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Physical and Chemical Quality Testing of Goat's Milk at the Teaching Farm of the Faculty of Animal Science

Muhammad Dohi¹, Ine Karni¹, Ica Ayu Wandira¹, I Nyoman Sadia I, Tahyah Hidjaz¹

¹Department of Animal Science, Faculty of Animal Science, University of Mataram, Mataram, Indonesia

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CORRESPONDING AUTHOR

*E-mail: muhammaddohi253@gmail.com

A B S T R A C T

This study aimed to evaluate the physical, microbiological, organoleptic, and chemical quality of PE Kaligesing, PE Jawarandu, and Boer goat milk produced at the Teaching Farm of the Faculty of Animal Science, University of Mataram. The parameters included viscosity, color, total dissolved solids, Total Plate Count, organoleptic properties, water content, dry matter, crude fat, crude protein, lactose, ash, and pH. PE Kaligesing milk had the highest viscosity, indicating a thicker texture. Boer milk had the highest total dissolved solids, suggesting higher dissolved components such as lactose, minerals, protein, and fat. The color characteristics of all samples remained within the normal range of fresh milk. The organoleptic results showed that all milk samples were acceptable to panellists, with PE Kaligesing milk preferred for colour, flavour, and texture, while Boer milk showed higher aroma acceptance. Chemical analysis showed that PE Kaligesing milk had the highest crude fat and crude protein contents, PE Jawarandu milk had the highest dry matter content, and Boer milk had the highest lactose, ash, and pH values. The Total Plate Count values for all samples were below the maximum limit set by the Indonesian National Standard, indicating good microbiological quality and hygienic handling. Overall, the three types of goat milk showed good quality and have potential to be developed into dairy products according to their specific characteristics.

Contribution to Sustainable Development Goals (SDGs):

SDG 2: Zero Hunger

SDG 3: Good Health and Well-being

SDG 12: Responsible Consumption and Production

SDG 6: Clean Water and Sanitation

1. INTRODUCTION

1.1. Research Background

Goats are among the most widespread livestock in West Nusa Tenggara (NTB). According to the Ministry of Animal Husbandry and Animal Health (2023), the goat population in West Lombok reached 46.87 animals in 2022. A dairy goat farm in West Lombok is located in the hamlet of Sandongan, Saribaye Village, Lingsar District. The farm is run by the Faculty of Animal Husbandry at Mataram University in cooperation with Pegadaian Indonesia under the name "Faculty of Animal

Husbandry Teaching Farm." This program aims to increase milk production, empower the local population, and promote the development of dairy goat farming in the region. The teaching farm raises, among other breeds, the Jawarandu-Etawa crossbreed goat, the Kaligesing crossbreed goat, and the Boer goat. Dairy goats are a source of animal protein, and their husbandry can be geared toward increasing milk production [1]. Furthermore, dairy goats have high economic value because they provide both meat and milk [2]. Goat milk production saw the highest increase between 2007 and 2017 at 22%, followed by Africa at 13%, Oceania at 9%, the Americas at 5%, and Europe at 4% [1]. Goat milk is highly nutritious because it contains protein, fat, lactose, vitamins, and minerals that support body



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metabolism [3]. Goat's milk also contains bioactive compounds, including peptides and lipids, such as conjugated linoleic acid, hormones, cytokines, oligosaccharides, nucleotides, and other trace components. These compounds play an important role in metabolism, strengthen the immune system, and support physiological functions [4] [5] [6]. High-quality and safe dairy products are enjoying increasing popularity worldwide. They must exhibit freshness characteristics such as good taste, texture, color, nutritional value, and aroma [7]. The current standard for fresh milk continues to be based on the standard for fresh cow's milk, as specified in SNI 01-1341-1998. This standard specifies a minimum density (at 27.5 °C) of 1.0280, a minimum fat content of 3.0%, a minimum fat-free dry matter content of 8.0%, a minimum protein content of 2.7%, an acidity level of 6–7, and a total bacterial count of 1×10^6 CFU/ml. Therefore, the quality of the goat's milk must be checked on the Faculty of Animal Science's farm in Sandongan to ensure its safety for consumption by the public.

2. MATERIALS AND METHODS

The Materials The sampling method used in this study was targeted sampling. The population was divided into three groups based on goat breed: PE Jawarandu, PE Kaligesing, and Boer goats. Three goats from each breed were randomly selected as samples.

