FUW CENTRE FOR RESEARCH JOURNAL OF SCIENCE AND TECHNOLOGY (FUWCRJST)

Physico-Chemical Properties and Sensory Evaluation of Coconut Milk Enriched Yoghurt during Refrigerated Storage

***OBASI, B.C[1]., ULUOCHA, B. E.[2] & Shehu, Umar[2].**

[1]Department of Microbiology, Federal University Wukari, Taraba State, Nigeria.

[2]Department of Food Science and Technology, Federal University Wukari,Taraba State

*Corresponding author e-mail: blessed 200067@Yahoo.com

phone : +2347035852279

Abstract

Recent researches are shifting focus to diverse components in dairy foods, particularly fermented dairy products. The current study was conducted to investigate the physicochemical, and sensory properties of yoghurt enriched with coconut milk during refrigerated storage. The yoghurt were produced by blending reconstituted powdered cow milk (CM) 800g with 6 litres of water. The percentage of coconut milk added ranged from 10, 20, 30, and 40 percent and a control of 100 percent cow milk after fermentation. The samples were stored in the refrigerator for a period of 2 weeks. The result for physico-chemical parameters of pH for sample A-E ranged from 3.54 to 4.08 for week zero, 3.48 - 3.97, 3.45 - 3.96 for weeks 1 and 2 respectively. Titratable acidity ranged from 1.67 to 1.8 for week 0, week 1, 1.90 to 2.26 and week 2, 1.77 to 2.44. The yoghurt generally showed decrease in pH and increased in titratable acidity. Total solid ranged from 72.25 to 81.20 for week 0, week 1, 59.61 to 71.05, week 2, 53.40 to 64.13. The total solid content increased with the increase in the level of coconut milk and decreased with respect to storage period. From sensory evaluation all samples A-E significantly decreased during storage ($p>0.05$). However, sample C was the most preferred based on consistency, flavor, taste and general acceptability. The result obtained from this study, revealed that the consumer's access to health benefits of coconut milk can be facilitated thereby promoting well-being, and enhancing the nutritional value of yoghurt.

Keywords: Coconut milk, yogurt, nutritional enrichment, sensory evaluation, refrigerated storage

Introduction

The recent increase in the number of nutritious milk products offered by the global dairy industry is remarkable. This is partly due to the growing consumer interest in healthy eating. Yogurt is commonly associated with beneficial effects on human health, and hence there has been an increase in the consumption of yogurt globally (Bhagiel, *et al.,* 2015). Yogurt/fermented milk is a semi-solid acidified dairy product that was first introduced at the end of the 19th century (Abd El-khair, 2009). Yoghurt is a fermented dairy product obtained through an anaerobic fermentation of lactose in milk by relevant micro-organisms (Ahmad *et al*; 2013). The microbial fermentation process resulted in the production of acetaldehyde, diacetyl, lactic, and acetic acids, which are responsible for the characteristic flavour of yoghurts (Sanful 2009). Yoghurt, apart from being a probiotic carrier, is a rich and known source of quality protein, calcium, milk fat, potassium, magnesium, phosphorus, zinc, vitamins B2, B6, and B12 (*O*thman *et al.,* 2019). Today, in the production of most yogurt, pasteurized milk is fermented with a starter culture

containing lactic acid bacteria such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Kayode *et al*.,2017). These bacteria convert lactose to lactic acid through fermentation, and hence are responsible for the development of yogurt's characteristic body and texture, contribute to the overall flavor, and enhance preservation (Hamad, *et al*., 2013).

Moreover, its low lactose content (relative to milk) makes it easily digestible (Jeremia et.al.,2013). Yogurt improves gastrointestinal health and is, for instance, an effective remedy for diarrhea (Igbabul *et al*., 2014), lower cholesterol levels and to prevent the development of tumors (Obasi *et al*., 2022). In addition, yogurt also has high antimicrobial activity (Buchilina, 2021). The exact composition of the raw milk, the strains of bacteria used, and the manufacturing process are the main factors that affect the physical properties of yogurt, such as its color, flavor, aroma, and texture (Dello Shaffolo *et al*., 2014).

