Comparative study between cow and goat milk yogurt based on composition and sensory evaluation

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Abstract. This present investigation aimed to compare between cow and goat yogurt based on compositions, physicochemical and sensory properties. The Association of Official Analytical Chemistry International and Indonesian National Standards were used to analyze the parameters of yogurt samples. One-way ANOVA was achieved to assess the variance between data by Microsoft Excel. Yogurt was made from different fresh milk samples; cow and goat milk. The results showed there were no significant differences between cow and goat yogurt on fat values were 2.02, 2.10%, ash values were 0.39, 0.59 and in viscosities values were 47.18 and 47.65 respectively. On the other side there were significant differences on total solids were 12.82 and 14.5%, protein content was 2.89 and 3.185%, and pH was 4.56 and 4.34, respectively. The results from this study concluded that goat yogurt had the best physicochemical properties and sensory characteristics comparable with cow yogurt.

1. Introduction

Yogurt is the most important dairy product in the world. Its production includes several steps; there are milk pasteurization, milk formulation, inoculum with culture, and fermentation at suitable conditions [1]. Yogurt is rich in nutrients as well as minerals, vitamins, and protein. Therefore, considered suitable for children and adults [2]. Yogurt is a fermented product obtained through the fermentation of milk, by Lactic Acid Bacteria Lactobacillus bulgaricus with Streptococcus thermophilus or with Lactobacillus acidophilus [3].

Yogurt is fermented milk produced from mammals’ milk or other sources of milk-based on fermenting of it by lactic acid bacteria. The ingredients used to produce the yogurt are fresh milk, skimmed milk, and partly skimmed milk. The source of fresh milk is mammals such as cows, goats, sheep, camels, etc [4]. Milk is a source of nutritional compounds; water, fat, protein, lactose, dissolved gasses, vitamins, minerals, and enzymes [5]. It’s a respectable food in the diet of humans. Milk is a rich source of vitamins dissolved in lipids, minerals, and protein which made it converted part of recommended food habits [6].
The milk composition depends on several non-genetic factors such as race, age, race, animals’ diet, and seasons [7][8].

Cow’s milk had contained most compounds that meet the human body’s required such as; protein content and which has an important role in growth and human nutrition. Its rich sources of minerals, vitamins, and protein, such as vitamins D, niacin, vitamin A, vitamin B12, riboflavin and potassium, calcium, phosphorus [9]. Cow’s milk is lower in fat, but it is rich in lactose compared to goat milk and similar to other animals in minerals content [5].

Goat’s milk contains a higher amount of magnesium, phosphors, and calcium than cow and human milk. Goat milk is very important for stimulating immunity and disease prevention [10]. It contains various nutrients and can be utilized in various dairy products. Goat milk is superior to cow’s milk in terms of nutritional value [11]. Goat milk has high nutritive value and beneficial properties as a purposeful diet for humanoid healthiness [12]. Be used pasteurization and fermentation with some food additives with good manufacturing practices for ensuring protection and safety of fermented milk products [13]. Goat’s milk can be consumed as an alternative to cow’s milk in the treatment of persons with cow milk allergies and gastrointestinal disorders, on the other hand, stimulating immunity [11][14].

Fermentation foods are considered the first foods produced and consumed since human civilization development. The majority of fermented foods are made through the growth of microbes such as lactic acid bacteria which is considered the commonly used microbiology in fermented dairy products [15]. The Yogurt contains Lactic Acid Bacteria (LAB) that have health. Their growth depends on fermentation time, heat treatment, and the kind of sugar in milk [16].

The LAB is a large group of bacteria widespread in nature and is beneficial in our digestive systems. Which are the most important microorganisms used in food fermentation, contributing to the taste and texture and inhibiting food spoilage [17]. The basic group of lactic acid bacteria most commonly included are Pediococcus, Streptococcus, Leuconostoc, and Streptococcus. Recent taxonomic reviews suggest several new genera and the remaining group now includes: Vagococcus, Tetragnococcus, Weissella, Oenococcus, Aerococcus, Dolosigranulum, Lactococcus, and Alloiococcus [18]. The most common bacteria in the milk industry are Streptococcus thermophilus, Lactobacillus acidophilus, and Lactobacillus bulgaricus [3][19]. This present study was aimed to compare cow and goat yogurt based on physicochemical and sensory characteristics.

2. Material and Method

2.1. Collection of milk samples

The samples of milk (cow and goat milk) were collected from the Farm of Baturaden, Purwokerto, Indonesia. They were obtained in plastic containers and transported to the laboratory in ice boxes. And culture was obtained from the Faculty of Animal husbandry at the University of Jenderal Soedirman.

2.2. Yogurt manufacturing

The yogurt was made according to the method of [20][21]. The milk samples were coded to C and G, where; C as cow milk samples and G as goat milk samples. And then fresh milk were pasteurized at 85°C for 5 s in an aluminum pot after that was cooling between 40 - 45°C. The milk samples were inoculated with commercial cultures at inoculum size 5% (v/v) and incubated at 37 ºC for 12 hr.

