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QUALITY CHARACTERISTICS OF IMITATION YOGHURT PRODUCED FROM THE BLENDS OF MILK FROM COW, COCONUT (*Cocos nucifera*), SOYBEAN (*Glycine max*) AND ALMOND (*Terminalia catappa*) SEEDS

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Abstract

The inadequacy of cow milk in Nigeria has stimulated the production of yoghurt from non-conventional milk sources such as plant seeds and nuts. The production of yoghurt from the composite formulation of cow milk, coconut milk, almond milk and soymilk was therefore investigated. The various component milk were blended at different proportions to produce yoghurt types. The proximate composition of the yoghurt types revealed the following trend: moisture content (79.3 - 80.7 g/100g), protein (2.2 - 3.1 g/100g), total lipids (9.8 - 11.2 g/100g), total ash (0.45 - 1.41 g/100g), crude fibre (0.36 - 1.64 g/100g), and carbohydrate (4.24 - 5.65 g/100g). The physicochemical properties of the yoghurt types exhibited value range of pH (3.91 - 4.05), total titratable acidity (0.66 - 0.78%), and total solids (19.3 - 20.7 g/100g). The yoghurt types contained appreciable quantity of Fe, Ca, Mg, Na, and P. The values were relatively lower than the recommended daily allowance (RDA) but the product could serve as a good complementary source for these mineral elements. The microbial load of the yoghurt types showed the following trend: bacterial count ($7.6x10^{3}$ - $7.5x10^{4}$ cfu/ml), yeast and mould count ($1.69x10^{2}$ - $2.30x10^{2}$ cfu/ml) while coliform was observed to be absent. The organoleptic characteristics of the yoghurt types revealed that sample YOGO-E (blend of 50% cow milk, 20% coconut milk, 10% almond milk, 20% soymilk) was rated closer to the control sample (100% cow milk alone) and is therefore recommended as an alternative imitation yoghurt since it did not show significant differences ($P<0.05$) in terms of appearance, aroma, taste, and overall acceptability.

Keywords: Imitation yoghurt, coconut, almond, soybean, cow milk.

1.0 Introduction

Yoghurt is one of the food products derivable from cow milk. It is essentially a milk product obtained from the fermentation of lactose component in milk of animal origin by the activities of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* (Sanful, 2009). Other fermented milk products include cottage cheese and sour cream. Cow milk is commonly available globally and as such is the milk of choice for yoghurt production (Tamime and Robinson, 1999). Yoghurt, being of animal origin, is good nutritionally containing protein, calcium, vitamins B_2 and B_{12}, potassium, and magnesium (Magee, 2020). The fermented milk product is also believed to possess therapeutic properties such as normalization of gastrointestinal disorder (Con *et al*., 1996; Adolfsson, 2004). People consume yoghurt as a dessert drink or snack while its popularity is due to its characteristic pleasant aromatic flavour, thick creamy consistency and its reputation as a food product associated with health benefits (Makanjuola, 2012).

Most of the commercial producers of yoghurt in Nigeria are making use of imported milk powder as a major ingredient and this trend has made the industry to be import-dependent. The dairy industry in Nigeria is not developed because the animal rearers are still practicing nomadic animal husbandry thereby giving rise to poor nutritional and health conditions of animals. The poor genetic conditions of the Nigerian breeds of ruminants also serve as part of the problems of underdeveloped dairy industry in the country (Ogbimi and Oyewale, 2000). All these challenges have therefore incapacitated the country from producing high quality animals and milk output. Due to insufficiency of cow milk in commercial quantity in Nigeria and many other countries, various efforts had been made by researchers to use plant-based milk-like alternatives for the production of yoghurt in composite formulation with cow milk. These include yoghurt production from cow milk and fresh corn milk, (Makanjuola, 2012); cow milk, soymilk and mango pulp (Walia *et al*., 2013);

cow milk and cashew nut milk (Olatidoye *et al.*, 2017); cow milk and tigernut milk (Sanful, 2009); and cow milk and peanut milk (Elsamani and Ahmed, 2014); among others.