Nutritional value is readily added to yogurt by combining it with nutritious fruits, nuts or even vegetables. Typically, fruits such as strawberry, peach, apricot, mango, banana, or blueberry are added. Fruit yogurts are popular with consumers because of their flavor and other sensory properties (e.g. texture) but also their nutritional value (Adubofour *et al.*, 2014). The FAO and the WHO have recommended that yogurt products contain 5–15% fruit by weight (Eke, 2015). However, the development of high-protein yogurt is a worthwhile challenge (Ehirim and Onyeneke , 2013).

When developing a new product it is generally important to use locally sourced ingredients, as they are more likely to be appreciated (principally in terms of taste) by consumers ((Ehirim and Onyeneke , 2013.). Coconut (*Cocos nucifera L.),* a versatile fruit of the family *Arecaceae,* is an economically important fruit that is extensively cultivated and marketed worldwide. Coconut provides nutritious sources of meat juice, milk and oil. It is classified as a "functional food" because it provides many health benefits beyond its nutritional content, due to its fiber and oil content (Sanful, 2009). The oil is known to contribute to improved insulin secretion and the utilization of blood glucose; reduce symptoms associated with mal absorption syndrome and cystic fibrosis; help to relieve symptoms associated with crohn's disease; ulcerative colitis and stomach ulcers; improve the utilization of essential fatty acids and protect them from oxidation (Sanful , 2009).

Coconut milk is a nutritious food product consumed all over the world. (Narataruka et al. (2010) defined coconut milk as a sweet, milky white cooking base obtained, by mechanical extraction, from the endosperm of mature coconut, with addition of water. According to Yaakob et al. (2012), the nutritional content of coconut milk is superior to cow milk. Coconut milk has about 35% fat, 54% moisture and 11% solid non-fat (Fadela *et al*., 2009), and is equally rich in minerals and vitamins (Sanful, 2009a).

Recently, researchers have become interested in "functional" foods – foods of high nutritional value that promote good health (Ehirim and Onyeneke, 2013). The incorporation of coconut milk from coconut into a yogurt will enhance its nutritional value. Nonetheless, an understanding of the underlying needs, values, and insights of the

consumer is the key to product optimization, especially for functional foods. Grainy texture, a flavor that is too tart, sloppiness and syneresis are common problems in the manufacture of yogurt. The effects of different concentrations of coconut milk in a yogurt product on its physicochemical properties and sensory evaluation remain largely unexplored. Therefore, the present work aimed to develop a coconut milk yogurt as a nutritious and healthy food that meets the approval of consumers.

Materials and Methods

Materials

Raw Materials Procurement

The coconut fruit and commercial powdered full cream peak) milk was obtained from Wukari new market, Taraba state Nigeria. The Yogourmet freeze-dried starter culture containing *Streptococcus thermophillus* and *Lactobacillus delbrueckiisubsp. Bulgaricus* was purchased from a chemical supermarket in Aba, Abia state Nigeria.

Sample Preparation

Extraction and Preparation of Coconut Milk

The method as described by Sanful (2009b) was used with some modification. The coconuts were cracked open and the water poured and stored in a refrigerator. Two kilogram (2 kg) of coconut flesh was scrapped off of the brown skin. The meat was cut into smaller pieces to facilitate blending. The flesh was blended with the coconut water and 2 litres of water for 2 minutes. It was passed through a double folded cheese cloth of 0.25 mm mesh size to get the coconut milk and stored in a container in a refrigerator (4ºC). Fig 1.

Fig 1: Process flow diagram for Extraction of Coconut Milk

Coconut
↓
Deshelling
↓
Refrigeration (coconut water)
↓
Cutting
↓
Grating (addition of water)
↓
Sieving
↓
Homogenization (coconut water and coconut milk extracted)
↓
Coconut milk
↓
Packaging
↓
Refrigeration (4ºC)

Source: Sanful, 2009.

Re – reconstituted powdered milk

Eight hundred gram (800g) of powdered milk (peak) was homogenized with 6 liters of water to produce equivalence of fresh milk (Sanful, 2009).