2.1. Color Analysis

The colour of goat's milk was analysed in this study using a colourimeter, according to the MSEZ operating instructions. The goat's milk samples were placed in transparent plastic bags prior to colour measurement. The colour coordinates were determined from the instrument's L* (brightness), a* (green/red), and b* (blue/yellow) values. Additionally, the hue (°Hue) was calculated using the formula $^{\circ}\text{Hue} = \tan^{-1}(b/a)$ and reported in the Hunter color scale [8]

2.2. Sample Condition Assessment

A sample condition analysis assesses the quality of food and beverages using the five senses. In this study, two senses were used: sight to assess the color and consistency of the milk, and smell to assess its aroma.

2.3. Total bacterial count determination

Bacterial culture was performed on plate counting agar (PCA). 1 ml of inoculum was pipetted into a sterile Petri dish, followed by the addition of 12–15 ml of PCA medium (40–50 °C). The mixture in the Petri dish was homogenized by rotating the dish in a figure-eight motion. After the agar had solidified, the Petri dish was incubated upside down at 37 °C for 24–48 hours. The bacterial count was determined by plate counting, and the results were evaluated according to the standard plate counting method (SPC) [9].

2.4. Water Content

The water content is determined gravimetrically by drying in a drying oven at 100–105 °C for 3–5 hours. The formula used [10] is:

$$\text{Water Content} = \frac{W1 - W2}{\text{Sample Weight}} \times 100 \%$$

Note:

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W1 = Weight (sample + beaker) before drying

W2 = Weight (sample + beaker) after drying

2.5. Protein Content

A 10–15 mg sample was weighed and placed in a Kjeldahl flask. A mixture of selenium, concentrated sulfuric acid (H₂SO₄), and boiling chips was then added. The solution was heated until it turned green and the SO₂ vapor had dissipated. The solution was transferred to a volumetric flask and diluted. 10 mL of the solution were then pipetted, 0.02% sodium hydroxide (NaOH) was added, and distillation was carried out until no further alkaline reaction was observed in the vapor. After distillation, the solution was titrated with hydrochloric acid (HCl) using methyl red as an indicator. The protein content was calculated by multiplying the nitrogen content by the conversion factor [9].

2.6. Fat content

The fat content was determined by Soxhlet extraction. The fat flask was dried for 30 minutes at 105 °C in a drying oven, cooled for 15 minutes in a desiccator, and then weighed (A). The liquid milk sample was dried, wrapped in filter paper with 5 g of sample (S), and extracted with a fat solvent for 3–4 hours. After extraction, the solvent was distilled off, the fat flask was dried again at 105 °C in a drying oven until constant weight was achieved, cooled for 20–30 minutes in a desiccator, and then weighed again (B) [9].

2.7. Lactose Content

The lactose content was determined using the AOAC method (2005). For this purpose, 0.2 ml of a solution of ZnSO₄ (5%) and Ba(OH)₂ (4.5%) was added to the goat's milk sample, which was then centrifuged for 5 minutes at 1000 rpm until a precipitate formed. 1 ml of the supernatant was removed, 2.5 ml of Telles reagent solution was added, and the mixture was heated in a boiling water bath for 6 minutes until the volume reached 12.5 ml. After homogeneous mixing, the solution absorbance was measured at 520 nm.

2.8. Data analysis

The data obtained were subsequently analysed for mean and standard deviation in Microsoft Excel and further tested in SPSS software using RAL at a significance level of 5%.

3. RESULT AND DISCUSSION

3.1. Sample Collection

Goat milk samples were collected from three dairy goat breeds at the teaching farm of the Faculty of Animal Husbandry at Mataram University: PE Jawarandu, PE Kaligesing, and Boer goat. The milk samples were then stored in sterile bottles and kept in a cooler to maintain their freshness before being transported to the laboratory for further analysis.

3.2. Physical Testing

3.2.1. Viscosity

The viscosity of milk is a measure of its thickness. It influences its flowability and thus the processing of dairy products. The research results show that the viscosity of PE Kaligesing goat's (6.8 ± 0.61 cP) is higher than that of PE Jawarandu goat's milk (6.77 ± 0.51 cP) and Boer goat's milk (6.45 ± 0.67 cP). This

suggests that PE Jawarandu milk is thicker than the other two types of milk. Viscosity measurements of milk from different goat breeds revealed significant differences between PE Jawarandu goats and PE Kaligesing and Boer goats. However, no significant differences were found between PE Kaligesing and Boer goats ($p < 0.05$).