The present study therefore seeks to produce yoghurt from milk alternatives such as coconut milk, almond seed milk, and soymilk in composite formulation with cow milk.

2.0 Materials and Methods

2.1 Sources of materials

Fresh cow milk was obtained from Fulani herdsmen within Bature village in Girei Local Government Area, Adamawa State, Nigeria; the almond (*Teminalia catappa*) seeds were harvested from trees within the University community (Modibbo Adama University of Technology, Yola, Nigeria); while soybean (*Glycine max.*) and coconut (*Cocos nucifera*) were purchased from Jimeta Ultra-Modern Market, Jimeta, Adamawa State, Nigeria. Commercially available yoghurt starter cultures (*Streptococcus thermophillus* and *Lactobacillus bulgaricus*) were obtained from Jimeta Ultra-Modern Market, Jimeta, Adamawa State, Nigeria.

2.2 Methods

2.2.1 Preparation of milk from different sources

The cow milk was initially sieved to remove all impurities followed by heat treatment at 72^{o}C for 5 min for the purpose of eliminating all pathogenic organisms and deactivation of inherent enzymes in the milk. This was followed by cooling and subsequent refrigeration at 5^{o}C.

The almond seeds were washed and cracked to remove the kernels and these were then sorted to remove all impurities. The kernels were then washed and grated using hot water (80^{o}C) in a blender at a ratio of 1:8 (kernel/water; w/v). The slurry obtained was then sieved using a muslin cloth and the almond milk ultimately obtained was pasteurized at 72^{o}C for 5 min. The almond milk was subsequently cooled and refrigerated at 5^{o}C.

The coconuts were similarly cracked and the meat removed using a dull knife followed by careful scrapping of the brown skin to discourage milk discolourization. Thereafter, the coconut meat was washed, grated with hot water (90^{o}C) in a blender at a ratio of 1:8 (meat/water; w/v). The slurry obtained was then sieved using a muslin cloth and the coconut milk finally obtained was pasteurized at 72^{o}C for 5 min. The coconut milk was subsequently cooled and refrigerated at 5^{o}C.

Soymilk was prepared from soybeans initially soaked in water at ambient temperature (30±2^{o}C) for 6 h at a ratio of 1:4 (beans/water; w/v). The soaked beans were then drained and grated with hot water (100^{o}C) in a blender at a ratio of 1:8 (beans/water; w/v). The slurry eventually obtained was then sieved using a muslin cloth to separate the soymilk from the insoluble residue. The soymilk was finally pasteurized at 100^{o}C for 5 min in order to inactivate spoilage enzymes. The soymilk was subsequently cooled and refrigerated at 5^{o}C.

2.2.2 Production of yoghurt from the milk blends

Milk from cow, coconut, almond seeds and soybean were formulated and blended at different ratios to produce six (6) yoghurt types. Each blend (3 litres) of milk was obtained using the formulation in Table 1. For yoghurt production, each milk blend (3 litres) was first subjected to pasteurization at 80^{o}C for 10 min after which it was cooled down to 43^{o}C and then inoculated with the starter culture (2% of the milk volume) in a stainless steel container. Fermentation of the mixture was carried out in an incubator at 40-43^{o}C for 6 h after which the yoghurt produced was cooled to 5^{o}C. Figure 1 shows the flowchart illustrating the production steps of yoghurt from each milk blend.

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Table 1: Yoghurt formulation from component milk categories (%).

Yoghurt type	Milk component (%)[1]			
	Cow milk	**Coconut milk**	**Almond milk**	**Soymilk**
YOGO-A	0	20	60	20
YOGO-B	20	20	40	20
YOGO-C	30	20	30	20
YOGO-D	40	20	20	20
YOGO-E	50	20	10	20
YOGO-F	100	0	0	0

[1]Total volume of milk used for each yoghurt type was 3 litres.