Experimental Treatments

The yoghurt samples were prepared from blends of powdered milk and coconut milk and the sample was divided into four batches as stated below:

i. Sample A: 100 % powdered milk (500ml)
ii. Sample B: 90 % powdered milk (1350ml) and 10 % coconut milk (150ml)
iii. Sample C: 80 % powdered milk (1200ml) and 20% coconut milk (300ml)
iv. Sample D: 70 % powdered milk (1050ml) and 30% coconut milk (450ml)
v. Sample E: 80% powdered milk (900ml) and 40% coconut milk (600ml)

Making a total of 4500ml of powdered milk and 1500ml of coconut milk.

Preparation of Fresh Yoghurts

The method of Sanful (2009a) was used. To the reconstituted powdered milk, 50 g of sugar were added to the sample and mixed thoroughly to homogenize. The mixtures were heated separately and gradually in a water bath to 85 ˚C and maintained at this temperature for 30 minutes. The pasteurized milk blends were cooled to 42 ˚C and each was inoculated with 10 g of yoghurt culture (*S. theophrmillus* and *L. bulgaricus*) and incubated at 28 ± 2 ˚C for a period of 16 hours to produce fresh yoghurt. Different composition of the yogurt and coconut milk was blended and stored in the refrigerator for two weeks and analyses was carried out every week.

Fig 2: Flow Chart for Fresh Yoghurt Composite Preparation

Reconstituted powered cow Milk (CM)
↓
Dosing of ingredients (sugar)
↓
Pasteurization (85^0C, 30 minute)
↓
Cooling (42^0C)
↓
Inoculation (yoghurt culture)
↓
Incubation (16h, 45^0C)
↓
Fresh yoghurt
↓
Filling
↓
Blending of yoghurt with coconut milk
↓
Refrigeration storage (4^0C)

Source: (Sanful, 2009a).

Physicochemical Analyses

Determination of pH : The pH value was determined by the direct reading with digital pH meter, a Seven Easy Mettler Toledo pH meter that had been calibrated with a buffer solution at pH 7.0 and 4.0 (Mettler Toledo, Switzerland).

Determination of Moisture Content

The moisture content of the samples was determined according to the standard methods of

Association of Official Analytical Chemists (AOAC, 2005). Two grams of the sample was weighed into the crucible and dried in a hot air oven for 24h at 100 ˚C until a constant weight was obtained. The lost in weight was determined and recorded as the moisture content and expressed as; % moisture content $\frac{(W2 - W3) \times 100}{(W2 - W1)}$

Where W1 = initial weight of empty crucible

W2 = weight of crucible + weight of sample before drying.

W3 = weight of dish + weight of sample after drying.

Determination of Total Solids

Ten milliliters of each of sample was weighed into a crucible and dried at 70^{o}C for 2 hours in a vacuum oven (AOAC, 2005). The Total Solid of the sample is the weight of the dried sample residue and was calculated as:

$$\% \text{ Total Solid} = \frac{(W3 - W1) \times 100}{(W2 - W1)}$$

Where :

W1 = weight of crucible

W2 = weight of sample + crucible before drying

W3 = weight of sample + crucible after drying

Determination of Total Titratable Acidity

Titratable acidity in terms of the % of lactic acid was measured according to (Hamad *et al*. 2017).Two gram (2.0 g) of the sample was dissolved in a beaker containing 10 mL of distilled water and three drops of 0.5% phenolphthalein were added. The mixture was titrated against 0.1 N NaOH until the solution turned pink. The amount of NaOH used was recorded and the total titratable acidity calculated as % lactic acid.

$$\text{Titratable acidity (\% lactic acid)} = \frac{\text{titre value} \times 0.009 \times 100}{\text{Weight of sample}}$$

Sensory Evaluation

The sensory quality parameters, for the six (6) yoghurt samples were evaluated by 20 member panelists on a 9 point hedonic scale for different parameters such as color, aroma, taste, consistency/texture and overall acceptability as described by Ranganna (2000).

Statistical Analysis

All analysis were conducted in duplicate. All the data obtained were subjected to one way analysis of variance (ANOVA) and the difference among the means were determined using the Duncan multiple range test ($p<0.05$). Data analysis were carried out using the Statistical Package for Social Sciences (SPSS) Version 20.0 and the results was presented as mean with standard deviation.

