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Comparative Evaluation of Nutritional Composition and Sensory Attributes of Yoghurts Produced from Cow, Goat, Soy, Tiger-Nut and Coconut Milk Sources

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ABSTRACT
Soy bean milk, tiger nut milk and coconut milk are plant-based milk, while cow milk and goat milk are animal-based milk used for production of yoghurt. The objective of this study was to evaluate the nutritional composition and sensory profiles of the yoghurt made from different milk sources such as cow, goat, soy bean, tiger-nut and coconut. The nutritional content of the yoghurt products samples was determined with standard methods, while for the sensory profiles (20)- trained panellists of both male and female were enrolled for the sample's evaluation. The yoghurt samples were assessed for colour, aroma, taste, texture and overall-acceptability. The results reveal that coconut milk yoghurt (CNY) have a higher carbohydrate content (18.04%), cow milk yoghurt (CMY) have (12.26%) and soy bean milk yoghurt have (10.80%), while least carbohydrate content is found in tiger nut milk yoghurt TNY (8.66%) and goat milk yoghurt GMY (3.04%). The moisture content was high in all the samples GMY (91.39%), TNY (85.82%), CMY (83.73%), SMY (78.23%) and CNY (77.52%); SMY with the highest content of protein (8.85%) and CMY with the lowest content of protein (3.81%), ash content was high in SMY (0.50%) and low content in TNY (0.20), while the fat content is high in CNY (5.92%) and low in SMY (2.17%). The SMY had the highest Na content (192.85%), CNY had the highest P content (4.06%), GMY had the highest Mg content (12.62%), and CMY had the highest content of Ca (16.05%). The sensory evaluation results reveal that the yoghurt products of SMY, TNY and CMY are acceptable in colour, aroma, texture, taste and overall-acceptability compared to CNY and GMY yoghurt products. The results revealed that the plant-based milk yoghurt as non-dairy products with the ability of a good distinct nutritious and healthy source of protein that can be used as substitute for dairy products compared to animal-based milk yoghurt.

Keywords: *Soybean milk yoghurt, Tiger-nut yoghurt, Coconut milk yoghurt, Cow and Goat milk yoghurt, Lactose intolerance*

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INTRODUCTION

The products of milk, that broadly undergo biological changes as result of the act of microorganisms, are consumed worldwide. Common among these-milk products is yoghurt and have assumed different product types such as set, stirred and frozen liquid yoghurts. Yoghurts is an essential diet worldwide that is make from anima-based milk or plant-based milk. The commonly used starter culture consortium by modern dairy facility comprises of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. These probiotic microorganisms grow symbiotically which are responsible for the manufacturing of taste and aroma in yoghurt production (Osundahunsi *et al*., 2007). The knowledge of the nutritional content and sensory evaluation of various types of yoghurt is vital, particularly in rising of the dairy substitute market.

Milk source from animal or plant can be used for production of yoghurt for commercial purposes and the most common source is from cow. Another excellent raw material that can be used for yoghurt production which is undeniable is goat milk that have useful effects on maintenance of health, physiological functions, old people and children nutrition. The goat milk can also be consumed by people that are affected by cow milk without having any negative effects on them According to some authors, so the goat milk market potential was highlights by this according to (Ribeiro and Ribeiro, 2010).

Efforts have been made by scientists to get substitute of raw material for production of yoghurt from diverse milk from plant have been tested like milk from groundnut, soybeans, almond, rice, tiger-nut and coconut, while soy-bean milk provided a promising result according to (Pinthong *et al.*, 1980). Soybean seed is a leguminous plant *Glycine max* used to produce soymilk and the research have revealed that soymilk is cholesterol free and sugar free with high content of isoflavon and protein according to (Pinthong, *et al*.,1980). Yoghurt from soymilk can also reduce menopausal symptoms, heart diseases risk and certain cancer and also enhance bone health (Sipos, 1988). The vast aids of soybean seed have moved many of the scientists to combining soybean into ethnic diets (Sipos, 1988).