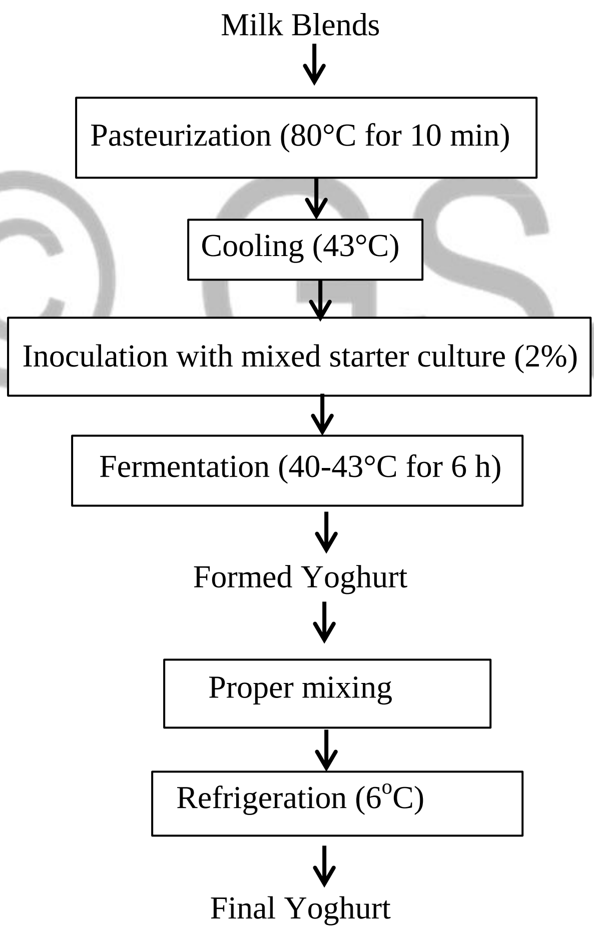

Figure 1: Flowchart illustrating the production of yoghurt from milk blends.

2.2.3 Determination of proximate composition of yoghurt samples

The moisture content of each yoghurt sample was determined by oven drying 2 g of the sample at 105^{o}C for 4 h (AOAC, 2012). The weight loss represented the amount of moisture in the sample. The crude protein in the sample was determined by Formol titration method (James, 1995). Ash content of the sample was determined by the furnace incineration method in which 20 g of the sample was incinerated at 575^{o}C for 10 h (Egan *et al*., 1981). The total lipid content of yoghurt sample was determined using Babcock method (Carpenter, 2010).

The crude fibre was determined using the procedure as described by Obadina *et al*. (2008). Two grams (2 g) of the sample was accurately weighed into a fibre glass and 100 ml of 0.255 N H_2SO4 was added. The mixture was heated under reflux for 1 h with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filterate obtained was thrown off and the residue was returned to the fibre glass to which 100 ml of 0.31 N NaOH was added and heated under reflux for another 2 h. The mixture was again filtered through a fibre sieve cloth and 10 ml of acetone was added to dissolve any organic constituent. The residue was washed with about 50 ml hot water twice on the sieve cloth after which it was finally transferred into the crucible. The crucible and the residue were oven dried at 105ºC overnight to drive off moisture. The weight of the final dried residue was calculated as the percentage crude fibre. Carbohydrate content was calculated by difference (AOAC. 2012).

2.2.4 Determination of physicochemical properties of yoghurt samples

The pH was determined using a pH meter (model WPA CD70, India). After each determination, the pH probe was rinsed with distilled water. The total titratable acidity (TTA) was determined by taking 2 g of each sample into a separate conical flask and 20 ml of distilled water was added to each sample and shaked properly on addition of indicator (phenolphthalein).The mixture was further shaken properly and titrated against 0.1M NAOH and the percentage acidity was expressed as lactic acid equivalent (Ariahu *et al.*, 1999). The total solids (TS) in the yoghurt sample was calculated by subtracting the percentage moisture of sample from 100% (Lees, 1975).

