

# Fermented Milk Products from Different Milk Types

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## Abstract

Yogurt was produced from milk obtained from cow milk, goat milk, soymilk and coconut milk by fermentation using starter cultures of *Lactobacillus bulgaricus* and *Lactobacillus acidophilus*. The results obtained showed that the initial pH of the fresh milk samples were slightly acidic: cow milk (6.3), goat milk (6.2), soymilk (6.4) and coconut milk (6.0). The pH results of the various fermented milk at 0 hour of production were goat milk (5.24), cow milk (5.85), soymilk (5.73) and coconut milk (5.98), but at 72 hours, all the milk samples tended to be more acidic due to the fermentation and had lower pH values. All the fresh milk samples had the high moisture content which ranged from 63.34% - 76.90%. Fat content ranged between 9.76% - 15.02%. Crude protein ranged from 7.17% - 32.17% with goat milk having the highest protein level of (32.17%). Ash content had the range of 0.52% - 0.96%. Goat milk had the highest ash content value and coconut milk had the least value. Specific gravities of soymilk, goat milk, cow milk and coconut milk were 1.018, 1.030, 1.016 and 1.01 g/ml respectively. Taste, color, mouth feel and odor were acceptable at 0 hours of production but their value depreciated with storage at room temperature. This study was able to establish the close nutritional gap between cow milk, goat milk, soya and coconut milk yoghurt preparations. The nutritional values obtained from the proximate analysis of the milk samples were comparable. This clearly points to the fact that either of the food can substitute for each other based on the values established from this study.

## Keywords

Yoghurt, Milk, *Lactobacillus bulgaricus* and *Lactobacillus acidophilus*

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## 1. Introduction

Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of nutrition for

young mammals before they are able to digest other types of food. Early-lactation milk contains colostrum, which carries the mother's antibodies to the baby and can reduce the risk of many diseases in the baby [1]. The major chemical components of milk include water, fats, proteins, carbohydrates, minerals, organic acids, enzymes and vitamins [2]. Several legume-based milk and milk products have been developed in attempts to extend the supply of milk-like products, especially in areas where milk is in short supply. Since legumes are important sources of relatively inexpensive protein, introduction of imitation milk products from legumes may contribute to the alleviation of protein malnutrition [3]. Traditionally, yogurt is fermented whole milk and is believed to possess nutritional and therapeutic properties [4] [5]. Lactic acid fermentation of legume based milks has been used as one of the approaches to prolong the shelf life of the products, create variety, improve the nutritional value and as well enhance the acceptability of the product. Yogurt-like products have been prepared by some workers from soybean [6], cowpeas, coconut and mug beans [3].

This study is aimed at conducting a proximate analysis of the samples, to determine the yielding strength of each milk in yogurt production, taking pH and sensory evaluation as marker for their yields studying the possibility of using the milk derived from coconut, soybeans, goat and cow as a yogurt-like product

## 2. Materials and Methodology

### 2.1. Collection of Milk Samples

Fresh Cow milk was obtained from the nomadic cattle herdsman at Ijaiye, Southwestern Nigeria. The goat milk was obtained from Akesan farm house in Oyo town, Southwestern Nigeria. The collected samples were stored in sterile 2 liter containers. The samples after collection were kept in an ice-frozen container and immediately transported to the laboratory and kept in the refrigerator at 4°C until it was ready for use. Soya beans and coconut were purchased locally from Orita-challenge market in Ibadan, and kept at ambient temperature prior to usage. The soya beans and coconut were subsequently taken for identification at the Agronomy department, University of Ibadan. They were identified as *Glycine max* and *Cocos nucifera* L. respectively.

#### 2.1.1. Soymilk Preparation

Soya beans was sorted to remove stones and damaged, deformed seeds. 300 g of soya beans was soaked in 2 litres of warm water for 6 hours to remove the skin and to make it easier for grinding. The beans were drained, rinsed with potable water and grinded with about 500 ml of water in a eurosonic auto-clean blender. The resulting slurry was filtered through a muslin cloth and the extract obtained was boiled for 25 minutes. The milk was allowed to cool, and refrigerated [6].