Tiger-nut (*Cyperus esculentus*) is type of native sedge to warm temperature to the sub-tropical country of Northern Hemisphere. The nut is cultivated because its edible tubers and its annual or perennial plant that is growing in 90 cm in height and solidary stems from tuber plant with distinctive flowers and a cluster of oval seeds which is surrounded by four hanging leaf like bracts position in 90^o from each other sometimes the nut is mistaken for grass. The tiger-nut plant foliage is extremely hard and fibrous. The tiger-nut milk drinks is local beverages that have presently become popular among different non- alcoholic drinks in the world, especially in school campuses of higher institutions as a result of their low price compare to other beverages (Gaffa, 2000). The milk drink from tiger-nut is non-alcoholic traditional beverage drink produced from tiger-nut, the species of tiger-nut (*Cyperus esculentius*) is tuber than nut which is minor but significant crops in rank in midst of the oldest cultivated plant in olden Egypt which was used to make cake in Egypt according to Daniel and Maria, (2000). Milk source from plant is a key diet in Africa because scholars have shown tough relevance in these milk sources because of their economic potentials and nutritive value (Belewu and Belemn, 2007). This study has shown that tiger nut milk contains no lactose with much Ca so it makes a numerous substitute to cow's milk for people that are Lactose intolerant. The nuts are also a good source of antioxidant and E Vitamin that help to protect against the free radical's damage caused in the body, while vitamin E in the tiger-nut can also help to prevent cancer and coronary diseases which also slow down the onset of the ageing signs. The cream of coconut can be dry into milk powder that have a long shelf life which is preserved by addition of malto-dextrin and casein to coconut cream to mend fluidity then spray dry mixture, then package the powder in containers of moisture proof. The milk can be used by adding water to the coconut milk powder to produce a product like yoghurt (Philippine coconut authority, 2016). The SMY, TNY and CNY consumption as non- dairy substitute recently, have rising awareness in its health benefits with ability to alleviate specific diseases (Gobana and Geleta, 2022). The animal source of protein is costly in our country Nigeria, which is why substitute is necessary which would also be beneficial to the lactose tolerance individuals (Kong *et al*., 2022).

MATERIALS AND METHODS

The materials for yoghurt preparation from plant-based milk includes soybean milk, tiger-nut milk and coconut milk while animal-based milk include cow milk and goat milk in liquid form about 4liter for both plant and animal base milk was used. The animal milk fresh samples were collected inside a sterile container and transported in the ice bag to laboratory for the processing within 30 minutes from Fulani herders' farm. Soy bean seed variety TGX-923-2E, tiger nut variety *Cyperus esculentus var. esculentus* and coconut variety East Coast Tall all was purchased from Modern Kure market Minna, Niger state, Nigeria.

Production of plant-base milk for yoghurt processing

The soy bean clean seed was soaked for 4hours and de-hulled, tiger-nut was clean and soaked for 8h and coco nut shell and brown back was removed with dull knife, well washed and all were wet milled with silver crest (SC-2023) Multifunctional industrial blender with 32000 RPM, on weight basis soy bean 4:1w/v, tiger nut 3:1w/v and coconut 3:1 w/v. The soybean, tiger-nut and coconut slurry were filtered with cheese cloth and re-filtered with mesh sieve 160 to get the soy milk, tiger nut milk and coconut milk (Figure 1). The samples of the 5 milk types were pasteurized at 80°C for 15min in clean pot. The pasteurized milk was placed subsequently in a water bath to cool down to 40-45°C, to be inoculation with the starter culture as described by (Collins *et al*., 1991). The cooled milk samples were inoculated with the commercial starter culture by 50:50 pure culture of mixed strains of *Lactobacillus bulgaricus* and *Streptococcus thermophillus* 0.1g was used to inoculate 100 ml of the sterile milk to start fermentation. All the sterile milk samples were poured into sterile plastic cups then inoculated and incubated at 40°C