Results and Discussion

Physico-Chemical Properties of Yoghurt Enriched with Coconut Milk

The result for physiochemical parameters of pH for sample A-E ranged from 3.54 to 4.08 for week 0, week 1, 3.48 to 3.97, week 2, 3.45 to 3.96 respectively. The pH values of the yoghurt samples decreased with a significant difference ($p<0.05$), with respect to storage period ranging from 3.54 – 3.45, 4.05 – 3.3, 2.8 – 3.91, 4.07 – 3.95. The result obtain where slightly similar to that obtained by (Ndife, 2014). Lactic acid bacteria produces lactic acid during fermentation of milk-lactose, thus lowering the pH of yoghurt (Eke *et al* ., 2013). Food standard code requires that the pH of yoghurt be a maximum of 4.50 in order to prevent the growth of any pathogenic organisms (Donkor *et al*., 2006).

The titratable acidity of the sample A-E ranged from 1.67 to 1.89 for week 0, week 1 ranged from 1.90 to 2.26 and week 2 ranged from 1.77 to 2.44. The yoghurt generally has decrease in pH and increase in titratable acidity, the relationship between these two parameters have been observed by earlier researcher (Kayode *et al*., 2017). The samples from A-E also show increase with respect to storage period ranging from 1.89 – 1.9, 1.81 – 2.44, 1.77 – 2.17, 1.63 – 2.05, and 1.67 – 2.40 respectively. Estevez *et al*, (2010) reported that high total solids leads to more acid production. The values obtained from pH and titratable acidity indicated that the yoghurts were acidic. Akoma *et al.,* (2006) attributed such acidity by some species of lactic acid bacteria during the fermentation process.

The total solid of the yoghurt sample A-E ranged from 72.25 to 81.26 for week 0, week 1, 59.61 to 71.02 and week 2, 53.64 to 64.13. Sample A-E decreased with a significant different ($p<0.05$) ranging from 72.25 – 61.99, 72.79 – 53.69, 81.26 – 60.75, 74.89 – 64.13, with respect to storage time. The total solid of the yoghurt samples increased with the increase in the level of coconut milk and decreased with respect to storage period. The result is however compared to the findings of Ndife *et al*., (2014) and Belewu *et al*., (2010) but with high values. The significant decrease in total solid with respect to storage time could be due to syneresis, that is, oozing out of whey which contains whey proteins, lactose and minerals (Selvamuthukumran and Farhath 2014). The total solid are an indication of the dry matter content of the yoghurt sample (Belewu et al 2010; Khalifa *et al*., 2011), sample C with 30% enrichment has the highest soluble solid content (81.26) at week zero, this can be mainly attributed to the contribution of monosaccharide sugar from coconut copra and the milk and are responsible for their sweet taste (Sanful, 2009b; Belewu *et al*., 2010).High total solids of the milk base has

been reported to improve growth of yoghurt bacteria, decreasing fermentation time and decreasing pH or increasing acidity (Yeganehzad *et al*., 2007).

The moisture content of sample A-E ranges from 83.75 to 85.00 for week 0, 82.75 to 86.50 for week 1, 83.75 to 86.75 for week 2. The result was slightly higher and similar to the range of values reported by Ndife et al., (2014). The moisture content of this sample also increases in respect to storage time ranging from 84.00 to 84.50 for sample B, 84.00 to 86.75 for sample D and 83.75 to 86.25 for sample E and shows a significant different ($p<0.05$). The higher the moisture content obtained from yoghurt samples of this study could be attributed to the higher moisture and lower dry matter content of coconut milk. The result also revealed that as the percentage of coconut milk increased in the blend, moisture content also increased. However, Izadi *et al*., (2014) reported that the viscosity may increase over time leading to lower moisture content due to rearrangement of protein and contact.

