The quality of low fat-fermented goat milk and low fat-fermented cow milk containing probiotic cultures

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Abstract. This research was conducted to study the quality of low fat-fermented milk containing probiotics cultures using goat and cow milk. The pH, Brix value, viscosity, and sensorial detection after 9 hours of incubation at 39°C were observed from the fermented milk containing Streptococcus thermophilus (St) and mixed cultures probiotic (Lactobacillus acidophilus, Bifidobacterium longum, and Lactobacillus casei, (ABC)). The result showed on the goat milk addition of St and ABC resulted to pH 4.25 ±0.02; 5.03 ±0.02, Brix value 6.05 ±0.10; 9.00 ±0.00, and viscosity 32.70 ±2.25; 4.05 ±0.30 respectively. The addition of St and ABC on cow milk showed pH 3.76 ±0.02; 4.80 ±0.00, Brix value 5.53 ±0.09 and 5.27 ±0.22, and viscosity 7.08 ±0.09; 3.00 ±0.08 respectively. Sensorial acceptance indicated sweetness and Acidity of goat milk containing St and ABC were 1.80 ±0.29 and 2.00 ±0.29; while for cow milk containing St and ABC were 1.6 ±0.52 and 1.1 ±0.32 respectively. It can be concluded that the addition of St to both kinds of milk resulted in better growth than the addition of ABC. According to Acidity, pH, viscosity, and sensorial acceptance of low fat-fermented goat milk had better quality and more preferred by trained panelists than those of low fat-fermented cow milk.

1. Introduction
Fermented milk is largely accepted as a way to extend milk shelf life and give a good flavor. Goat milk is rarely found in Indonesia's market; possibly, it is unfavorable due to its unpleasant odor. However, this milk contains particular nutritional properties, and the combination with bacterial strains that have probiotics properties are essential to be developed as a new technology functional dairy products in the future [1]. Streptococcus thermophilus have been known as one of the yogurt bacteria which contribute to flavor with Lactobacillus delbrueckii subsp bulgaricus. Probiotics culture represents health-promoting microbes for human food. Goat milk has better digestibility, mineral bioavailability, protein, and fat profiles than cow milk [2]. This research was conducted to study the quality of low fat-fermented goat milk compared to cow milk. Fermented milk was developed using a unique culture of Streptococcus thermophilus (St) and mixed culture containing probiotic bacteria ABC: L. acidophilus, Bifidobacterium sp and L. casei.

2. Material and methods

2.1. Material
Goat milk and cow milk were collected from Sleman District, Yogyakarta-Indonesia. Probiotic cultures from the Center for Food and Nutrition Studies at Universitas Gadjah Mada and St culture from Indrakila
cheese company, Boyolali, were used. They were developed at the Laboratory of Dairy Science and Milk Industries, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta-Indonesia.

2.2. Methods

2.2.1. Milk preparation. Low fat-milk were prepared by cream separator, and it was considered as low fat if its reached < 0.5%, then the low fat-milk were pasteurized at 85 °C for 10 minutes.

2.2.2. Bacterial cultures. The unique culture of St and ABC culture was prepared according to the method carried out by [3]. The pure bacterial isolate was reproduced in the Scott Duran-bottle milk media containing 90 ml of milk, which were then heated in the oven at 110 °C for 15 minutes. Milk was cooled to 40°C before inoculated by bacteria at 10 % v/v. The first, second, and third rejuvenations of each culture of bacteria was carried out in the same way to reach 0.3 % acidity, considered at the beginning of the logarithmic phase.

2.2.3. Developing fermented milk. Scott bottles sized 100 mL were sterilized before used and it then were filled with 90 ml of low-fat-milk goat or cow-milk and with 10 % (v/v) of St culture or 10 %(v/v) of mixed cultures of ABC. They were incubated at 39°C for 9 hours of incubation [4].

2.2.4. Tests. Acidity levels were measured according to [3,5]. The detection pH used a digital pH meter branded pH Lutron Probe Sensor. The value of Brix in milk samples were dropped into refractometer (Bertuzzi) and seen in contrast at the boundary between dark and light on the scale. The viscosity test was carried out using a Viscometer Brookfield. The sample was transferred into a beaker glass and then dipped with an L2 sized needle and rotated at 12 rpm. Then the number that appears was read and recorded as the value of viscosity (cP). The sensory testing procedure was performed by 10 entrained panelists, which have started to detect standard solution of flavor score of (acidity, sweetness, and bitterness) following [3,6] at scale of 0, 1, 2, 3, and 4 using a spoon.