2.2.5 Determination of selected mineral elements in yoghurt samples

The resultant ash from the furnace incineration method was further subjected to mineral profiles analysis where the concentration of calcium (Ca), magnesium (Mg), and iron (Fe) was determined using atomic absorption spectrophotometer (Model SP9 Pye Unicam, UK); having initially prepared a standard curve for each mineral element under investigation. The concentration of each mineral element was calculated as mg/kg of sample. The analysis of sodium (Na) concentrations of the sample was carried out using flame photometry while the phosphorous (P) content in the sample was determined by vandate-molybdate method as described by Egan *et al.* (1981).

2.2.6 Evaluation of microbial load in the yoghurt samples

The microbial load in each yoghurt sample was evaluated by serially diluting the sample in sterile, distilled water to obtain the inoculum. Aliquot (0.1 ml) of each dilution was cultured on nutrient agar (NA) for bacteria, MacConkey Agar (MA) for coliforms, while Sabouraud dextrose agar (SDA) was used for the evaluation of fungi. The incubation conditions for bacteria and fungi evaluation was at ambient temperature (30±2^{o}C) for 36 h while that of coliform was at 34±2^{o}C for 48 h (Ogbulie *et al.*, 1998). After incubation, the colonies that were observed on plates were counted and multiplied by the reciprocal of dilution power and reported as colony forming unit per sample ml (cfu/ml).

2.2.7 Sensory quality rating of yoghurt samples

This was carried out to evaluate the level of acceptability and best sample that was preferred by the panelists. A 40-member panelist consisting of staff and students who were familiar with yoghurt consumption were involved in the evaluation. Each of the panelists was asked to rate the samples on the basis of appearance, taste, aroma, consistency, and overall acceptability using a nine-point Hedonic scale (i.e. 9=like extremely; 5=neither like nor dislike; 1=dislike extremely) (Larmond, 1977).

2.2.8 Statistical analysis

All determinations reported in this study were carried out in triplicates. In each case, a mean value and standard deviation were calculated. Analysis of variance (ANOVA) was also performed and separation of the mean values was by Duncan's Multiple Range Test at P<0.05 using Duncan procedures of Statistical Analytical Systems (SAS, 1990).

3.0 Results and Discussion

3.1 Proximate Composition of Different Yoghurt Types Produced from the Milk Blends

Table 2 shows the proximate composition of different yoghurt types produced from the blends of milk from cow, coconut, almond seeds and soybean. The moisture content of all the yoghurt types ranged between 79.3 and 80.7 g/100g with no significant differences at P<0.05. The implication of this high moisture content in the yoghurt types is that the food product has a tendency of very low shelf stability as high moisture content in food encourages thriving of micro-organisms (Butt *et al*., 2004). However, due to the acidic nature of yoghurt, the product might be able to endure relative shelf stability to a short extent (Amanze and Amanze, 2011). The protein content of the yoghurt types had a range of

Table 2: Proximate composition of different yoghurt types produced from the milk blends[1].

Yoghurt type	Proximate composition (g/100g)					
	Moisture	**Protein**	**Total lipids**	**Total ash**	**Crude fibre**	**Carbohydrate**
YOGO-A	79.3±0.4[a]	2.2±0.1[cd]	9.8±0.3[d]	1.41±0.03[a]	1.64±0.07[a]	5.65±0.23[a]
YOGO-B	80.5±0.5[a]	2.4±0.1[c]	10.3±0.2[cd]	1.32±0.07[b]	1.24±0.09[b]	4.24±0.14[c]
YOGO-C	79.9±0.6[a]	2.5±0.2[bc]	10.7±0.2[bc]	1.13±0.06[c]	0.93±0.06[c]	4.84±0.21[b]
YOGO-D	79.3±0.5[a]	2.6±0.2[bc]	10.9±0.2[ab]	0.81±0.02[d]	0.75±0.08[d]	5.64±0.25[a]
YOGO-E	80.7±0.3[a]	2.7±0.1[b]	11.1±0.1[a]	0.52±0.01[e]	0.63±0.04[e]	4.35±0.22[c]
YOGO-F	80.1±0-4[a]	3.1±0.1[a]	11.2±0.1[a]	0.45±0.02[f]	0.36±0.02[f]	4.79±0.19[b]

[1]Mean values within the same column having the same letter are not significantly different at P<0.05.