#### 2.1.2. Coconut Milk Preparation

Coconut milk was prepared by breaking the shells and taking the nuts by using a dull knife. The weight of the coconut was 306.3 g. The brown skin was removed from the nuts with a knife and the nuts were thoroughly washed. The nuts were blended with 200 ml warm water and allowed to stand for 20 minutes. The extract was passed through 0.18 mm sieve while the residue was discarded [7]. The milk obtained was eventually refrigerated.

#### 2.1.3. Starter Culture

*Lactobacillus bulgaricus* and *Lactobacillus acidophilus* were purchased locally from the market in Ibadan, Southwestern Nigeria.

## 2.2. Chemical and Proximate Analysis

The pH value was determined immediately after production, 24 hours and 72 hours respectively. The moisture content was determined by placing 10 g of the different samples in an oven maintained at 105°C for 6 hours. Total ash was determined by heating in a muffle furnace at 630°C for 3 hours. Protein content was determined through Kjeldahl analysis using block digestion and steam distillation. Determination of ether extract was carried out using Soxhlet apparatus.

## 2.3. Processing of Experimental Yogurts

Fresh goat milk, cow milk, soymilk and coconut milk samples were separately processed into yogurt (fermented

milk using the starter culture). Fresh milk was preheated to about 45°C and filtered. 15 g of sugar was added and mixed to each milk sample. Milk samples were pasteurized at 95°C and held for 30 minutes, and then it was cooled to inoculation temperature of 45°C in closed vessel and in a bath of cold water. 2.5 g of starter culture and 2 ml food flavour were added and mixed. This was incubated at 45°C for 3 hours to coagulate [8]. After coagulation, it was stored in a bath of cold water overnight. Pasteurization is believed to modify milk protein so as to enhance proper viscosity and gelatinization of the product [4]. And this could account for the uniformity and smoothness in body texture in all products as observed in this study resulting to these sensory quality attributes (texture and mouth feel) not being significantly different.

The products were then ready for analysis and sensory evaluation. This procedure was done for all the four (4) milk samples and the control (Dano skimmed milk).

All the yogurt-like samples were subjected to sensory assessment by people that are familiar with the quality attributes of these yogurt products. Clean cups were provided for each sample; each panelist was requested to taste the samples one after the other and to indicate their degree of likeness or preference. The samples were evaluated for taste, sweetness, texture and odor. The panelist were asked to rate the samples for appearance, flavour, texture, aroma. The ratings were scored from a Hedonic scale ranging from 1.0 - 5.0.

Keys:

5.0 = Very Good.

4.9 - 4.0 = Good.

3.9 - 3.0 = Fair.

2.9 - 2.0 = Poor.

1.9 - 1.0 = Bad.

### Statistical Analysis

The results obtained were subjected to analysis of variance (ANOVA). Mean comparison were carried out among the 4 yogurt-like products by Statistical Programs for Social Sciences (SPSS, 1992).

## 3. Result and Discussion

**Table 1** shows the proximate composition of the different milk samples. The ash content ranged between 0.5 and 0.96%. The ash content is a reflection of the mineral compositions of the milk samples and is quite comparable. This was an indication that all the samples investigated had micronutrients. However it is apparent that the value of goat milk (0.96%) was higher than the other milk samples [9]. The ash content which was highest in goat milk and lowest in coconut milk could be due to the salt lick activities done by the herbivores [10]. All the samples had high moisture contents which ranged between 63.34% - 76.90%. The moisture content of cow milk was the highest with 76.90% followed by that of goat milk, then coconut milk and soymilk. This could affect the stability and safety of food with respect to microbial growth and proliferation hence the products will require cold storage.

