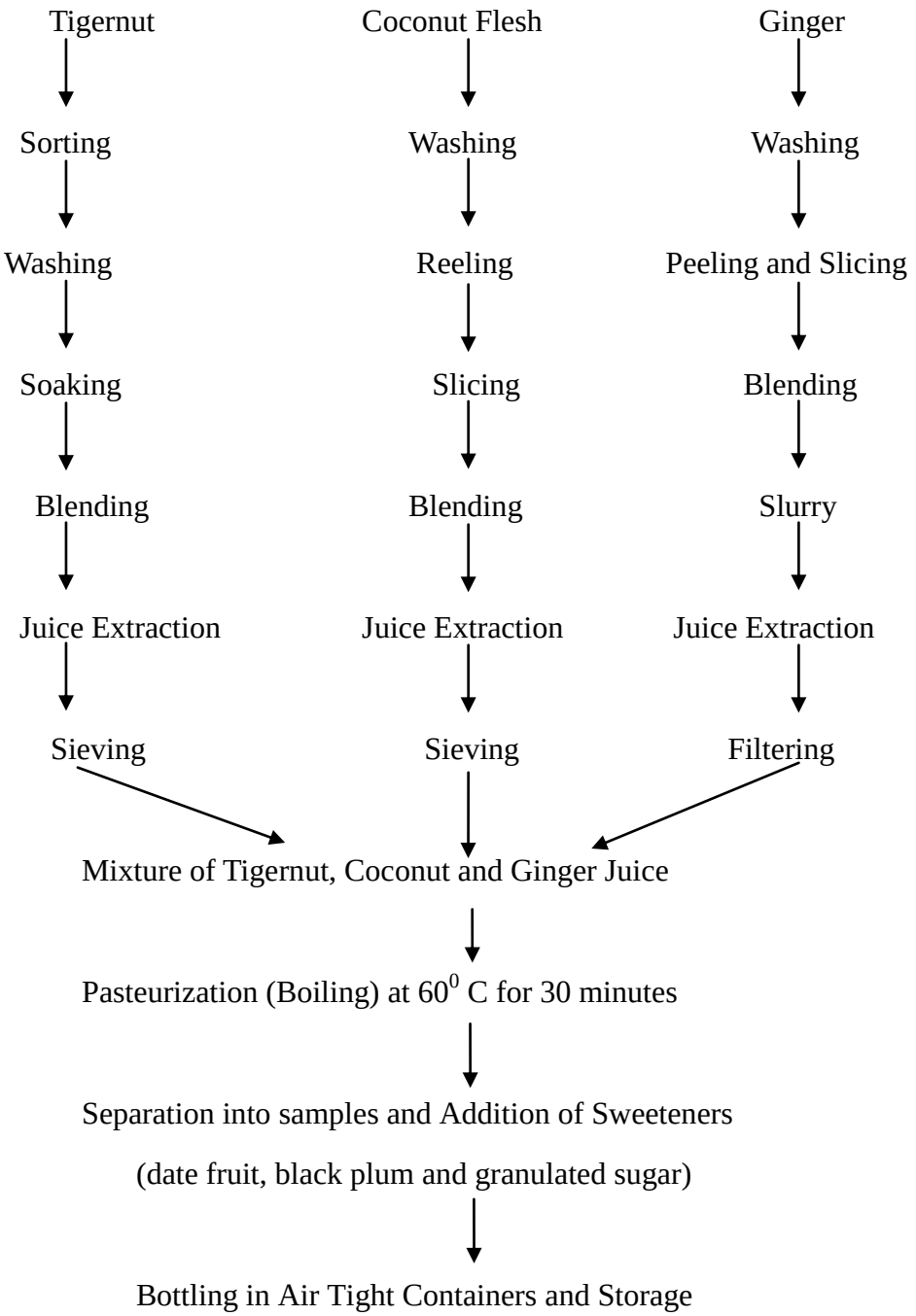

Figure 1: Flow Chart for the Processing of Tigernut-Coconut Drinks Sweetened with Date fruit, Black Plum, Sugarcane and Granulated Sugar