These differences in viscosity may be due to variations in lactose content across the milk varieties. Lactose, which is converted to lactic acid by lactic acid bacteria (LAB) that produce the enzyme lactase, can increase milk viscosity [11]. [12] explain that the viscosity of dairy products is due to the coagulation of casein, which is caused by the low acidity resulting from bacterial activity.

Table 1. Physical quality of milk from PE Kaligesing, PE Jawarandu, and Boer goats on Teaching Farm in Sandongan

Sample	Viscosity (cP)	L*	a*	b*	Total dissolved solids	Total Plate Count	
						10 ²	10 ³
PEK	6.8±0.61	87.56±0.80	-0.37±0.55	3.17±0.92	12.17±0.29	2 x 10 ² ±1.01	2 x 10 ³ ±1.23
PEJ	6.77±0.51	87.37±1.96	-0.13±1.22	4.36±1.80	11.83±1.76	3 x 10 ² ±3.12	2 x 10 ³ ±2.17
KB	6.45±0.67	88.71±0.36	1.10±0.47	3.58±1.28	13.00±1.00	1 x 10 ² ±0.28	2 x 10 ³ ±0.5

Description: Values are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences based on Duncan's multiple range test ($p < 0.05$), while the same letters indicate no significant difference. PEK = PE Kaligesing goat; PEJ = PE Jawarandu goat; KB = Boer goat.

3.2.2. Color Analysis

Color is one of the most important quality indicators and influences consumer acceptance of food products (Gozali et al., 2025). Color changes in milk depend on the fat content (Asmaq & Marisa, 2020). In this study, the color of PE goat's milk was measured using a manual colorimeter that recorded the color values a, L*, a*, and b* [14].

The results of this study show that the colour of goat milk, depending on the dairy goat breed, did not significantly influence the L*, a*, and b* values of PE goat milk. Milk from the PE-Kaligesing breed (PEK) had L* values of 87.56 ± 0.80, a* values of -0.37 ± 0.55, and b* values of 3.17 ± 0.92, indicating a lighter, more yellowish colour. Milk from the Jawarandu breed (PEJ) had L* values of 87.37 ± 1.96, a* values of -0.13 ± 1.22, and b* values of 4.36 ± 1.80, indicating a slightly yellower colour than the Kaligesing breed. Boer goat (KB) milk, on the other hand, has L* = 88.71 ± 0.36, a* = 1.10 ± 0.47, and b* = 3.58 ± 1.28. This means that Boer goat milk tends to be lighter in color and has a slightly higher red component than the other two milk types. Differences in milk color can be influenced by genetic factors and feed. In general, milk with a higher fat content, such as that found in Boer goat milk, is yellower due to its higher carotenoid content [15]. The results of the goat milk color test are shown in Table 1.

3.2.3. Total Dissolved Solids

Total soluble solids are the dissolved components in milk, including sugars, proteins, fats, and minerals. These components significantly influence the nutritional value and physical quality of the milk, which, in turn, determine its suitability for use in dairy products and for direct consumption. According to Table 1, the total soluble solids content is 12.17 ± 0.29% for Kaligesing goat's milk, 11.83 ± 1.76% for Jawarandu goat's milk, and 13.00 ± 1.00% for Boer goat's milk. This difference indicates that Boer goat's milk contains more soluble solids than the other two goat's milk varieties.

The higher viscosity of PE Jawarandu milk may be due to its higher soluble solids content, although Boer goat milk generally has a higher fat content. Variations in milk viscosity are influenced by genetic factors and milk processing, contributing to differences in viscosity between various goat milk varieties. A higher fat content in Boer goat milk can indeed increase milk viscosity. In this case, however, the milk of the PE Jawarandu has higher viscosity, even though its fat content is lower than that of Boer goats. This suggests that other factors, such as protein and carbohydrate content, also influence milk viscosity [13].

The higher soluble solids content in Boer goat milk indicates higher fat and protein levels, consistent with the breed's characteristic high-fat milk [16]. Boer goats, a large, high-yielding breed, often produce milk with high nutritional value. This makes Boer goat milk particularly well-suited for high-fat dairy products such as cheese or butter.