The moisture content of the milk samples studied was in conformity [11]. The significance of moisture content in milk is that, high moisture content implies high water activity which supports microbial growth consequently reducing the shelf life of the milk sample [12]. The pH value showed that soymilk was the least acidic of the milk samples and will be suitable for ulcer. Soymilk is regarded as a stimulant and tonic and it can be used in

**Table 1.** Proximate composition of the different milk samples.

Parameters	Cow Milk	Goat Milk	Soy Milk	Coconut Milk
% Ash	0.71	0.96	0.57	0.52
% Moisture	76.90	73.00	63.34	65.00
pH Values	6.3	6.2	6.4	6.0
% Fat	9.76	14.84	14.44	15.02
% Crude Protein	27.97	32.17	12.59	7.17
Specific Gravity	1.018	1.030	1.016	1.010

the treatment of indigestion, colic diarrhea and dysentery [13]. pH values of prepared yoghurts are near neutrality [14] [15]. The fat content of the milk samples ranged from 9.76% - 15.02%. The major contrast in the food proximate content was the values obtained for the fat contents. From previous studies, fat contents are usually higher in animal origin than plant origin. The findings in this study disagree with earlier studies because coconut milk was the richest in fat with 15.02%, followed by goat milk with 14.84%. Soymilk had a fat content of 14.44% and cow milk had the least value with 9.76% [16]. Fat content of food is the major contributor to the energy value of food. This implies that coconut milk and goat milk are more energy yielding than soya and cow milk. This is because of low risk of dietary cholesterol. Fats of animal origin like goat rather than plant usually contain some high saturated fatty acid implicated for raising blood cholesterol [17]. The presence of high levels of cholesterol in the bloodstream may form some fatty deposits in the artery which is a serious marker for atherosclerosis and it can form plaques which can cause obstruction in the blood stream. These deposits may slow or block the flow of blood through the body and possibly causing heart attack or stroke. The total energy value of the milk is from the fat content hence, higher fat content is an indication of more total energy available. High fat content of coconut milk and soymilk further enhances their utilization for the extraction of edible oil thereby enhancing their nutrient densities as well as boosting their value as alternative feed supplement in human and livestock diets. The protein content of the milk samples ranged from 7.17% - 32.17%. Goat milk had the highest protein level of 32.17% followed by cow milk with 27.97% then soy milk and coconut milk had 12.59% and 7.17%. The protein content is in agreement with the work of Henry *et al.* [11]. Although, most authors recorded a very low value for the crude protein [11], it is believed that this might be due to the fact that the milk samples that were analyzed by most of these authors are dry milk sample. The high protein content of this product showed that its consumption will help eliminate protein deficiencies that have become the bane of poor nations. Lactation could be responsible for the high protein content seen in the milk samples of goat and cow milk respectively. Soymilk also contain appreciable amount of protein sufficient for body growth and development. Milk protein is considered complete proteins because it contains all of the essential amino acids our bodies need. Plant proteins, found in soy beans and coconut lacked one or more of the essential amino acids. However, plant proteins can be combined in the diet to provide all of the essential amino acids. Marasmus and kwashiorkor, both life-threatening conditions, are the two most common forms of protein malnutrition. Some health conditions, such as illness, stress, pregnancy and breast-feeding in women, place an enormous demand on the body as it builds tissue or fights infection, and these conditions require an increase in protein consumption. For example, the digestive system breaks protein down into amino acids which may enhance tissue growth and repair to remedy whatever damage occur to body. Dietary proteins are powerful compounds that build and repair body tissues, from hair and fingernails to muscles. In addition to maintaining the body's structure, proteins speed up chemical reactions in the body, serve as chemical messengers, fight infection, and transport oxygen from the lungs to the body's tissues. Proteins are made of smaller units called amino acids. Specific gravity is basically done to determine the volume equivalent to 1 g of each milk samples so as to establish the volume corresponding to mass required when subjected to proximate analysis. The specific gravity for soymilk was 1.018 g/ml, goat milk had a specific gravity of 1.03 g/ml, cow milk had 1.016 g/ml and coconut milk had 1.01 g/ml.

Yogurt is a fermented milk product whose typical flavour (sour taste) is attributable to the production of lactic acids, acetaldehyde, acetic acid and diacetyl from carbohydrate by the fermenting organisms [18].