Table: 3.1.1 Effect of Coconut milk on the pH Content of Yoghurt at Refrigeration Storage

Storage Period (Weeks)	Sample A	Sample B	Sample C	Sample D	Sample E
0	3.54 ± 0.021^{d}	4.05 ± 0.007^{b}	3.98 ± 0.007^{c}	4.07 ± 0.007^{ab}	4.08 ± 0.14^{a}
1	3.48 ± 0.007^{d}	3.97 ± 0.007^{a}	3.87 ± 0.014^{c}	3.96 ± 0.014^{ab}	3.94 ± 0.007^{b}
2	3.45 ± 0.007^{c}	3.93 ± 0.014^{ab}	3.91 ± 0.014^{b}	3.95 ± 0.007^{a}	3.96 ± 0.007^{a}

Mean ± Standard Deviation of duplicate readings. Means in column with different superscript alphabet are significantly different ($p<0.05$)Sample A; control, yoghurt without coconut milk, sample B, C, D, and E; yoghurt with 10%, 20%, 30%, 40% coconut milk.

Table: 3.1.2 Effect of Coconut milk on Total Titratable Acidity of Yoghurt at Refrigeration Storage

Storage Period (Weeks)	Sample A	Sample B	Sample C	Sample D	Sample E
Zero(0)	1.89 ± 0.007^{a}	1.81 ± 0.014^{b}	1.77 ± 0.007^{c}	1.63 ± 0.007^{e}	1.67 ± 0.007^{d}
1	1.99 ± 0.007^{d}	2.06 ± 0.007^{c}	2.26 ± 0.014^{a}	2.17 ± 0.014^{b}	1.90 ± 0.007^{e}
2	1.77 ± 0.007^{e}	2.44 ± 0.014^{a}	2.17 ± 0.007^{c}	2.08 ± 0.014^{d}	2.40 ± 0.014^{b}

Mean ± Standard Deviation of duplicate readings. Means in column with different superscript alphabet are significantly different ($p<0.05$)Sample A; control, yoghurt without coconut milk, sample B, C, D, and E; yoghurt with 10%, 20%, 30%, 40% coconut milk.

Table: 3.1.3 Effect of Coconut on Total Solid of Yoghurt at Refrigeration Storage

Storage Period (Weeks)	Sample A	Sample B	Sample C	Sample D	Sample E
Zero(0)	72.25 ± 0.354^{e}	72.79 ± 0.262^{d}	76.71 ± 0.007^{b}	81.26 ± 0.014^{a}	74.89 ± 0.007^{c}
1	62.42 ± 0.028^{c}	60.59 ± 0.014^{d}	59.61 ± 0.014^{e}	64.41 ± 0.014^{b}	71.05 ± 0.071^{a}
2	61.99 ± 0.007^{b}	53.69 ± 0.007^{d}	53.40 ± 0.007^{e}	60.75 ± 0.007^{c}	64.13 ± 0.014^{a}

Mean ± Standard Deviation of duplicate readings. Means in column with different superscript alphabet are significantly different ($p<0.05$)Sample A; control, yoghurt without coconut milk, sample B, C, D, and E; yoghurt with 10%, 20%, 30%, 40% coconut milk.

Table: 3.1.4 Effect of Coconut on the Moisture Content of Yoghurt at Refrigeration Storage

Storage Period (Weeks)	Sample A	Sample B	Sample C	Sample D	Sample E
Zero(0)	84.75 ± 0.3536^{ab}	84.00 ± 0.7071^{ab}	85.00 ± 0.0000^{a}	84.00 ± 0.0000^{ab}	83.75 ± 0.3536^{b}
1	82.75 ± 0.3536^{c}	84.25 ± 0.3536^{b}	84.75 ± 0.3536^{b}	84.50 ± 0.0000^{b}	86.50 ± 0.7071^{a}
2	83.75 ± 1.0607^{b}	84.50 ± 0.0000^{b}	84.75 ± 0.3536^{b}	86.75 ± 0.3536^{a}	86.25 ± 0.3536^{a}

Mean ± Standard Deviation of duplicate readings. Means in column with different superscript alphabet are significantly different ($p<0.05$)Sample A; control, yoghurt without coconut milk, sample B, C, D, and E; yoghurt with 10%, 20%, 30%, 40% coconut milk.