YOGO-A= (0% Cow milk; 20% Coconut milk; 60% Almond milk; and 20% Soymilk).
YOGO-B= (20% Cow milk; 20% Coconut milk; 40% Almond milk; and 20% Soymilk).
YOGO-C= (30% Cow milk; 20% Coconut milk; 30% Almond milk; and 20% Soymilk).
YOGO-D= (40% Cow milk; 20% Coconut milk; 20% Almond milk; and 20% Soymilk).
YOGO-E= (50% Cow milk; 20% Coconut milk; 10% Almond milk; and 20% Soymilk).
YOGO-F= (100% Cow milk alone).

2.2-3.1 mg/100g. The protein concentration was generally low in the product and this may be attributed to the relative low concentration of protein in the component milk used for the production. Soymilk, cow milk, almond milk and coconut milk had earlier been observed to be low in protein content (Belewu and Belewu 2007; Guetouache *et al.,* 2014; Alozie and Udofia, 2015; Ugochi *et al.,* 2015). The total lipids in the various yoghurt types ranged between 9.8 and 11.2 g/100g. This relative high concentration of lipids may be attributed to the fact that the plant-based milk sources used in this study are rich in oil (Belewu and Belewu 2007; Guetouache *et al.,* 2014; Alozie and Udofia, 2015; Ugochi *et al.,* 2015). The implication of relative high concentration of lipids in the yoghurt is that the product may be liable to oxidative rancidity. It had earlier been observed that lipids in food are highly susceptible to oxidative reactions and the oxidation products are responsible for rancid flavour development in foods (Galano *et al*., 2015).

The total ash in the yoghurt types ranged from 0.45 to 1.41 g/100g, the crude fibre also ranged between 0.63 and 1.64 g/100g, while the carbohydrate content in the product ranged from 4.24 and 5.65 g/100g. These values are relatively low and therefore yoghurt as a food product cannot be regarded as a good source of these nutrients. Nevertheless, most people consume yoghurt not as a main drink but as a dessert drink, snack, or as a probiotic food drink for the re-establishment of a balance within intestinal microflora (Olatidoye *et al*., 2017).

3.2 Physicochemical Characteristics of Different Yoghurt Types Produced from the Milk Blends

The physicochemical properties of yoghurt types produced from the plant-based milk components are presented in Table 3. The pH values of the products ranged from 3.91 to 4.05 with sample YOGO-F having the lowest pH while sample YOGO-A had the highest value

Table 3: Physicochemical properties of different yoghurt types produced from the milk blends[1].

Yoghurt type	pH	TTA (%)	Total solids (g/100g)
YOGO-A	4.05 ± 0.03[a]	0.66 ± 0.03[d]	20.7±0.2[a]
YOGO-B	4.01 ± 0.01[ab]	0.68 ± 0.01[cd]	19.5±0.2[c]
YOGO-C	3.97 ± 0.03[b]	0.69 ± 0.03[bcd]	20.1±0.3[ab]
YOGO-D	3.95 ± 0.03[bc]	0.71 ± 0.01[bc]	20.7±0.3[a]
YOGO-E	3.94 ± 0.03[bc]	0.73 ± 0.01[b]	19.3±0.1[c]
YOGO-F	3.91 ± 0.03[c]	0.78 ± 0.03[a]	19.9±0.1[b]

[1]Mean values within the same column having the same letter are not significantly different at P< 0.05.
YOGO-A= (0% Cow milk; 20% Coconut milk; 60% Almond milk; and 20% Soymilk).
YOGO-B= (20% Cow milk; 20% Coconut milk; 40% Almond milk; and 20% Soymilk).
YOGO-C= (30% Cow milk; 20% Coconut milk; 30% Almond milk; and 20% Soymilk).
YOGO-D= (40% Cow milk; 20% Coconut milk; 20% Almond milk; and 20% Soymilk).
YOGO-E= (50% Cow milk; 20% Coconut milk; 10% Almond milk; and 20% Soymilk).
YOGO-F= (100% Cow milk alone).

with significant differences at P<0.05. The lowest pH value in sample YOGO-F may be attributed to the highest volume of lactose-rich cow milk present in the sample. It had earlier been observed that the lower pH in yoghurt could be attributable to the conversion of lactose in milk to lactic acid by the fermenting micro-organisms (Zourari *et al*., 1992). The lower pH in the yoghurt makes the product to be acidic and this serves as a major contributor to the overall taste of the food drink (Guzel-Seydim *et al*., 2005).