Furthermore, the higher soluble solids content in Boer goat milk may also indicate better milk quality, including consistency and shelf life. Milk fat plays a crucial role in the shelf life of dairy products and contributes to the thicker, creamier texture of products like yoghurt and cheese [17]. Therefore, Boer goat milk, with its higher soluble solids content, offers advantages for dairy processing, especially for high-fat products.

3.3. Total Plate Count

The total plate count is an important indicator of the microbiological quality of goat's milk, as it reflects the total number of bacteria growing in a sample [18]. Based on the research results (Table 1), the total plate count values for the three goat's milk samples tested were very low, ranging from 1 × 10² to 3 × 10² CFU/mL. This value indicates that the milk of all samples meets the microbiological quality standards for fresh milk according to SNI 3141.1:2011 (maximum 1 × 10⁶ CFU/ml) and can therefore be classified as high-quality and suitable for consumption. The results also showed that the goat breed had no significant effect on the total viable count of goat milk.

The milk from PE Kaligesing (PEK) goats showed a total bacterial count of 2 × 10² ± 1.01 to 2 × 10³ ± 1.23, indicating good hygiene and proper milking practices. A low total plate count value signals hygienic post-milking care and hygienic milking equipment [19]. In addition, it is possible that the natural antibacterial effect of goat's milk, for example through the enzymes lysozyme and lactoferrin, inhibits microbial growth [20]. In PE Jawarandu (PEJ) goats, the total plate counts were slightly higher at 3 × 10² ± 3.12 and 2 × 10³ ± 2.17, respectively. However, these values are still considered low and safe. The

difference could be due to environmental factors, udder hygiene, and milking methods. The higher solids content and viscosity of PEJ milk may provide a more favourable medium for microbial growth, which, however, remains controlled by good husbandry conditions [21].

Boer goat (KB) milk had the lowest total bacterial counts (TPC) among the three samples, at $1 \times 10^2 \pm 0.28$ and $2 \times 10^3 \pm 0.5$. These low values indicate hygienic milking and careful milk processing, and the smaller milk volume likely reduces the risk

of microbial contamination. The smaller udder structure of the Boer goat may also reduce the risk of exposure to environmental bacteria.

3.4. Organoleptic Examination

The organoleptic examination in this study was based on hedonic test results and assessments of PE Kaligesing, PE Jawarandu, and Boer goat milk. The results are presented in Table 2.

Table 2. Organoleptic test of PE Kaligesing, PE Jawarandu and Boer goat's milk at the Teaching Farm Sandongan.

Sample	Color		Flavor		Aroma		Texture	
	Hedonic	Scoring	Hedonic	Scoring	Hedonic	Scoring	Hedonic	Scoring
PEK	3.77±0.86 ^a	2.30±0.81	3.52±0.88	2.18±0.77	3.06±0.83 ^b	2.09±0.75 ^b	3.61±0.83	2.78±0.87 ^a
PEJ	3.37±0.84 ^b	2.28±0.91	3.51±0.99	2.20±0.87	3.27±0.99 ^{ab}	2.30±0.80 ^{ab}	3.47±0.95	2.87±0.95 ^a
KB	3.73±1.09 ^a	2.37±1.28	3.43±1.23	2.40±1.02	3.50±1.23 ^a	2.47±1.20 ^a	3.43±1.28	2.43±1.15 ^b

Description: Values are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences based on Duncan's multiple range test ($p < 0.05$), while the same letters indicate no significant difference. PEK = PE Kaligesing goat; PEJ = PE Jawarandu goat; KB = Boer goat.

According to Table 2, organoleptic tests of PE Kaligesing (PEK), PE Jawarandu (PEJ), and Boer goat milk (KB) showed significant differences in various aspects, including color, aroma, and texture. Based on hedonic and rating tests, PE Kaligesing milk achieved the highest ratings across almost all parameters. Regarding colour, PE Kaligesing milk achieved a hedonic score of 3.77 ± 0.86 (positive) and a rating score of 2.30 ± 0.81 (yellowish-white), indicating that consumers tend to prefer its colour. The milk from the PE Jawarandu line received a hedonic value of 3.37 ± 0.84 (rather good) and a value of 2.28 ± 0.91 (yellowish-white), while the milk from the Boer goat had a hedonic value of 3.73 ± 1.09 (good) and a value of 2.37 ± 1.28 (yellowish-white). This difference was not statistically significant, as all milk samples fell into the "yellowish-white" color category.