Sensory Evaluation of Yoghurt Enriched with Coconut milk at Refrigeration Storage

Temperature (4ºc)

The result from the sensory evaluation of sample from plain yoghurt and that enriched with coconut milk which was compared to show that all the sensory attributes tested were constantly reduced during storage. This could be as a result of chemical changes and fermentation of the yoghurt thereby altering its preferences. The acceptance in terms of overall acceptability, flavor, and taste significantly changed with storage time, for all the sensory attributes. Addition of coconut milk produced significant effect on color. The result also revealed that sample C and D in the zero and first week were the most preferred on consistency, flavor, taste, and generally accepted when compared with other samples. The lower the organoleptic properties of yoghurt, with addition of coconut may be attributed to many factors including higher level of polyunsaturated fatty acids, difficulty of fat hydrolysis during fermentation and poor protein content (Isam *et al*.,

2011). The mouth feel of yoghurt is directly related to texture and consistency DelloStaffolo *et a*l., (2014).

Table 3.2.1: Effect of Coconut Milk on Sensory Analyses of Yoghurt Stored In Refrigeration Temperature(4^0 C)

Yoghurt Sample/ Storage Period (weeks)	Color	Appearance	Taste	Aroma	General acceptability
A_0	7.70 ± 1.780^{ab}	7.65 ± 1.182^{ab}	7.00 ± 1.919^{a}	7.60 ± 1.789^{a}	7.50 ± 1.147^{a}
A_1	6.50 ± 1.573^{b}	6.70 ± 0.923^{b}	6.50 ± 1.000^{a}	6.40 ± 1.095^{a}	6.55 ± 0.945^{a}
A_2	7.50 ± 0.889^{ab}	6.35 ± 1.182^{bc}	4.55 ± 1.538^{b}	5.60 ± 1.465^{ab}	5.65 ± 1.785^{ab}
B_0	7.55 ± 1.701^{b}	7.15 ± 1.531^{b}	6.85 ± 1.226^{a}	7.15 ± 1.268^{a}	6.95 ± 1.791^{a}
B_1	7.55 ± 1.050^{a}	6.90 ± 0.852^{ab}	6.85 ± 1.631^{a}	6.85 ± 1.089^{a}	7.15 ± 1.182^{a}
B_2	7.80 ± 0.616^{a}	6.65 ± 0.813^{b}	3.90 ± 1.586^{b}	5.40 ± 1.095^{ab}	4.80 ± 1.795^{b}
C_0	8.20 ± 0.834^{ab}	8.20 ± 0.768^{a}	7.15 ± 1.599^{a}	7.75 ± 0.910^{a}	7.70 ± 0.979^{a}
C_1	7.75 ± 1.070^{a}	6.95 ± 1.605^{ab}	6.95 ± 2.064^{a}	7.25 ± 1.803^{a}	7.25 ± 1.713^{a}
C_2	7.90 ± 0.553^{a}	7.40 ± 0.754^{a}	5.70 ± 1.455^{a}	6.25 ± 1.118^{a}	6.25 ± 1.860^{a}
D_0	8.50 ± 0.513^{a}	7.60 ± 1.142^{ab}	7.50 ± 0.889^{a}	$7.30 \pm 1.031a$	7.45 ± 0.945^{a}
D_1	7.65 ± 0.933^{a}	7.70 ± 1.031^{a}	6.90 ± 1.334^{a}	7.30 ± 1.261^{a}	7.10 ± 1.119^{a}
D_2	7.15 ± 1.089^{b}	6.10 ± 1.410^{bc}	4.60 ± 1.536^{b}	$5.00 \pm 2.026b$	4.75 ± 1.552^{b}
E_0	8.05 ± 1.317^{ab}	8.10 ± 0.912^{a}	6.85 ± 1.872^{a}	6.80 ± 2.191^{a}	5.95 ± 2.282^{b}
E_1	7.05 ± 1.317^{ab}	7.10 ± 1.294^{ab}	6.45 ± 2.114^{a}	6.75 ± 1.293^{a}	6.35 ± 1.694^{a}
E_2	7.10 ± 1.334^{b}	5.80 ± 1.361^{c}	4.60 ± 1.698^{b}	5.10 ± 1.619^{b}	5.30 ± 1.380^{ab}

Values are mean ± standard deviation. Means in column with different superscript alphabet are significantly different ($p<0.05$)

Conclusion

This study showed that delicious and acceptable yoghurts could be produced from powdered cow milk and coconut milk, which could be advantageous, especially to people who are moderately lactose intolerant and those in resource poor setting. The result obtained indicates that yoghurt with 20% coconut milk and 80% powered cow milk was rated best in all attributes based on sensory evaluation. The product at refrigerated condition had increased shelf life. The coconut enriched yoghurt was more nutritious than the commercial yoghurt. The syneresis was not affected by enrichment of coconut milk in yoghurt.