2.2.5. Data analysis. The Acidity, pH, Brix value, and viscosity were analyzed by a completely randomized design method of factorial pattern (2x4), the sensorial test was analyzed by quantitative descriptive method with Spider Web patterns.

3. Results and discussion

3.1. Acidity and pH.

The development of fermented goat milk using probiotic cultures is not only for gaining better physic-chemical utility but also to make it healthier. It has been found that *Streptococcus thermophilus* (St) could be developed well in low fat-goat milk as well as in low fat-cow milk. All of the samples seemed to have slow growth at 6 hours of incubation time to reach less than 1 % of acidity equivalent to lactic acid. This result also indicated that mixed cultures containing *L. acidophilus- La*, *B. longum -B* and *L. casei-Lc* in both media were the same, even though those media contain more bacteria than single culture of *Streptococcus thermophilus*. Reference for mixed probiotic cultures in milk is rarely found. Mixed probiotic cultures have given acidity of around 0.7 % (mild acid). Unique culture of St resulted in pH 4.2 after 9 hours of incubation in low fat-goat milk and about 3.7 in fermented low fat-cow milk, but the unique culture of St in low fat cow milk presented more acid than in reduced fat goat milk. While for mixed culture ABC in both media, they showed pH 4.8 to 5.0 after 9 hrs of incubation, higher than that of the unique culture of St (Figure 1). The culture containing mixed probiotics in both media had presented less acid than in singles cultures St.
Fermentation have augmented the value of Brix and viscosity values due to the firmness of curd [1]. Viscosity is influenced by the heat treatment of milk, incubation temperature, acidity, and type of starters. It plays an essential role in the quality of products regarded by consumers [7]. The results of this research had shown that the Brix value during incubation time of both cultures in low fat-cow milk lower than those in low fat-goat milk, and decreased during incubation time until 9 hours of incubation (Figure 2).
Table 1. Viscosity of fermented products (cP)

| Storage time (day) | Goat ST | Goat ABC | Cow ST | Cow ABC |
|-------------------|---------|----------|--------|---------|
| 0                 | 32.70 ±2.25<sup>a</sup> | 4.05 ±0.30<sup>c</sup> | 7.08 ±0.09<sup>e</sup> | 3.00 ±0.08<sup>g</sup> |
| 21                | 50.25 ±2.04<sup>b</sup> | 34.43 ±0.73<sup>d</sup> | 26.35 ±0.17<sup>f</sup> | 19.40 ±0.18<sup>h</sup> |

Different letter in the rows indicated differences (P <0.05) statistically.

Viscosity of fermented low fat-goat milk (Table 1) using the unique culture of St was better than in mixed probiotic fermented low fat-cow milk. The viscosity increased during storage time (days) at 7°C as well phenomenon as mixed culture ABC. However, mixed cultures of ABC presented a lower value of viscosity than that of single culture St, suggested of viable cellsin storage treatment. New oligosaccharide may have been developed due to the transgalactosydic reaction. The enzymes β-galactosidase secreted by probiotics [8] or by yogurt bacteria [9] can produce variable amounts of oligosaccharide which rise viscosity of products [10] and act as viscosifiers.

Sensory properties of fermented milk are related to its taste, such as sweetness and Acidity that are important in cheese make[3]. In both cultures, the sweetness of the product in low fat-fermented goat milk was higher than in cow milk. While for Acidity, it showed that in low fat-fermented cow milk were higher than in low fat-fermented goat milk (Figure 3). It seemed that entrained panellists preferred fermented milk with more sweetness than higher Acidity.

Figure 3. Sensorial acceptance of entrained panelists

4. Conclusion
Single cultures of St and mixed probiotic cultures of ABC growth well in low fat-fermented goat milk and low fat-fermented cow milk. They grow better in cow milk than in goat milk, which leaded to higher Acidity, but the entrained panellist preferred low Acidity in reduced fat-goat milk with higher sweetness than in reduced fat-cow milk, which was more acid but less sweet. The quality of fermented milk represented by acidity pH, Brix, Viscosity, and sensorial detection in goat milk added by mixed culture had presented higher pH, less acid, less sweet, less accepted in cow milk than in goat milk.
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