Milk (soy bean, tiger-nut, coconut, goat and cow)
↓
Pasteurization (at 80ºC for 15min)
↓
Sugar added
↓
Cooling (40-45ºC)
↓
Inoculation of starter culture 0.1g/100ml
↓
Fermentation for 4-6h at 40ºC
↓
Curd form and mixing
↓
Filling into sterile bottles
↓
Refrigeration at 4-10ºC

Figure 1: Flow chart for yoghurt production with soy milk, tiger-nut milk, coconut milk, cow milk and goat milk.

to ferment for 4-6 h. After incubation, the samples were cooled in a deep freezer to stop fermentation then stored in refrigerator at 4°C for further evaluation (Mustafa *et al*., 2020).

Proximate analysis and pH content of the yoghurt samples

The moisture content of the sample was determined using the procedure outlined by AOAC, (2005) method number 930.15 of oven drying method for moisture content. Ash content of the yoghurt samples was determined by using AOAC, (2005) method number 942.05, the fat content of the samples was determined by using AOAC, (2005) method number 922.06, protein content of the samples was determined by using AOAC, (2005) method number 991.20 using Kjeldahl method, The carbohydrate content of the samples was determined by the subtraction of the addition of the percentage values of moisture content, protein, ash content and fat content from 100%. Carbohydrate (%) =100% – (% moisture + % ash + % protein + % fat). The samples' pH was measured with pH meter after standardization with buffers of pH 4, 7 and 10.

Determination of vitamins and minerals composition

The Fe, Ca, Zn, Cu, P, Na, K and Mg contents of the yoghurt samples were determined by absorption spectrometer according to method described by AOAC, (2005) method number 999.01. Vitamin C content was determined using the method described by Osborne and Voogt, (1978) and Vitamin A was determined according to method described by Rutkowski *et al*., (2007).

Sensory analysis

Sensory analysis of the samples was done by trained panelists of 20 who are acquainted to the products. The yoghurt samples were coded and presented to panelist by using disposable cups. The water was provided to the panelist for mouth wash in between the evaluation process. The panelists were asked to analyze the yoghurt samples for the colour, aroma, taste, texture and overall acceptability by using the scale of 9 hedonic scale that is 1= extremely dislike; 9= extremely like (Wichchukit and O'Mahony, 2015).

Statistical analysis

Statistical package for social science (SPSS) version 24 was used to analyze data and $p < 0.05$ was consider to be statistically significant, and the results were expressed as in M ± SD using Analysis of Variance (ANOVA) and significant means were separated using Duncan's multiple range test.

RESULTS

Proximate composition of soy milk yoghurt, tiger-nut yoghurt, coconut yoghurt, CMY and GMY

Table 1 reveals the proximate composition and pH

Table 1: pH and proximate composition of yoghurt samples.

Sample code	pH	MOISTURE (X ± SD) %	ASH (X ± SD) %	FAT (X ± SD) %	PROTEIN (X ± SD) %	CHO (X ± SD) %
SMY	5.02 ± 0.01^{b}	78.23±0.51^{cd}	0.50±0.01^{a}	2.17±0.00^{i}	8.85±0.01^{bcd}	10.80±0.01^{b}
TNY	3.91±0.07^{abc}	85.82±1.22^{bcd}	0.20± 0.01^{b}	3.94 ± 0.19^{hijk}	5.31 ± 0.07^{i}	8.66 ±1.28^{bcde}
CNY	3.91±0.065^{abc}	77.52 ± 0.71^{h}	0.22 ± 0.06^{de}	5.92 ± 0.44^{h}	4.22 ± 0.04^{d}	18.04 ± 0.68^{ab}
GMY	4.81±0.05^{ab}	91.39 ± 0.73^{a}	0.46 ± 0.00^{bc}	2.81 ± 0.03^{f}	5.11 ± 0.14^{b}	3.04 ± 0.58^{i}
CMY	5.18±0.05^{a}	83.73 ± 0.15^{abcd}	0.21 ± 0.02^{b}	5.31 ± 0.07^{a}	3.81 ± 0.06^{hij}	12.26 ± 0.10^{bc}

Keys: SMY- Soy milk yoghurt; TNY- Tiger-nut milk yoghurt; CNY- Coconut milk yoghurt; GMY-Goat milk yoghurt; CMY- Cow milk yoghurt, NB: Values bearing different alphabets down group are significantly different ($p<0.05$), Values are presented as M ± SD at ($p<0.05$).