The lactose (as added) probably influenced the sugar content of all the products. Furthermore, coagulation of milk became evident 4 hours following fermentation as it was seen that the pH of the milk products dropped which signified that they tend to be more acidic [7] [19]. The shelf life and the gradual decrease in the pH of fermenting milk samples (goat milk, cow milk, soy milk and coconut milk) during yogurt production over a 72 hours period is shown in **Table 2**.

**Table 3** reveals the mean scores for acceptability of all the milk samples.

The skimmed milk served as the control. It was noticed that the shelf life of the milk yogurt samples derived from plant origin (soy and coconut) was less than 72 hours. The shelf life reported for the cow and goat milk was around 27 - 30 hours although the shelf life of the milk produced at room temperature was 24 hours, this is the average shelf life reported generally for most milk and milk-based products.

Keys: 5.0 = Very Good; 4.9 - 4.0 = Good; 3.9 - 3.0 = Fair; 2.9 - 2.0 = Poor; 1.9 - 1.0 = Bad.

This is probably the reason why several workers are exploring the use of chemical preservatives for prolonging the shelf life of milk products [20] [21]. Remarkable mouth feel, odour, colour, appearance and overall acceptability were recorded for all the milk samples. Soymilk and coconut milk were highly acceptable by the pa-

nelists at 0 hours of production of the yogurt but the mean scores for the aroma and visual appearance/colour of the yogurts decreased with storage time and so were the yogurts produced from cow and goat milk. One way Anova test of homogeneity shows no significant difference for general sensory evaluation of the milk samples at 5% confidence level as shown in **Figure 1**.

#### 4. Conclusion and Recommendation

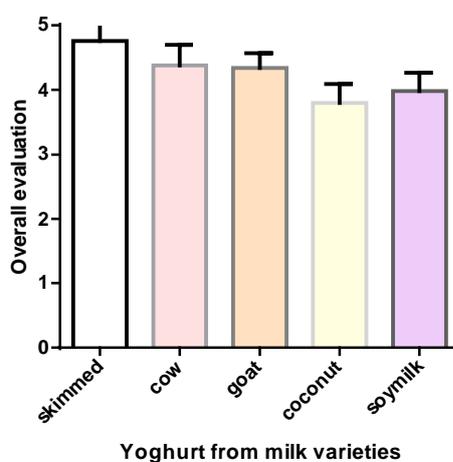
The result revealed that milk prepared from coconut and soybean could be used as a beverage for both the young and old due to the high fat and protein contents. Based on the sensory evaluation, the soy milk and coconut milk were also acceptable. This indicates that utilization of soymilk and coconut milk may be enhanced when processed into beverage drinks. It is therefore suggested that milk from coconut and soya beans be encouraged so as to solve the problem of protein-calorie malnutrition in Africa in particular and the world in general. The nutritional values derived from proximate analysis of the milk samples are comparable. This clearly shows that either of the food can substitute for each other based on the values obtained from this study. Further study on microbial susceptibility and contaminants is required.

**Table 2.** pH of fermenting milk sample during yogurt production.

Milk type	pH of fresh milk yogurt at 0 hour	pH of fermenting milk after 48 hours	pH of fermenting milk after 72 hours
Skimmed milk	5.37	5.10	4.09
Goat milk	5.24	4.99	4.28
Cow milk	5.85	5.31	5.11
Soy milk	5.73	5.33	5.07
Coconut milk	5.98	5.62	5.33

**Table 3.** Mean scores for acceptability of all the milk samples.

Sample	Colour	Appearance	Odour	Mouth feel	Overall acceptability
Skimmed Milk	4.1	4.3	5.0	4.8	4.6
Cow milk	4.0	4.2	4.8	4.6	4.3
Goat milk	4.2	4.4	4.7	4.1	4.3
Coconut milk	3.4	3.7	4.2	3.9	3.8
Soy milk	3.6	3.8	4.2	4.3	4.0



**Figure 1.** Overall evaluation of yoghurt from milk varieties.

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