The total titratable acidity (TTA) of the various yoghurt types ranged between 0.66 and 0.78% with significant differences at P<0.05. The TTA was observed to increase in the samples as the quantity of cow milk in the product was increasing. The TTA is essentially the total acid concentration contained within a food system (Sadler and Murphy, 2010). The TTA as a variable is usually used as a good predictor of acid’s impact on food flavour (Sadler and Murphy, 2010).

The total solids in the various yoghurt types was found to range between 19.3 and 20.7 g/100g with significant differences at P<0.05. The total solids of food are basically the dry matter that remains after moisture removal (Bradley, 2010). Therefore the total solids can be used as a quality indicator to know whether a liquid food product is over-diluted or not (Bradley, 2010).

3.3. Selected Mineral Composition of Different Yoghurt Types from the Milk Blends

The selected mineral profile of yoghurt types produced from the milk blends is presented in Table 4. The iron (Fe) content exhibited a range of 0.76-0.85 mg/100g which can be regarded as being low and cannot meet the recommended daily allowance (RDA) of 8 – 18 mg per day (Szefer and Grembecka, 2007). The major function of Fe in human nutrition is related to the synthesis of haemoglobin and myoglobin in the blood (Huskisson *et al.*, 2007).

Table 4: Selected mineral composition of different yoghurt types produced from the milk blends[1].

Yoghurt type	Selected mineral composition (mg/100g)				
	Fe	**Ca**	**Mg**	**Na**	**P**
YOGO-A	0.76 ± 0.05^{d}	214.3 ± 3.5^{f}	24.5 ± 0.8^{f}	21.1 ± 1.3^{d}	48.5 ± 0.3^{f}
YOGO-B	0.78 ± 0.05^{c}	244.3 ± 4.7^{e}	27.8 ± 0.9^{e}	34.5 ± 1.1^{c}	50.1 ± 0.8^{e}
YOGO-C	0.82 ± 0.01^{b}	278.5 ± 1.8^{d}	31.3 ± 0.4^{d}	35.7 ± 2.3^{c}	52.47 ± 0.4^{d}
YOGO-D	0.82 ± 0.01^{b}	281.4 ± 2.3^{c}	33.8 ± 0.5^{c}	45.4 ± 2.8^{b}	62.8 ± 0.3^{c}
YOGO-E	0.82 ± 0.01^{b}	287.5 ± 1.3^{b}	34.5 ± 0.6^{bc}	57.1 ± 3.5^{a}	68.7 ± 0.5^{b}
YOGO-F	0.85 ± 0.02^{a}	295.1 ± 3.8^{a}	40.2 ± 0.9^{a}	58.6 ± 2.1^{a}	80.6 ± 0.9^{a}

[1]Mean values within the same column having the same letter are not significantly different at $P < 0.05$.

YOGO-A= (0% Cow milk; 20% Coconut milk; 60% Almond milk; and 20% Soymilk).

YOGO-B= (20% Cow milk; 20% Coconut milk; 40% Almond milk; and 20% Soymilk).

YOGO-C= (30% Cow milk; 20% Coconut milk; 30% Almond milk; and 20% Soymilk).

YOGO-D= (40% Cow milk; 20% Coconut milk; 20% Almond milk; and 20% Soymilk).

YOGO-E= (50% Cow milk; 20% Coconut milk; 10% Almond milk; and 20% Soymilk).

YOGO-F= (100% Cow milk alone).