Table 2: Mineral composition of soy milk, tiger-nut milk, coconut milk, cow milk and GMY yoghurts samples.

Sample code	Na (X ± SD)	K (X ± SD)	P (X ± SD)	Ca (X ± SD)	Mg (X ± SD)	Fe (X ± SD)	Cu (X ± SD)	Zn (X ± SD)	Cd (X ± SD)
SMY	5.85±0.55^{bcd}	192.85±4.55^{a}	2.18±0.05^{a}	5.66±0.05^{cd}	6.88±0.54^{efg}	0.80±0.05^{efg}	0.35±0.05^{abcdef}	0.38±0.05^{d}	0.62±0.45^{d}
TNY	2.77±0.37^{a}	72.88±0.28^{bcde}	2.72±0.39^{a}	4.50±0.50^{b}	3.86±0.45^{fg}	1.94±0.05^{d}	0.01±0.00^{d}	1.94±0.09^{bc}	0.00±0.00^{a}
CNY	2.20±0.10^{a}	17.20±0.10^{d}	4.06±0.83^{a}	3.21±0.01^{c}	3.46±0.05^{d}	3.60±0.05^{cd}	0.01±0.00^{ab}	2.89±0.19^{efg}	BDL
GMY	4.85±0.05^{cd}	82.90±0.40^{ef}	3.18±0.05^{ab}	9.61±0.00^{k}	12.62±0.06^{b}	2.93±0.05^{defg}	0.02±0.00^{ab}	3.54±0.05^{d}	BDL
CMY	4.75±0.05^{cde}	81.40±0.10^{g}	2.18±0.05^{b}	16.05±0.02^{f}	4.40±0.01^{d}	3.05±0.07^{abc}	0.02±0.00^{abc}	3.54±0.05^{d}	BDL

Keys: SMY- Soy milk yoghurt; TNY- Tiger-nut milk yoghurt; CNY- Coconut milk yoghurt; GMY-Goat milk yoghurt; CMY- Cow milk yoghurt; Values bearing different alphabets down group are significantly different (*p<0.05*), Values are presented as M ± SD at (*p<0.05*).

percentage of the SMY, TNY, CNY, GMY and CMY samples. The findings shows that the GMY sample have the highest moisture content value (91.39 %), CMY had the highest pH (5.18 %), SMY had the highest ash content (0.50 %), CNY had the highest fat content (5.92 %), SMY had the highest protein (8.85 %), which reveal that all the samples proximate composition values exhibited statistically significant difference across the column at *p=0.05,* respectively.