In terms of taste, the milk from the PE Kaligesing line received a hedonic value of 3.52 ± 0.88 (good) and a value of 3.52 ± 0.88 (very strong milky taste), indicating that consumers preferred and perceived this milk's taste as dominant. The flavor of PE Jawarandu milk was rated as pleasant by panelists, with a hedonic score of 3.51 ± 0.90 , and was characterized by a strong milky taste based on the scoring assessment, while the Boer goat milk received a hedonic rating of 3.43 ± 1.23 (pleasant) and a rating of 3.43 ± 1.23 (strong milk flavor). Although the milk from the PE Kaligesing line was preferred in terms of taste, the differences between the three milk types were not statistically significant. This suggests that the taste differences between the three milk types fall within the range preferred by consumers.

The aroma of the PE Kaligesing milk received a hedonic rating of 3.06 ± 0.83 (pleasant) and a rating of 3.06 ± 0.83 (very strong milk flavor). The PE Jawarandu milk achieved a hedonic value of 3.27 ± 0.99 (pleasant) and a rating of 3.27 ± 0.99 (weak milk aroma). The Boer goat milk achieved a hedonic value of 3.50 ± 1.23 (pleasant) and a rating of 3.50 ± 1.23 (weak milk aroma). The aroma difference suggests that Boer goat milk is preferred. However, the overall difference among the three milk types is not

statistically significant, suggesting that the aromas of all three are acceptable to consumers. The texture of the PE Kaligesing milk achieved a hedonic value of 3.61 ± 0.83 (good) and a rating of 3.61 ± 0.83 (very thick). This suggests that this milk is preferred due to its consistency. The PE Jawarandu milk achieved a hedonic value of 3.47 ± 0.95 (good) and a rating of 3.47 ± 0.95 (thick), while the Boer goat milk achieved a hedonic value of 3.43 ± 1.28 (good) and a rating of 3.43 ± 1.28 (thick). The texture differences among these three milk types are not statistically significant, but PE Kaligesing milk has a thicker texture and is preferred by consumers.

3.5. Chemical analysis of goat's milk

3.5.1. Water Content

Water content in milk refers to the amount of water it contains. A higher water content can affect the consistency and shelf life of the milk, as well as its further processing into other products [3]. According to Table 3, PE Kaligesing (PEK) milk has the highest water content (84.77 ± 0.97 %), followed by PE Boer goat milk (KB) at 84.28 ± 1.58 % and Jawarandu (PEJ) milk at 83.19 ± 1.38 %. There was no significant difference in the water content of PE Kaligesing, PE Jawarandu, and Boer goat milk. This suggests that while Boer goat milk is somewhat drier, the difference in water content among these three milk types is not significant enough to affect overall milk quality.

In general, milk with a lower water content has a higher solids content, which can increase its nutritional value [22]. Boer goat milk, which has a lower water content, can have a higher solids content, particularly fat, and is therefore more energy-dense.

Table 3. Physical quality of milk from PE Kaligesing, PE Jawarandu and Boer goats on Theacing Farm in Sandongan

Sample	Dry Ingredients (%)	Water Content (%)	Crude Fat (%)	Crude Protein (%)	lactose (%)	Ash (%)	pH
PEK	15.23±0.97	84.77± 0.97	6.53±0.16 ^a	4.38±0.06 ^a	1.44±0.24 ^c	0.57±0.13	6.65±0.05
PEJ	16.81±1.38	83.19±1.38	5.77±0.05 ^b	4.23±0.04 ^b	2.29±0.33 ^b	0.61±0.61	6.63±0.08
KB	15.72±1.58	84.28±1.58	4.25±0.03 ^c	4.36±0.06 ^a	3.68±0.19 ^a	0.72±0.21	6.80±0.13

Description: Values are presented as mean ± standard deviation. Different superscript letters within the same column indicate significant differences based on Duncan's multiple range test ($p < 0.05$), while the same letters indicate no significant difference. PEK = PE Kaligesing goat; PEJ = PE Jawarandu goat; KB = Boer goat.