The calcium (Ca) concentration in the yoghurt types produced ranged between 214.3 and 295.1 mg/100g with significant differences at P<0.05. The sample YOGO-F had the highest Ca content while YOGO-A exhibited the lowest value. This may be attributed to the highest concentration of cow milk contained in YOGO-F and cow milk is known to contain appreciable quantity of Ca (Guetouache *et al*., 2014). An inadequate intake of Ca in human diet can lead to such disease conditions as osteoporosis, hypercholesterolemia and high blood pressure (Unal *et al*., 2007).

The magnesium (Mg) content of the yoghurt types exhibited a range of 24.5 – 40.2 mg/100g with significant differences at P<0.05. These values are far below the recommended daily allowance (RDA) of 200-400 mg per day (Szefer and Grembecka, 2007) but since yoghurt is usually consumed as a snack drink, it may be regarded as a good complementary source for Mg. In human nutrition, Mg has been implicated in energy metabolism, release of neurotransmitter and endothelial cell functions (Bo and Pisu, 2008). It is also a co-factor of up to about 300 enzymes in the body system (Huskisson *et al*., 2007).

The sodium (Na) concentration in the various yoghurt types produced from the milk blends ranged between 21.1 and 58.6 mg/100g with significant differences at P<0.05. These yoghurt types can serve as a good complementary source for Na due to the relative high content of this mineral. The principal role of Na in human physiology is related to the maintenance of physiological fluids such as blood pressure (Sobotka *et al.*, 2008).

The phosphorus (P) content of the yoghurt types exhibited a range of 48.5 to 80.6 mg/100g with significant differences at P<0.05. Sample YOGO–F had the highest phosphorus concentration than all other samples although the concentration was lower than the recommended daily allowance (RDA) of 800-1300 mg per day. However, the consumption of yoghurt might serve as a complementary source for the mineral element. Phosphorus has been implicated in majority of the metabolic actions in the body system including kidney functioning, cell growth and contraction of the heart muscle (Renkema *et al.,* 2008).

3.4 Microbial Load and Organoleptic Characteristics of Different Yoghurt Types Produced from the Milk Blends

Table 5 shows the microbial load of yoghurt types produced from the milk blends. Sample YOGO-B had the lowest bacterial load of $7.6x10^3$ cfu/ml while sample YOGO-F had the highest load of $7.5x10^4$ cfu/ml. This relative high population of bacteria generally found in the yoghurt samples may be attributed to possible residual fermenting micro-organisms in the products which might still be alive even after cold storage. This occurrence, however, does not predispose the yoghurt products to be called ‘probiotic yoghurt’ because the residual fermenting micro-organisms (*Streptococcus thermophilus* and *Lactobacillus bulgaricus*) had been observed not to be bile resistant and so do not survive in the passage of intestinal tract (Yilmaz-Ersan and Kurdal, 2014). The yeast and mould count of the yoghurt types also ranged between $1.69x10^2$ and $2.30x10^2$ cfu/ml with sample YOGO-D having the lowest population and sample YOGO-F the highest population. Some countries like Turkey had set a maximum standard of 100 cfu/ml of yeast and mould for yoghurt (Agarwal and Prassad, 2013). Therefore going by this Turkish maximum standard, the yeast and mould population obtained for yoghurt samples in this study could be said to be outside of that limit. Zero value were returned for the coliform count for all the yoghurt samples in this study. The non-presence of coliform in the samples is an indication of high hygienic conditions by which the product was prepared. It is also a reflection that the water used in the processing of the product was of no faecal contamination since coliform is normally used as an indicator of such contamination (Kirby *et al.,* 2016).

Table 5: Microbial load of different yoghurt types produced from the milk blends.