Disclosure of Conflict of Interest

No conflict of interest to disclosure**.**

REFERENCES

Abd El-khair, A.A., (2009).Production and evaluation of a high protein version of non-fat yogurt. *Research Journal of Agriculture and Biological Sciences, 5(4): 310-316.41*

Adubofour, J., Dzibordi, B. and Wireku-Manu, F.D.(2014). Comparative Studies on the Qualities of Seven Brands of Vanilla-flavoured Stirred Yoghurt Produced within the Kumasi Metropolis of Ghana. International Food Research Journal. 21: 1243 – 1248.

Ahmad I, M Gulzar, F Shahzad, M Yaqub, T Zhoor (2013). Quality assessment of yoghurt produced at large (industrial) and small scale. *The Journal of Animal and Plant Sciences,* 23(1 Suppl.); 58-61.

Akoma O., Jiya E.A., Akumka D.D., and Mshelia, E (2006). Influence of malting on the nutritional characteristics of kunuzaki. *African journal of Biotechnology, 5(10).*

AOAC. (2005).Association of Official Agricultural Chemists. "Official Methods of Analysis. " (18th Ed.). Washington DC.

Belewu, M.A., Belewu, K.Y., Bamidele, R.A. (2010): Cyper-coconut yoghurt: preparation, compositional and organoleptic qualities. *Afr. J. Food Sci. Technol. 1(1), 010-012.41*

Bhagiel, I., Mustafa, E.A., Tabidi M.M., and Ahmed M.E.,(2015). Comparison between the physicochemical attributes of yogurt processed from camel milk and that processed from cow mlk and the effect of storage period on pH and acidity. World J. Pharmacy and pharmaceutical science.

Buchilina A.K. (2021) Physicochemical and microbiological characteristics of camel milk yogurt as influenced by monk fruit sweet J, Dairy Sci 104:1484–1493. https:// doi. org/ 10. 3168/ jds. 2020- 18842

Dello Shaffolo M, Bertola N, Martino M, Bevilacqua A.(2014). Influence of Dietary Fiber Addition on Sensory and Rheological Properties of Yoghurt. International Dairy Journal. 14: 263- 8.

Donkor, N.O., Henriksson, A., Vasiljevic, T., Shah, N. (2006): Effect of acidification on the activity of probiotics in yoghurt during cold storage. Int. *Dairy J. 16, 1181±1189. https://dx.doi.org/10.1016/j.idairyj.2005.10.008.41*

Edem, V. E. and Elijah, A. I. (2016 a).Development of starter culture for the production of coconut yoghurt.Annals. *Food Science and Technology, 17(1), 41-49*..

Ehirim F.N, and Onyeneke E.N. (2013). Physicochemical and organoleptic properties of yoghurt manufactured with Cow milk and Goat milk. Natural and Applied Sci. 4(4).

Eke, M.O, Olaitan, N.I and Sule, H.I (2013). Nutritional evaluation of yoghurt-like product from baobab (Adansoniadigitata) fruit pulp emulsion and the micronutrient content of baobab leaves. *Advance Journal of Food Science and Technology, 5(10): 1266-1270.*

Estevez, A, Mejía J, Figuerola F and Escobar B (2010). Effect of solid content and sugar combinations on the quality of soymilk-based yogurt. *Journal of Food Processing and Preservation, 34: 87–97.*

Fadela, C, Abderrahim C, and Ahmed, B..(2009). Sensory and physicochemical characteristic of yoghurt manufactured with Ewes and skim milk. World J. dairy and Food Sci. 4(2): Idosi publications Pp 136-140.