3.6. Dry Ingredients

The dry Ingredients content of milk describes the amount of solids in the milk excluding water, such as fat, protein, carbohydrates, minerals, and other components [23]. The table shows that goat breed does not significantly influence the dry matter content of goat's milk. Jawarandu goat's (PEJ) milk has the highest dry matter content (16.81±1.38%), followed by Boer goat's milk (KB) with a dry matter content of 15.72±1.58% and Kaligesing goats (PEK) with the lowest dry matter content (15.23±0.97%). This suggests that Jawarandu and Boer goat's milk are rich in solids, which contributes to their nutritional value. Higher dry matter can improve the nutritional value and processing quality of milk, especially for products such as cheese, yogurt, and cream.

A higher dry matter content directly affects the taste and texture of dairy products [24]. Studies by [1] show that milk with a higher dry matter content yields a more stable, higher-quality processed product, particularly in terms of taste and texture. Factors such as the goat's genetics and feed also influence milk dry matter content. Nutrient-rich feed, especially high-protein and energy-rich feed, can increase the dry matter content of milk [25]. This is supported by [26], which shows that high-quality feed can increase milk fat and protein content and thus its dry matter content.

3.7. Crude Fat

Crude fat in milk is one of its main components and contributes significantly to its energy content. It imparts a richer flavour and creamier consistency and is an important energy source in the human diet [27]. Furthermore, crude fat is essential for the absorption of fat-soluble vitamins such as vitamins A, D, E, and K. The higher the crude fat content of milk, the higher its energy content. Fat also contributes to the stability and quality of dairy products such as cheese and cream, which require a high fat content for good texture and full flavor [28].

The results showed significant differences in the crude fat content of various goat breeds. The milk of the Kaligesing goat had the highest crude fat content (6.53±0.16%), followed by the Jawarandu goat (5.77±0.05 %) and the Boer goat (4.25±0.03%), which had the lowest crude fat content. This difference indicates that Kaligesing goat milk has a higher crude fat content, which increases its nutritional value. The higher fat content also contributes to a richer flavour and enables the production of higher-quality dairy products [17]. Cheese and butter, for example, require a high fat content to achieve a creamy consistency and distinctive flavor.

3.8. Crude Protein Content

Crude protein content is a measure of the nitrogen content in a feed or other ingredient and serves as an estimate of the total protein content. Crude protein is important because it provides the amino acids necessary for growth and tissue repair [29].

Table 3 shows that PE Jawarandu (PEJ) goats differ significantly from PE Kaligesing and Boer goats in milk crude protein content. PE Kaligesing (PEK) milk has the highest crude protein content (4.38 ± 0.06%), followed by Boer (KB) milk (4.36 ± 0.06%). PE Jawarandu (PEJ) milk has the lowest crude protein content (4.23±0.04%). PE Kaligesing goat milk had the highest crude protein content among the three goat breeds and is therefore richer in protein. The protein content of all three goat breeds meets the Indonesian National Standard (SNI) of 2.8% or higher. The proteins in milk play a role in many biological processes, such as antibody and enzyme production [30].

3.9. Lactose Content

Lactose is a natural sugar in milk, responsible for its sweetness and an important energy source. It consists of the two monosaccharides glucose and galactose, which are broken down in the body by the enzyme lactase. Lactose has many beneficial properties for the body; for example, it provides calories and promotes the absorption of calcium and phosphorus [31]. However, some people are lactose intolerant, meaning their bodies cannot properly digest lactose, which can lead to symptoms such as bloating, diarrhea, and abdominal cramps [32].

The results (Table 3) show that goat breed significantly influences the lactose content of goat milk. Boer goat milk has the highest lactose content (3.68 ± 0.19%), followed by Jawarandu goat (PE) milk (2.29 ± 0.33%) and Kaligesing goat (PE) milk (1.44 ± 0.24%) with the lowest lactose content. This difference reflects variations in lactose content, which can affect milk sweetness and its suitability for lactose-intolerant individuals. Milk with a higher lactose content, such as Boer goat milk, tends to be sweeter but may be less suitable for people with lactose intolerance [32].

According to Indonesian standards (SNI), the lactose content in fresh milk is typically between 4.0% and 5.0%. The lactose content of the tested goat milk varieties, such as Boer (3.68 ± 0.19%) and PE Jawarandu (2.29 ± 0.33%), was still within the acceptable range, although lower than in cow's milk, which typically has a higher lactose content.