Table 2 reveals mineral compositions of the SMY, TNY, CNY, GMY and CMY samples. The mineral composition of the SMY, TNY and CNY were comparable to CMY and GMY samples. The sodium values recorded in each sample of SMY (5.85±0.55), TNY (2.77±0.37), CNY (2.20±0.10), GMY (4.85±0.05) and CMY (4.75±0.05) where GMY and CMY indicated statistically significant difference at (*p<0.05*). The K values recorded in each samples are SMY (192.85±4.55), TNY (72.88±0.28), CNY (17.20±0.10), GMY (82.90±0.40) and CMY (81.40±0.10) indicating significant difference across the column at (*p<0.05*). P content of CNY (4.06±0.83) and GMY (3.18±0.05) samples are higher than SMY (2.18±0.05), TNY (2.72±0.39) and CMY (2.18±0.05); Ca content of CMY (16.05±0.02) and GMY (9.61±0.00) samples are higher than SMY (5.66±0.05), TNY (4.50±0.50) and CNY (3.21±0.01). Mg content values are GMY (12.62±0.06) have the higher value than SMY (6.88±0.54), CMY (4.40±0.01), TNY (3.86±0.45) and CNY (3.46±0.05). Fe content of the sample CNY (3.60±0.05) is higher than others like CMY (3.05±0.07), GMY (2.93±0.05), TNY (1.94±0.05) and SMY (0.80±0.05). Cu content values for each sample are SMY (0.35±0.05), GMY (0.02±0.00), CMY (0.02±0.00), TNY (0.01±0.00) and CNY (0.01±0.00). Zn content values for GMY (3.54±0.05) and CMY (3.54±0.05) values are higher than others like CNY (2.89±0.19), TNY (1.94±0.09) and SMY (0.38±0.05). Cd contents in samples SMY (0.62±0.45), TNY (0.00±0.00), CNY, GMY and CMY, while Pb are below detectable limit. All the mineral content reveals that there was statistically significant difference in all the yoghurt samples.

Vitamin composition

Table 3 reveals the composition of vitamins analyzed like vitamin A which is retinol A and Ascorbic acid as vitamin C for each sample. The vitamin A values recorded in sample GMY (53.41±0.09) and TNY (52.81±0.55) are higher compare to other products of SMY (46.01±1.00), CMY (42.48±0.05) and CNY (41.83±0.67) there was statistically significant difference across the column at p>0.05 in vitamin A values. The vitamin C values in samples of CMY, SMY and TNY are 6.20±0.10, 6.02±0.10 and 6.00±0.10 which are higher than other samples values like GMY (2.47±0.05) and CNY (2.46±0.05).

Sensory evaluation

Table 4 reveals sensory analysis for colour, aroma, texture, taste and overall-acceptability of the SMY, TNY, CNY, GMY and CMY by the members of panelists which ranges between 5.60 to 7.30, in which all are above mean scores for 9 hedonic point used. All the samples were acceptable by the panelists, some samples exhibited significant difference at p<0.05 in the parameters analyzed like colour, aroma, texture, taste and overall-acceptability. Although, there was no significant difference in TNY, CNY and GMY for colour, SMY, CNY and GMY for aroma, CNY and CMY for texture, CNY, GMY and CMY for taste and CNY and GMY for overall-acceptability.

DISCUSSION

The pH and proximate compositions results of the yoghurts samples is presented in (Table 1).

Table 3: Vitamin composition of yoghurt samples.

Samples code	Vitamin A (IU/g) (X ± SD)	Vitamin C(mg/100ml) (X ± SD)
SMY	46.01±1.00^{def}	6.02±0.10^{a}
TNY	52.81±0.55^{e}	6.00±0.10^{a}
CNY	41.83±0.67^{g}	2.46±0.05^{c}
GMY	53.41±0.09^{i}	2.47±0.05^{c}
CMY	42.48±0.05^{h}	6.20±0.10^{a}

Keys: SMY- Soy milk yoghurt; TNY- Tiger-nut milk yoghurt; CNY- Coconut milk yoghurt; GMY-Goat milk yoghurt; CMY- Cow milk yoghurt; Values bearing different alphabets down group are significantly different (*p<0.05*), Values are presented as M ± SD at (*p<0.05*).

Table 4: Sensory evaluation of yoghurt samples.