2.5.6. Coding of the Drink Products:

Sample A: TCDF - Tigernut milk (40%), Coconut Milk (40%), Ginger (5%) and Date (15%);

Sample B: TCBP - Tigernut milk (40%), Coconut milk (40%), Ginger (5%) and Black Plum (15%)

Sample C: TCGS -Tigernut milk (40%), Coconut milk (40%), Ginger extracts (5%) and Granulated Sugar (15%). (Control Group)

2.5.7. Proximate Analysis Procedure: The nutrient composition (moisture content, protein, fats/oil, crude fibre, ash content) of the drink samples were determined using the method described by Association of Official Analytical Chemists (AOAC) (2010). Carbohydrate composition was determined by difference.

2.5.8. Organoleptic Evaluation: Three copies of the 9-point hedonic scale was given to each of the 60 judges. Each of the respondents evaluated the three drink samples based on flavour (taste), colour (appearance), consistency (mouth feel), aroma and general acceptability were determined using the 9-point hedonic scale. The organoleptic evaluation attributes (sensory evaluation) was done at the Food and Nutrtion Laboratory at the Department of Home Economics and Hospitality Management Education, University of Nigeria, Nsukka.

2.6. Data Analysis Technique

In order to answer the research questions, we analyzed the data using the mean and standard deviation, whereas we used ANOVA to test the hypothesis at a significance level of 0.05. In order to analyze all data, the Statistical Package for Social Sciences (SPSS), version 25, was used.

3. Results and Discussion

3.1. Research Question 1: What are the proximate compositions (moisture, ash, fats/oils, fibre, protein and carbohydrate) of the three drink samples of tigernut-coconut sweetened with date fruit, black plum and granulated sugar?

Table 1: Proximate Compositions of the Processed Tigernut-Coconut Drink samples Sweetened with Date Fruit, Black Plum and Granulated Sugar

Sample	Moisture (%)	Ash (%)	Crude Fibre (%)	Fats (%)	Protein (%)	Carbohydrate (%)
TCDF	89.66	0.16	3.4	2.4	4.2	0.18
TCBP	90.60	0.10	3.2	2.2	3.8	0.10
TCGS	88.68	0.14	2.4	2.0	3.2	3.58

Key:TCDF = Tigernut milk (40%), Coconut Milk (40%), Ginger extracts (5%) and Date (15%); TCBP = Tigernut milk (40%), Coconut milk (40%), Ginger (5%) and Black Plum extracts (15%) and TCGS = Tigernut milk (40%), Coconut milk (40%), Ginger (5%) and Granulated Sugar (15%).

3.2. Hypothesis 1: There is no significant difference between the mean proximate compositions (moisture, ash, fats/oils, fibre, protein and carbohydrate) of the three drink samples of tigernut-coconut sweetened with date fruit, black plum and granulated sugar.

Table 2: Analysis of Variance (ANOVA) of the Proximate Compositions (Moisture, Ash, Fats/oils, Fibre, Protein and Carbohydrate) of the three drink samples.

Proximate Compositions	SSb	SSw	MSb	MSw	F	Sig.	Decision
Moisture	4.07	0.36	1.36	0.09	14.96	0.120	NS
Ash	0.00	0.00	0.00	0.00	1.69	0.306	NS
Fats & Oil	0.27	0.16	0.09	0.04	2.21	0.229	NS
Crude Fibre	1.67	0.26	0.55	0.06	8.42	0.033	S
Protein	0.85	0.26	0.28	0.06	4.38	0.094	NS
Carbohydrate	9.60	1.30	3.22	0.32	9.87	0.025	S

3.3. Research Question 2: What are the organoleptic attributes (taste, consistency / mouthfeel, aroma, colour and general acceptability) of the drink samples?

Table 3: Organoleptic Attributes of the drink Samples produced from tigernut-coconut sweetened with date fruit, black plum and granulated sugar.