Gilbert, A, Turgeon S.L. (2021) Studying stirred yogurt microstructure and its correlation to physical properties: a review. Food Hydrocoll 121:106. https:// doi. org/ 10. 1016/j. foodh yd. 2021. 106970

Hamad, M.F., Ismail, M.M., Elraghy, E.M. (2017): Impact of addition of tamrine and honey on chemical composition, starter activity and rheological characteristics of goat's milk. *World J. Food Sci. Bergey's manual of systematic bacteriology (3) vol 2.*

Isam, A. M. A. D., Eissa, A. E., Yogoub, A. E. A. and Babiker, E. E. (2011). Physiochemical, microbiological and sensory characteristics of yoghurt produced form camel milk during storage. Electronic Journal of Environmental*, Agricultural and Food Chemistry. 10(6): 2305-2313.*

Izadi, Z., Nasirpour, A., Garoosi, G.A and Tamjidi, F 2014. Rheological and physical properties of yoghurt enriched with phytosterol during storage *(J.food science and technology) 52(8): 5341-5346.*

Igbabul B., Shember J. and Amove J.(2014). Physicochemical, microbiological and sensory evaluation of yoghurt sold in Makurdi metropolis. Afr. J. Food Sci. Technol. 5(6):129-135.

Jeremia N.M, Afam I.O, Jideani (2013). The physicochemical and sensory evaluation of commercial sour milk (*amasi)* products. African J. Food science 7(4) Pp 56-62

Kayode, R.M., Joseph, J.K., Adegunwa, M.O., Dauda, A.O., Akeem, S.A., Kayode, B.I.

Babayeju A.A., Olabanji, S.O. (2017): Effects of addition of different spices on the quality attributes of tiger-nut milk (kunun-aya) during storage. *J. Microbiol. Biotechnol. Food Sci. 7 (1), 1-6. https://dx.doi.org/10.15414/jmbfs.2017.7.1.1-6. 42*

Khalifa, M.E.A., Elgasim, A.E., Zaghloul, A.H., Maufouz, M.B. (2011): Application of inulin and mucilage as stabilizers in yoghurt production. *Am. J. Food Technol. 6 (1), 31-39. https://dx.doi.org/10.3923/ajft.2011.31.39. 42*

Narataruka, P., Pichitvittaykarn, W., Heggs, P. and Tia, S. (2010). Fouling behaviour of coconut milk at pasteurization temperature. *Journal of Applied Thermal Engineering, 30, 1387-1395.*

Ndife, J., Idoko, F., Garba, R. (2014): Production and quality assessment of functional yoghurt enriched with coconut. *Int. J. Nutr. Food Sci. 3 (6), 545 550.https://dx.doi.org/10.11648/j.ijnfs.20140306.19. 42*

Obasi B.C ., Popoola C.A, Yakubu M.N , Okpasu A.A and Yusuf M.N (2022). Assessment of the quality of different brands of commercial yoghurt sold in Wukari Metropolis, Taraba State-Nigeria. Open Access Research Journal of Life Sciences, 03(01), 039–045

Othman, N., Hazren, A. Hamid and , Suleiman, N. (2019). Physicochemical properties and sensory evaluation of yogurt nutritionally enriched with papaya. *Food Research 3* (6) : 791 - 797

Ranganna, S. (2000). "Handbook of Analysis and Quality Control for Fruit and Vegetable Products." (2nd ed.). *TaTa McGraw-Hill Publishing Co. Ltd. New Dehli.*

Sanful, R.E., (2009a).Promotion of Coconut in the Production of Yoghurt.*African Journal of Food Science 3 (5): 147-149.*

Sanful, R.E., (2009b).The Use of Tiger-Nut (Cyperusesculentus), Cow Milk and Their Composite as Substrates for Yoghurt Production.*Pakistan Journal of Nutrition 8 (6): 755-758.*

Selvamuthukumran,M and Farhath K (2014).Evaluation of shelf stability of antioxidant rich fruit yogurt. *International food research journal, 21(2) 759-765.*

Yaakob, H., Ahmed, N. R. Daud, S. K., Malek, R. A. and Rahman, R. A. (2012). Optimization of ingredient and processing levels for the production of coconut yoghurt using Response Surface Methodology. *Journal of Food Science and Biotechnology, 21(4), 933 – 940.*

Yeganehzad, S., Mazaheri-Tehrani, M. and Shahidi, F., (2007). Studying microbial, physiochemical and sensory properties of directly concentrated probiotic yoghurt. *African Journal of Agricultural Research, 2 (8): 366-36943*