Sample code	Colour (X ± SD)	Aroma (X ± SD)	Texture (X ± SD)	Taste (X ± SD)	Overall acceptability (X ± SD)
SMY	6.75±1.48^{ab}	6.25±1.59^{a}	6.30±1.22^{abcd}	6.45±1.39^{ab}	6.75±1.29^{ab}
TNY	7.05±0.22^{a}	5.60±0.75^{d}	6.10±1.37^{bc}	4.55±0.83^{d}	5.10±1.21^{c}
CNY	7.20±1.01^{a}	6.45±1.57^{a}	6.20±1.61^{ab}	5.90±1.59^{a}	6.70±1.42^{a}
GMY	7.45±0.76^{a}	7.10±1.07^{a}	6.80±0.95^{a}	6.65±1.31^{a}	7.30±0.73^{a}
CMY	6.75±1.33^{ab}	6.05±1.64^{bc}	6.25±1.52^{ab}	5.80±1.64^{a}	6.75±1.07^{ab}

Keys: SMY- Soy milk yoghurt; TNY- Tiger-nut milk yoghurt; CNY- Coconut milk yoghurt; GMY-Goat milk yoghurt; CMY- Cow milk yoghurt; Values bearing different alphabets down group are significantly different (*p<0.05*), Values are presented as M ± SD at (*p<0.05*).

The yoghurt samples pH values range from 3.91 to 5.18 signifying that the yoghurt samples are acidic in nature. The sample with highest pH values is CMY 5.18± 0.05 that is closed to the range of neutral pH, which can be as a result of milk used and the lowest pH values in TNY and CNY 3.91± 0.07 and 3.91 ± 0.06 which are acidic than other samples which can be as a result of lactic acid bacteria presence that produce extra acid in fermentation process. Moisture content of the samples ranges from 77.52 to 91.39% signifying that the samples have high content of water. GMY samples 91.39 ± 0.73% with the highest moisture content that may be due milk type used while CNY samples have the lowest moisture content 77.52 ± 0.71% that can be as a result of solid which reduce the content of water. According to report of Bukar and Salami-Suleiman, (2019), reduction in moisture causes an increase in the concentration of nutrients generally. Yoghurt samples' ash contents range from 0.20 to 0.50% signifying that the samples have low content of ash. SMY have the highest content of ash 0.50 ± 0.01% as a result of minerals or inorganic compounds present in sample, while TNY have the lowest content of ash 0.20 ± 0.01% which may be as a result of milk type, the decrease in ash content of the sample may be as a result of decrease in contents of carbohydrate, fat and moisture during the yoghurt fermentation (Obadina *et al*., 2013). Yoghurt fat content ranges from 2.17 to 5.92% signifying that samples have changing levels of fat content. CNY have the highest fat content of 5.92 ± 0.44% due milk type used and lowest content of fat found in SMY samples 2.17 ± 0.00 % which may be due milk with low fat content. The coconut and soy fat are plant fat that composed of unsaturated fats mainly, that have high health benefit to human (Mehaya *et al*., 2023). The yoghurt samples' protein content ranges from 3.81 to 8.85% signifying that yoghurt samples have changing levels of the protein content. SMY sample have the highest content of protein 8.85± 0.01% which is due to type of milk with protein rich ingredients, while CMY yoghurt sample have the lowest content of protein 3.81 ± 0.06% as a result of milk type used for sample production.

Yoghurt samples carbohydrate content ranges from 3.04 to 18.04% signifying that samples have changing levels in carbohydrate content. CNY sample have the highest content of carbohydrate 18.04 ± 0.68% that may be due to sugar added or carbohydrate rich ingredients like sucrose, raffinose, glucose, galactose, fructose and stachyose that breakdown during fermentation, while GMY sample with the lowest content of carbohydrate 3.04 ± 0.58% can be due to activity of *Lactobacillus* species that breakdown mono-saccharides completely in yoghurt which, is crucial as source of energy for cellular activities and growth (Vondrasek, 2014).