Organoleptic Attributes Evaluation	TCDF	TCBP	TCGS
Taste			
Sweet	5.41 ± 3.83	4.33 ± 4.06	3.63 ± 4.00
Bland	1.40 ± 3.17	1.33 ± 3.03	0.58 ± 2.01
Sour	0.00 ± 0.00	0.38 ± 1.35	0.18 ± 0.99
Tasty	1.73 ± 3.33	0.53 ± 1.99	0.35 ± 1.58
Tasteless	0.15 ± 1.16	0.33 ± 1.51	0.25 ± 1.36
Bitter	0.00 ± 0.00	0.00 ± 0.00	0.20 ± 1.10
Sugary	0.00 ± 0.00	0.12 ± 0.69	2.21 ± 3.73
Consistency			
Creamy	5.41 ± 3.98	5.00 ± 4.16	1.91 ± 3.62
Sticky	0.67 ± 2.22	0.95 ± 2.65	0.83 ± 2.49
Smooth	2.85 ± 3.79	1.60 ± 3.41	2.60 ± 3.46
Light/Watery	0.71 ± 2.21	0.38 ± 1.62	1.03 ± 2.73
Thick/Syrupy	0.28 ± 1.34	1.50 ± 1.71	0.13 ± 0.74
Aroma			
Pungent	0.18 ± 0.79	0.48 ± 1.89	0.81 ± 2.44
Spicy	3.85 ± 4.07	2.60 ± 3.89	0.71 ± 2.40
No Smell	1.76 ± 3.24	2.45 ± 3.79	2.30 ± 3.70
Fruity	0.83 ± 2.53	175 ± 2.75	2.08 ± 3.51

Earthy	0.08 ± 0.46	0.10 ± 0.47	0.00 ± 0.00
Colour			
Dark	1.21 ± 2.99	0.86 ± 2.43	1.63 ± 3.34
Bright	4.76 ± 3.88	3.43 ± 4.10	1.08 ± 2.62
Dull	0.13 ± 0.53	0.88 ± 2.16	0.41 ± 1.54
Colourful	0.15 ± 0.81	0.65 ± 2.01	0.08 ± 0.64
Milky	2.65 ± 3.44	1.70 ± 3.12	1.13 ± 2.83
Light	0.15 ± 0.86	0.25 ± 1.12	0.00 ± 0.00
General Acceptability	7.93 ± 1.33	7.28 ± 2.08	6.66 ± 2.43

3.4. Hypothesis 2: There is no significant difference in the mean organoleptic attributes(consistency, taste, aroma, colour and general acceptability) of the three drink samples of tigernut-coconut sweetened with date fruit, black plum and granulated sugar.

Table 4: Analysis of Variance (ANOVA) of the Organoleptic attributes (Consistency, Taste, aroma, Colour and General Acceptability) of the three drink Samples of Tigernut-Coconut sweetened with Date Fruit, Black Plum and granulated Sugar

Organoleptic Attributes	**SSb**	**SSw**	**MSb**	**MSw**	**F**	**Sig.**	**Decision**
Taste							
Sweet	9.72	0.00	3.24	0.00	6173.65	0.000	S
Bland	1.46	0.00	0.48	0.00	2173.70	0.000	S
Sour	0.41	0.00	0.13	0.00	262.76	0.000	S
Tasty	2.54	0.00	0.84	0.00	5214.43	0.000	S
Tasteless	0.08	0.00	0.03	0.00	590.66	0.000	S
Acidic	0.00	0.00	0.00	0.00	0.00	0.000	S
Bitter	0.06	0.00	0.02	0.00	804.00	0.000	S
Sugary	6.27	0.00	2.09	0.00	5575.44	0.000	S
Consistency							
Creamy	17.45	0.00	5.81	0.00	46550.00	0.000	S
Sticky	0.07	0.00	0.02	0.00	57.62	0.001	S
Smooth	1.93	0.00	0.64	0.00	3438.46	0.000	S
Watery	12.44	0.50	4.77	0.12	3313.53	0.000	S
Thick	2.37	0.00	0.79	0.00	6319.06	0.000	S
Aroma							
Pungent	0.45	0.00	0.15	0.00	3009.00	0.000	S
Spicy	10.08	0.00	3.36	0.00	5722.74	0.000	S
No Smell	2.12	0.00	0.70	0.00	3783.17	0.000	S
Fruity	1.79	0.00	0.59	0.00	6827.19	0.000	S
Earthy	0.03	0.00	0.01	0.00	280.33	0.000	S
Colour							
Dark	1.13	0.00	0.38	0.00	584.28	0.000	S