2.3. Parameters Analysis

The chemical composition of milk samples and physicochemical of yogurt samples were determined that were: the milk and yogurt samples determined according to procedures method recommended by [22], the pH of samples was measured according to the method recommended by [23], the viscosity was measured conferring to trials method suggested by [23], the total solids of samples were determined according to the
method of [24], and the density was measured in as mass per volume of foam expressed as g cm$^{-3}$ according to the method of [25].

$$\text{density} = \frac{\text{sample weight}}{\text{sample volume}} \times 100.$$  

2.4. Organoleptic test

The sensory evaluation test was carried out in triplicate according to a 7-point hedonic scale was used, (15 panelists from Food Technology student), who assessed the samples and acceptability of the aroma, color, taste, texture, and overall acceptability. According to the method of [26].

2.5. Statistical analysis

All data were conducted for statistical analysis using one-way ANOVA by Microsoft Excel version 13. And used Duncan Multiple Range Tests to separate between means, and ($P \leq 0.05$) according to the method of [27].

3. Results and discussion

3.1. The compositions of milk

| Parameters       | Values (%) | Cow | Goat |
|------------------|------------|-----|------|
| Protein          | 2.79       | 3.24|
| Lactose          | 4.19       | 3.25|
| Fat              | 4.35       | 6.68|
| Solids Non-fat   | 7.61       | 6.82|

The results obtained from fresh cow and goat milk samples analyzed by the Lactoscan analyzer (Table 1) shown the values of fat were 4.35, 6.68%, respectively. These results refer to goat milk having a higher amount of fat content from cow milk samples, which hence to good taste and flavor or smell in the final production of yogurt. These results in line with [30], and not in similar results with [28], they noted the fat of fresh and pasteurized goat milk were 4.5% and 5%. These differences in fat content due to animal type, oldness, competition, season, location, and feedstuffs [8]. The solids non-fat values were 7.61, 6.82%, respectively, this result of goat milk is lowest from cow milk sample in solids non-fat, also shown disagrees with [29]. From these results there were differences in the non-fat solids content of cow goat milk, this different due to nature of carbohydrate in cow and goat milk, also goat milk had lowest lactose content, that has an effect on decrease non-fat solids of its, in addition, the added water to milk had an effect on decrease the percentage of milk compositions. The lactose value obtained was 4.19, 3.25%, these results showed the lactose values of fresh goat milk are lesser than cow milk, thus the goat milk better than cow milk for lactose intolerance peoples, but lactose is very important for making yogurt because the lactic acid bacteria consumption it during yogurt fermentation. This result was not in range of standards of [29], which noted the milk lactose value is at least was 4.5% and (NFS) is 7.8%, these differences refer to animal category, oldness, competition, season, location, and feedstuffs. These results exposed that cow milk has heist lactose and solids non-fat to compare with goat milk, while goat milk had the highest in protein and fat contains than cow milk.
3.2. The Compositions of Cow and Goat yogurt

Table 2. The compositions of cow and goat yogurt.

| Samples | Protein (%) | Fat (%) | Ash (%) | Water (%) | Carbohydrate (%) |
|---------|-------------|---------|---------|-----------|------------------|
| G       | 3.18<sup>a</sup> | 2.10<sup>a</sup> | 0.59<sup>a</sup> | 85.77<sup>a</sup> | 7.75<sup>a</sup> |
| C       | 2.89<sup>b</sup> | 2.02<sup>ab</sup> | 0.39<sup>ab</sup> | 87.27<sup>b</sup> | 7.43<sup>ab</sup> |

G: Goat milk, C: Cow milk.

The compositions of goat and cow milk yogurt showed that in Table 2. The results obtained from a sample show that the protein values of the G sample were 3.18% and the C sample was 2.89%. These results showed there were significant differences (P ≤ 0.05) between both samples, these results showed the protein value of goat yogurt sample (G) is higher than cow yogurt. These results of protein content G sample agree with [30], and these results agree with [32], and not in line with reported [33]. The fat values of yogurt samples were 2.02 and 2.10%, respectively. These results showed there were no significant differences between cow and goat yogurt samples, and the fat value of the goat yogurt sample is slightly higher than cow yogurt. These results of the fat content of G and C showed disagreement with [31], [34], also both samples are comparable with [35] standard that mentioned, the fat content of 0.5 – 10 is good but the fat content of 3.0 is the best. These different due to animal type, feeding, age, and environment. The water content values of cow and goat were 87.27 and 85.77% respectively. These results showed that the water value of the cow yogurt sample is higher than the goat yogurt sample, this result refers to the goat yogurt sample because it has a higher total solid than another cow yogurt sample. This result showed significant differences between both samples in water content values. These results of the water content of all samples showed disagree with [31]. The carbohydrate values were 7.43 and 7.75%, respectively. This is the result shown there were slight differences between cow and goat yogurt samples the carbohydrate value of the goat sample is highest compared with cow yogurt. These samples had no significant differences between [35] standard, that reported the yogurt must contain protein content minimum 2.75%, fat content less than 15%. These results showed that the goat yogurt sample is better than the cow yogurt sample.