Table 2 presents mineral content of different yoghurt samples such as calcium (Ca), sodium (Na), magnesium (Mg), potassium (K), iron (Fe), phosphorus (P), zinc (Zn), copper (Cu) and cadmium (Cd). Yoghurt samples calcium (Ca) content ranges from 3.21 to 16.05 mg/100g showing significant difference p< 0.05 in the content. CMY sample have the highest Ca content of 16.05 ± 0.02 mg/100 g as a result of high content of calcium in the milk used while CNY sample have the lowest calcium content of 3.21± 0.01 mg/100 g as a result of type of milk used or processing methods. In human diet insufficient Ca intake can cause conditions of disease as hypercholesterolemia, high blood pressure and osteoporosis (Oladele and Aina, 2007). Yoghurt samples Na content ranges from 2.20 to 5.85 mg/100 g showing significant difference in levels of Na content. SMY sample have the highest content of Na 5.85 ± 0.55 mg/100 g, which may be because of milk used, while CNY sample have lowest content of Na 2.20 ± 0.10

mg/100 g that can be due to low sodium milk used. The yoghurt samples with high Na content may serve as complementary source for Na due to high content of the mineral. The main role of Na mineral in human physiology is related to maintenance of physiological fluids like blood pressure (Usman and Bolade, 2020). Yoghurt samples' Mg content ranges from 3.46 to 12.62mg/100g showing significant difference in Mg content. GMY sample have the highest Mg content of 12.62 ± 0.06 mg/100 g, while CNY sample have the lowest Mg content of 3.46 ± 0.05 mg/100 g which is as a result of type of milk used. The values obtained in this study are far below recommended daily allowance of 200-400 mg per day (Kelly *et al*., 2022) however, since yoghurt is consumed as a snack drink, which can be regarded as a complimentary source for Mg. In the nutrition of human, Mg have been linked to metabolism of energy, endothelial cells function and release of neurotransmitter which is also a co-factor of about 300 enzymes in the system of body (Farinde *et al*., 2012). Yoghurt sample potassium (K) content ranges from 17.20 to 192.85 mg/100 g showing significant difference $p<0.05$ in the K content. SMY sample have the highest K content of 192.85 ± 4.55 mg/100 g which can be because of high K content presence in milk used while CNY sample have low content of K 17.20 ± 0.10 mg/100 g that may be as a result of type of milk used. One of the most vital minerals in the body is K, which helps to regulate the fluid balance, nerve signals and muscle contractions. A diet with high content of K can help to decrease water retention and blood pressure, protection against kidney stone, osteoporosis and stroke (Usman and Bolade, 2020). Yoghurt samples' Fe content ranges from 0.80 to 3.60 mg/100g showing significant difference in Fe content. CNY sample have the highest content of Fe 3.60 ± 0.05 mg/100 g, while SMY have the lowest content of Fe 0.80 ± 0.05 mg/100 g, which may be as a result of the type of milk used for yoghurt production. In this study, its reveal that the plant-based milk has high content of Fe than the animal-based milk. Although, main function of iron in human nutrition is linked to synthesis of myoglobin and hemoglobin in the blood (Kelly *et al*., 2022). Yoghurt sample phosphorus content ranges from 2.18 to 4.06 mg/100 g and show significant difference at $p>0.05$. CNY sample have the highest P content of 4.06 ± 0.83 mg/100g, while SMY and CMY sample have the lowest P content of 2.18 ± 0.05 mg/100 g, which may be as a result of the type of milk used for yoghurt product with low P content. The phosphorus have been involved in metabolic actions in the body system such as cell growth, contraction of the heart muscle and kidney function (Gonzalez-Tenorio *et al*., 2014). The minerals are used by the body to make hormones, regulate body and build bones which are also important for making enzymes (Usman and Bolade, 2020). Yoghurt sample's zinc (Zn) content ranges between 0.38 and 3.54 mg/100 g showing significant difference at $p>0.05$ of Zn content. The highest content of Zn was found in GMY and CMY sample with 3.54± 0.05 mg/100 g, while the lowest Zn content is found in SMY sample (0.38±0.05 mg/100 mg), which can be due to type of milk used for the sample production. The content of Zn is higher in animal-based milk than in plant-based milk. Zn in human nutrition is needed to defend body immune system and also to work effectively. Zn plays a vital role in cell growth, cell division, carbohydrate breakdown and wound healing (Oladele and Aina, 2007). Yoghurt sample's copper content (Cu) ranges between 0.01 and 0.35 mg/100 g showing significant difference with low Cu content. SMY sample have the highest content of Cu (0.35 ± 0.05 mg/100 g), while TNY, CNY, CMY and GMY have the lowest content of Cu, which may be as a result of the milk type used or processing conditions for the samples production. All the yoghurt samples' cadmium (Cd) content was below the detection limit showing that Cd is not the main contaminant in these samples.