Bright	14.72	0.00	4.90	0.00	8182.33	0.000	S
Dull	0.61	0.00	0.20	0.00	5464.33	0.000	S
Colourful	0.44	0.00	0.14	0.00	2950.66	0.000	S
Milky	2.69	0.00	0.89	0.00	1709.39	0.000	S
Light	0.06	0.00	0.02	0.00	547.88	0.000	S
General Acceptability	2.82	0.00	0.94	0.00	25145.22	0.000	S

Findings in Table 1 revealed that for the moisture content of the tigernut-coconut drink samples, TCBP had highest percentage moisture of 90.60, followed by TCDF had 89.66%, then TCGS had 88.68%. In line with the findings, Eke-Ejiofor and Baleya (2018) noted that high moisture content of 70.98% to 82.42% for spiced tigernut drink samples. However, the present study revealed higher levels of moisture content from 88.68% to 90.60%. Moisture content of the tigernut-coconut drink samples which ranged from 88.68% to 90.60% aligns with the report on moisture content of 83.97% to 90.10% in a study of tigernut sweetened with pineapple by Abdulfatai et al. (2013). The high moisture content implies that the drink samples can be used as a refreshing vegetable drink. Findings on the ash content of the tigernut-coconut drink samples revealed that TCDF contained 0.16%, TCGS had 0.14% and TCBP had 0.10%. The ash content of the tigernut-coconut drink samples which ranged from 0.10% to 0.16% can be comparable to ash content values of 0.2% to 0.5 % reported by Awonorin and Udeozor (2014). The finding also aligns with the report of Abdulfatai et al. (2013) that tigernuts have low ash content because of its high calorific value.

Findings on the crude fibre content of the tigernut-coconut drink samples indicated that TCDF had highest with 3.4%, followed by TCBP with 3.2% and TCGS with 2.4%. Oladele and Aina (2007) reported a higher crude fiber content of 5.62% and 6.26% in their study. This high fibre content in the study of Oladele and Aina (2007) can be attributed to the tigernut sample (flour) used for the study since the present study focused on tigernu-coconut drink samples. Findings on the fats and oil content of the tigernut-coconut drink samples showed that TCDF contained 2.4%, TCBP 2.2% and TCGS 2.0%. On the contrary, Adesokan et al. (2013) reported a higher fat content that ranged from 2.04% to 4.30% while Eke-Ejiofor and Beleya (2018) reported a lower fat content that ranged from 0.01% to 0.92%. These differences in fat content of the tigernut-coconut drinks can be attributed to the ingredients added by each of the experimental studies. However, similar fat content of 2.48% to 2.54% were reported by Maxwell et al. (2019) in a study on tigernut drink blends.

Findings on the protein content of the three drink samples indicated that TCDF contained 4.2%, followed by TCBP with a value of 3.8% and TCGS contained 3.2%. The protein content in the three drink samples can be comparable to the values ranging from 2.7% to 3.3% reported by Musa and Hamza (2013), but the values obtained were higher than 1.0% reported by Nwobosi et al. (2013). The increased protein content in the tigernut-coconut drink samples can be attributed to the protein content of the natural sweeteners utilized by the present study. Findings on the carbohydrate content of the tigernut-coconut drink samples indicated that TCGS contained highest with 3.58%, followed by TCDF with 0.18% and then TCBP with 0.10%. Gambo and Da'u (2014) reported a higher carbohydrate value of 15.96% and 19.15% in their study. This implies that the carbohydrate content of the tigernut-coconut drinks can be used as an additional nutrient compliment to meet human carbohydrate need. Test of Hypothesis 1 revealed that there was no significant difference in the proximate composition of moisture, ash, protein and fats and oil content of the drink samples. However, significance difference exists in the crude fibre and carbohydrate contents of the three drink samples.