This difference suggests that goat's milk tends to have a lower lactose content than cow's milk and may therefore be an alternative for people with mild lactose intolerance. For example, goat's milk from the PE Kaligesing breed, which has the lowest

lactose content ($1.44 \pm 0.24\%$), might be more suitable for people with lactose sensitivity. However, the Indonesian Standard (SNI) stipulates that the lactose content in fresh milk must meet quality standards. The tested goat's milk met these criteria, despite variations between goat breeds.

3.10. Ash

Ash content in milk refers to the total amount of minerals remaining after complete combustion of the organic matter (by heating at high temperatures). It includes various essential minerals such as calcium, phosphorus, magnesium, potassium, sodium, and chloride. A higher ash content indicates a higher mineral content in the milk, which is important for bone health and other bodily functions. The ash content also influences the quality of dairy products, as minerals such as calcium and phosphorus are essential for the production of products like cheese and milk powder [33].

The ash content of goat milk in this study (Table 3) ranged from 0.57% to 0.72%. Boer goat milk had the highest ash content, at $0.72 \pm 0.21\%$, followed by PE Jawarandu goat milk at $0.61 \pm 0.61\%$, while PE Kaligesing goat milk had the lowest value, at $0.57 \pm 0.13\%$. However, the statistical analysis showed that goat breed did not have a significant effect on milk ash content. This means that the differences among treatments were only numerical and could not be interpreted as a significant effect of goat breed.

Ash content is the mineral residue remaining after combustion and can be used as an indicator of total mineral content in milk. Compared with the Indonesian National Standard (SNI), which sets the ash content of fresh milk at 0.9% to 1.2%, all samples in this study were below the standard range. This result indicates that the mineral content of the goat milk samples was relatively low. This condition may have been influenced by factors other than breed, such as feed type and quality, lactation stage, goats' physiological condition, and husbandry management.

3.11. pH

The pH value of milk measures its acidity or alkalinity. It is an important parameter because it influences taste, stability, and processing possibilities for products such as cheese, yogurt, and cream [34]. A low pH value indicates acidic milk, while a high pH value indicates alkaline milk. Fresh milk usually has a slightly acidic pH of about 6.5 to 6.7, reflecting the acid-base balance in the milk [35].

The results showed that goat breed did not significantly affect the pH of goat's milk. The milk from the Boer goat had the highest pH (6.80 ± 0.13), followed by the milk from the PE Kaligesing goat (6.65 ± 0.05) and the milk from the PE Jawarandu goat (6.63 ± 0.08). These three goat milk samples had quite similar pH values and were within the pH range typically found for fresh milk. The pH difference between the goat milk samples is not significant; however, the Boer goat milk has a slightly higher pH, which could indicate a lower acidity level compared to the PE Kaligesing and PE Jawarandu milk.

The standard SNI 01-3141-1998 specifies that the pH of fresh milk should be between 6.5 and 6.8. The goat milk varieties examined in this study – Boer (6.80 ± 0.13), PE Kaligesing (6.65 ± 0.05), and PE Jawarandu (6.63 ± 0.08) – all met the pH criteria established by the SNI, indicating good milk quality. Although the pH differences between the goat milk varieties are small, the slightly higher pH of Boer milk may contribute to a milder, less

acidic taste. pH also influences the physical properties of milk, such as its stability during processing and the texture of processed products, such as cheese.

4. CONCLUSION

Based on the physical, TPC, scoring, hedonic, and chemical tests, the milk from PE Kaligesing, PE Jawarandu, and Boer goats showed good quality and was suitable for consumption. PE Kaligesing milk had the best characteristics in viscosity, fat content, protein content, and sensory acceptance for color, taste, and texture. This indicates that PE Kaligesing milk has strong potential for producing high-nutritional-value dairy products. PE Jawarandu milk had the highest dry matter content, making it suitable for products that require higher milk solids. Boer milk showed higher total dissolved solids, lactose, ash content, pH, and aroma acceptance. This means Boer milk tends to have a sweeter taste, higher mineral content, and a more preferred aroma. The TPC values of all three milk samples were low and remained below the maximum SNI limit. This indicates that the milk had good microbiological quality, was handled hygienically, and was safe for consumption. Overall, the three types of goat milk differ in characteristics and can be used for their respective processing purposes.

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