Table 3 presents the results of vitamins A and C composition. The vitamin A composition of the yoghurt samples is between 41.83 and 53.41 IU/g showing significant difference at various levels of vitamin A content. GMY samples' is found with the highest content of vitamin A (53.41± 0.09 IU/g) and CNY sample had the lowest vitamin A content (41.83± 0.67 IU/g) that resulted from the type of milk used for production. Yoghurt samples vitamin C content ranges between 2.46 and 6.20 mg/100 ml showing significant difference at various levels of vitamin C content. CMY samples have the highest content of vitamin C (6.20 ± 0.10 mg/100 ml) that is comparable to TNY and SMY, while CNY and GMY with the lowest vitamin C content of 2.46 ± 0.05 mg/100 ml and 2.47± 0.05 mg/100 ml respectively, which may be as a result of the type of milk used production. Vitamin A contents in GMY and TNY had higher values compared to other samples, while SMY, TNY and CMY vitamin C content are higher when compared to GMY and CNY that can be beneficial to consumers that are looking for yoghurt products with high content of vitamins A and C. The carbohydrate in the body is breakdown by help of vitamins into glucose that is used by the body to produced energy, which also help to metabolize protein and fat (Yadav *et al*., 2015). Although, vitamins are classified based on material they dissolve in either water as water soluble or in fat as fat soluble vitamin.

Table 4 presents sensory profile results of different 5 yoghurt samples such as colour, aroma, texture, taste and overall-acceptability. The samples' colour ranged from 6.75 to 7.45 showing that all samples have high scores for colour. GMY samples had the highest colour score of 7.45 ± 0.76 than SMY samples with the lowest colour score of 6.75±1.48. Aroma scores range from 5.60 to 7.10 showing significant difference at various levels of aroma acceptability. GMY sample had the highest aroma score of 7.10 ± 1.07 than TNY with the lowest aroma score of 5.60 ± 0.75. Texture score of yoghurt samples ranged from 6.10 to 6.80 showing high texture scores. GMY sample had the highest texture score with 6.80 ± 0.95 and TNY sample with the lowest texture score of 6.10 ± 1.37. Taste of yoghurt samples ranges between 4.55 to 6.65 showing significant difference at various levels of acceptability.

GMY samples had the highest scores for taste (6.65 ± 1.31) and TNY sample had the lowest taste score of 4.55 ± 0.83, while overall-acceptability scores for yoghurt samples ranged from 5.10 to 7.30 showing different levels of overall acceptability. GMY sample with the highest overall acceptability score of 7.30 ± 0.73, whereas TNY sample with the lowest overall acceptability score of 5.10 ± 1.21. The findings show that sensory profiles of yoghurt samples differ significantly that can be as a results of various type of milk used for the yoghurt production (Obiora *et al*., 2020).

Conclusion

The yoghurts can be produced from raw materials of tiger-nut, coco nut and soy beans as a source from plant and from cow milk and goat milk. The yoghurt produced from coconut yoghurt, soy yoghurt and tiger-nut yoghurt have possibilities to give equal measurement of nutrition and sensory parameters value as obtained in the animal source yoghurt from increment of values at different profile analyzed. By using coconut, tiger-nut and soybeans as a product that is possible for production of yoghurt in other to influence the consumer's nutritious spectrum indicate results that is acceptable respectively. The manufacture of tiger-nut yoghurt, coconut yoghurt and soy yoghurt can serve the same purpose as CMY and GMY to those that are looking for low calories diets and lactose intolerance people.

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