Yoghurt type	**Microbial load (cfu/ml)**		
	Bacterial count	**Yeast and mould count**	**Coliform count**
YOGO-A	7.8×10^3	2.12×10^2	Nil
YOGO-B	7.6×10^3	2.05×10^2	Nil
YOGO-C	7.9×10^4	1.87×10^2	Nil
YOGO-D	7.3×10^4	1.69×10^2	Nil
YOGO-E	7.2×10^4	2.10×10^2	Nil
YOGO-F	7.5×10^4	2.30×10^2	Nil

YOGO-A= (0% Cow milk; 20% Coconut milk; 60% Almond milk; and 20% Soymilk).
YOGO-B= (20% Cow milk; 20% Coconut milk; 40% Almond milk; and 20% Soymilk).
YOGO-C= (30% Cow milk; 20% Coconut milk; 30% Almond milk; and 20% Soymilk).
YOGO-D= (40% Cow milk; 20% Coconut milk; 20% Almond milk; and 20% Soymilk).
YOGO-E= (50% Cow milk; 20% Coconut milk; 10% Almond milk; and 20% Soymilk).
YOGO-F= (100% Cow milk alone).

The sensory quality rating of different yoghurt types produced from the milk blends is presented in Table 6. Sample YOGO-E was rated the highest in appearance and taste while sample YOGO-F was rated the highest in aroma, consistency and overall acceptability. There were no significant differences at $P<0.05$ among all the sensory factors in samples YOGO-E and YOGO-F except only in consistency. Therefore, for the involvement of blends of cow milk, coconut milk, almond milk and soymilk in the production of yoghurt, sample YOGO-E (blend containing 50% cow milk, 20% coconut milk, 10% almond milk, and 20% soymilk) is considered to be the closest to the control sample (YOGO-F, 100% cow milk alone).

Conclusion

It may be concluded that the production of imitation yoghurt from the blend of cow milk, coconut milk, almond milk and soymilk is highly possible and the sensory quality rating of sample YOGO-E (blend of 50% cow milk, 20% coconut milk, 10% almond milk, 20% soymilk), in particular, was closer to that of the control sample (100% cow milk alone) as it did not exhibit significant differences ($P<0.05$) in terms of appearance, aroma, taste, and overall acceptability.

Table 6: Sensory quality rating of different yoghurt types produced from the milk blends.

Yoghurt type	Sensory factor[1]				
	Appearance	Aroma	Taste	Consistency	Overall acceptability
YOGO-A	4.8 ± 0.1^{c}	4.7 ± 0.2^{c}	4.4 ± 0.2^{d}	4.4 ± 0.3^{d}	4.2 ± 0.3^{c}
YOGO-B	4.6 ± 0.2^{c}	4.9 ± 0.1^{c}	5.3 ± 0.2^{c}	4.6 ± 0.2^{d}	4.4 ± 0.2^{c}
YOGO-C	6.1 ± 0.1^{b}	6.1 ± 0.2^{b}	6.2 ± 0.2^{b}	5.8 ± 0.3^{c}	6.1 ± 0.1^{b}
YOGO-D	6.2 ± 0.2^{b}	6.5 ± 0.2^{b}	6.4 ± 0.1^{b}	6.2 ± 0.2^{c}	6.2 ± 0.1^{b}
YOGO-E	7.3 ± 0.2^{a}	7.4 ± 0.2^{a}	7.4 ± 0.2^{a}	7.2 ± 0.1^{b}	7.1 ± 0.01^{a}
YOGO-F	7.1 ± 0.1^{a}	7.6 ± 0.1^{a}	7.2 ± 0.1^{a}	7.8 ± 0.2^{a}	7.3 ± 0.2^{a}

[1]Mean values within the same column having the same letter are not significantly different at $P < 0.05$.

YOGO-A= (0% Cow milk; 20% Coconut milk; 60% Almond milk; and 20% Soymilk).
YOGO-B= (20% Cow milk; 20% Coconut milk; 40% Almond milk; and 20% Soymilk).
YOGO-C= (30% Cow milk; 20% Coconut milk; 30% Almond milk; and 20% Soymilk).
YOGO-D= (40% Cow milk; 20% Coconut milk; 20% Almond milk; and 20% Soymilk).
YOGO-E= (50% Cow milk; 20% Coconut milk; 10% Almond milk; and 20% Soymilk).
YOGO-F= (100% Cow milk alone).

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