3.3. The physical and chemical characteristics of cow and goat milk yogurt

Table 3. Physical and chemical characteristics of cow and goat yogurt.

| Samples | Viscosity | Density | Total Solids | PH | Total LAB (10<sup>6</sup>cfu/ml) |
|---------|-----------|---------|--------------|----|-------------------------------|
| G       | 47.18<sup>a</sup> | 1.05<sup>c</sup> | 14.52<sup>c</sup> | 4.34<sup>a</sup> | 5.6<sup>a</sup> |
| C       | 47.65<sup>a</sup> | 1.03<sup>d</sup> | 12.82<sup>d</sup> | 4.56<sup>b</sup> | 4.8<sup>c</sup> |

G: Goat milk (100%), C: Cow milk (100%).

The physical and chemical properties of cow and goat milk yogurt showed that in Table 3. The viscosity of cow and goat yogurt samples was 47.18, and 47.65 respectively. This result showed the
viscosity of both samples is similar in values. These results showed there were no significant differences (P≤0.05) between viscosity values of yogurt samples. These results are in line with reported [33], but not comparable to that reported by [36].

The density values of yogurt samples were ranged between 1.03 to 1.05 which is in line with the International Standard (1.040 - 1.070). From these results, there was a significant difference between yogurt samples. The highest total solids content was recorded for goat yogurt and the lowest total solids were recorded for cow yogurt. Both samples were significantly (P < 0.05) different. These results showed the sample G is the best sample in total solids than cow yogurt. The pH values collected are ranged from 4.34 to 4.56. The highest pH values were recorded for C (4.56) and the lowest pH was recorded for G (4.34). These samples of cow and goat yogurt showed significant differences (P < 0.05). This study in the line with [37] reported that the average pH in yogurt is 4.5. and not comparable with [19] that mentioned the average pH in yogurt is 4.8. From these results, the goat yogurt shown had a better property into pH, totally solid, and density than cow yogurt.

**Table 4. The colour of cow and goat yogurt**

| Samples Code | Color value |
|--------------|-------------|
|              | a           | b           | L           |
| G            | -13.94<sup>a</sup> | 13.30<sup>b</sup> | 31.22<sup>c</sup> |
| C            | -15.26<sup>a</sup> | 14.26<sup>ab</sup> | 45.62<sup>d</sup> |

G: Goat milk (100%), C: Cow milk (100%).

The color properties of cow and goat yogurt showed that in Table 4. These results showed there were no significant differences (P≥0.05) between both yogurt samples. Besides, there were significant differences in values of L color, the color of cow yogurt is wight yellowish, whilst goat yogurt is wight color. These differences into color due to the nature of chemical compositions of fatty acids, feeding, race, and nature of pigments in milk.

### 3.4. Sensory characteristics

**Table 5. Sensory evaluation of cow and goat milk yogurt**

| Samples | Color | Texture | Aroma | Taste | Overall acceptability |
|---------|-------|---------|-------|-------|-----------------------|
| G       | 5.25<sup>a</sup> | 2.90<sup>b</sup> | 2.90<sup>a</sup> | 2.5<sup>ab</sup> | 5.3<sup>ab</sup> |
| C       | 4.25<sup>b</sup> | 2.62<sup>a</sup> | 2.65<sup>a</sup> | 2.2<sup>b</sup> | 4.7<sup>b</sup> |

G: Goat milk (100%), C: Cow milk (100%).

The sensory evaluation showed that in Table 5. The colors of yogurt samples were 5.25, and 4.25 respectively. These results showed that the color of sample G was white, while the C sample color was white-yellowish. There were significant differences (P < 0.05) between goat and cow yogurt samples. The Texture of all samples respectively was 2.9 and 2.62. There was no significant difference (P < 0.05) between both samples. The average value of C sample was 2.62, which is the lowest percentage compared to G sample value was 2.29 is the highest percentage compared with C sample. The Aroma of yogurt
samples showed no significant difference (P < 0.05) between both samples. The taste of yogurt samples showed a significant difference (P < 0.05) between both samples. The G goat yogurt is the highest percentage compared to the cow yogurt sample. The overall acceptability was 5.3 and 4.7 respectively. The overall acceptability scores show that goat yogurt has the highest percentage compare with cow yogurt. The general results of this study established that the goat yogurt was giving better chemical compositions, physicochemical and sensory characteristics.

4. Conclusion
This study established that the goat yogurt had a good composition as; fat, protein, ash, and carbohydrate, on the other side, also has a better viscosity, pH, and total solids. General results from this present study concluded that goat yogurt can be used as alternative products to cow yogurt, due to people have lactose intolerance. Besides, it gave the best physicochemical properties and sensory characteristics comparable with cow yogurt.

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