Findings in Table 3 contained the organoleptic evaluation attributes (taste, consistency, aroma, colour and general acceptability) of the tigernut-coconut drink samples. From the analysis, the highest rated attribute for taste was "sweet" with mean values ranging from 3.63 to 5.41. For consistency and mouth feel, the panelists rated "creamy" as highest with values ranging from 1.91 to 5.41; followed by "smooth" with values ranging from 1.60 to 2.85. For aroma, the highest rated was "spicy" with values ranging from 0.71 to 3.85. For colour, the highest rated attribute was "bright" with values ranging from 1.08 to 4.76; followed by "milky" with values ranging from 1.13 to 2.65. For general acceptability, the panelists rated high values ranging from 6.66 to 7.93 with sample containing date fruit as sweetener as highest rated. The high acceptability can be attributed to the high values rated for taste, consistency, aroma and colour of the sample. In agreement with the findings, Antie et al. (2006) noted that consumers' preference of most food products are often based on associating sensory attributes with the physiologic consequences such as eye appeal, colour, flavour aroma and taste. Also, in line with the findings, Bolarinwa et al. (2017) found out that the panelists rated high levels of overall acceptability of tigernut drink samples in their study on nutritional composition and sensory evaluation of *Kunnu-aye* fortified with *Vigna-racemasa* flour. Test of hypothesis 2 indicated that there is a significant difference in the organoleptic attributes of

the drink samples. Hence, the null hypothesis of no significant difference at 0.05 level of significance was not upheld. The researchers suggest that a study can be carried out to determine consumers' perception and acceptability of different packaging materials for tigernut-coconut drink samples. The implication is that natural sweeteners (date fruit and black plum) can be processed, stored separately and used as homemade sweeteners for different cereals and drinks by home makers. Another study can be carried out to determine the effect of other natural sweeteners such as honey and pineapple on the proximate, vitamin, mineral and brix compositions of tigernut-coconut drink samples.

4. Conclusion

Based on the findings of the study, it was concluded that tigernut and coconut drink samples can be sweetened with date fruit and black plum. The proximate compositions of the drink samples indicated appreciable values of protein, moisture, crude fibre, ash, fats/oils and carbohydrate content indicating that the drink samples can be used as nourishing drinks. The organoleptic evaluation revealed high acceptability of the drink samples by the panelists; however, the sample containing date fruit as sweetener was the highest rated. Based on the findings of the study, it was recommended that local food producers can utilize black plum and date fruit as natural sweeteners in the production of drinks. Furthermore, unemployed youths and home makers can prepare tigernut-coconut drinks sweetened with different natural sweeteners (such as date fruit and black plum) in large quantities and sell in different strategic places.

Acknowledgements

Authors would like to express gratitude to staff at Energy Center, UNN, for use of the laboratory and also the staff of Home Economics and Hospitality Management Education Department, Faculty of Vocational Technical Education, UNN for use of the Food and Nutrition Laboratory during the Sensory evaluation phase.

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

UGO and FNO conceptualized the idea. UGO and FNO developed the design for the study, UGO and FNO processed the drink samples, organized the meeting with respondents for organoleptic evaluation and collected data through the use of the 9-point hedonic scale. UGO and

FNO analyzed the data. Both authors approved the final draft of the manuscript.

Data Availability Statement

The original contributions presented in the study are included in the article. Further enquiries can be directed to the corresponding author.

Funding Information

The authors have no funding to disclose

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Publisher: Department of Home Economics and Hospitality Management Education, University of Nigeria, Nsukka 41001, Nigeria