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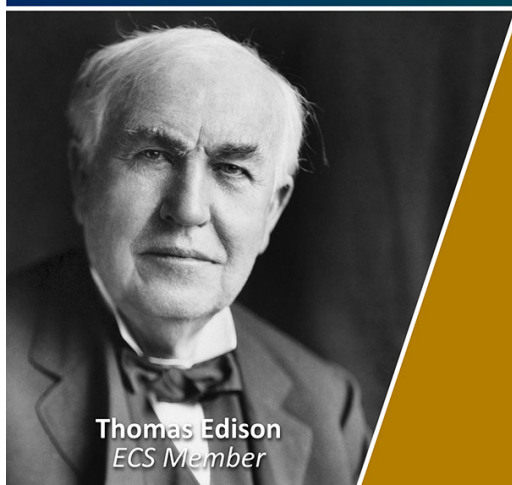
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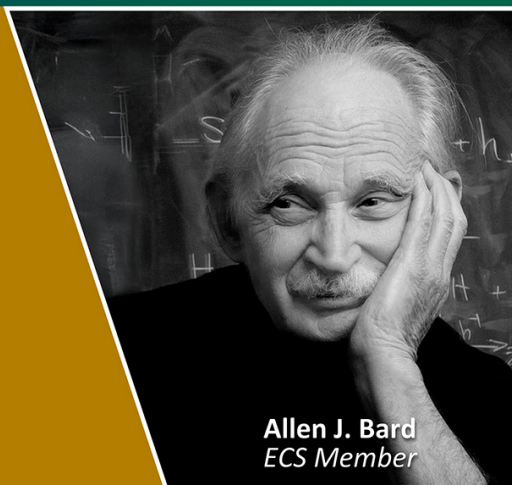
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Nutritional Profile and Antioxidant Activity of Milk from Different Goat Breeds in Padang City, Indonesia

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Abstract. Goat milk is known to have high nutritional value, but its quality can vary depending on factors such as goat breed, rearing environment, and milking method. This study aimed to compare the quality of goat milk from different breeds reared at Elfitra Farm, Padang City, focusing on chemical and microbiological characteristics and antioxidant activity. The study involved five breeds of goats, A (Angola+Nubian), B (Angola+PE), C (Angola+Saanen+PE), D (Saanen+PE) and E (Peranakan Ettawa) that have been cultivated at the farm. Milk samples were collected from each goat breed and analyzed using standard methods to determine chemical composition, such as moisture content, protein content, fat, and ash content. In addition, microbiological tests related to total lactic acid bacteria and total plate count are indicators of milk hygiene quality. The antioxidant activity of milk was also measured using the DPPH method to determine the ability of milk to counteract free radicals. The results showed significant differences between the three goat breeds in terms of chemical composition and antioxidant content. Etawa goats had higher protein content than the other breeds, while Saanen goats showed better antioxidant activity. In terms of microbiology, Boer goat milk tended to have lower microbial contamination than the other two breeds, indicating better hygiene quality. This study is expected to provide vital information for farmers and goat milk processing industries in Indonesia to improve the quality and safety of goat milk products that are beneficial to health.

1. Introduction

Goat's milk has long been recognised as a rich source of nutrients and has significant health benefits. In many regions, goat's milk is often used as an alternative to cow's milk, especially for lactose intolerant individuals. Along with the increasing public awareness of health and well-being, the assessment of the nutritional value and antioxidant activity of goat milk from different breeds of livestock has become highly relevant in this era.

Various studies have shown that goat milk is rich in protein, healthy fats, vitamins, and minerals such as calcium and magnesium, and has a unique fatty acid profile that contributes to its



colour, flavour, and nutritional value [1]. In addition, goat milk is known to contain bioactive compounds with potential as antioxidants, which may help fight oxidative stress and contribute to the prevention of various degenerative diseases, such as diabetes, heart disease and cancer [2]. Milk is recognised as a naturally occurring dietary substance that is 'nutritionally complete' for human consumption and health benefits. Goat milk is particularly nutritious due to its beneficial constituents, including carbohydrates, proteins, fats, micronutrients, macronutrients, and vitamins, among others [3].

The urgency of this research has increased with the phenomenon of globalisation and the rapid changes in food consumption patterns. Dietary transition in many countries has resulted in increased consumption of dairy products that are not always guaranteed in terms of nutritional quality. Goat milk and its derivatives are recognised as functional foods that significantly enhance human health [4]. Milk and dairy products provide numerous nutritional advantages to various vulnerable and food-insecure populations worldwide, particularly children and adults [5, 6]. The United Nations [7] asserts that goat milk can be a significant instrument in realising its 2030 Agenda for Sustainable Development, established in 2016, along with its seventeen interrelated sustainable development goals (SDGs).

In this context, it is important to explore and compare the nutritional value and antioxidant activity of goat milk from different breeds, which can provide useful information for producers, consumers, and researchers in the field of food science and nutrition. Especially in goat milk processing where the different chemical compositions and nutritional values can serve as a foundation in processing various goat milk-based preparations [8].

Furthermore, understanding the nutritional variations and health potential associated with goat milk from different breeds of livestock can provide guidance in the development of better food products and support the sustainability of the livestock industry [9]. Indonesia already has a quality standard for cow's milk, but there is no standard for goat's milk, so the standard to determine the quality of goat's milk uses Thai Agriculture Standard (TAS) No 6006-2008 [10].

Against this background, this article aims to present comprehensive data on the nutritional and antioxidant value of goat milk from different breeds of livestock and its relevance in the current public health context. This study aims to determine the nutritional, microbiological and chemical qualities of goat milk from different breeds of livestock as a basic research for various goat milk preparations according to their respective characteristics.

2. Materials and Methods

2.1 Sample Collection

Goat milk used in the study was taken as much as 150 ml for each replicate from Elfitra Farm in Padang City. Samples were collected using sterile containers and analysed in the laboratory. The breeds used in this study consisted of A (Angola+Nubian), B (Angola+PE), C (Angola+Saanen+PE), D (Saanen+PE) and E (Peranakan Ettawa). All goats received the same type of concentrate and forage feed and milking was done in the morning.

2.1 Nutrition Analysis

Water content with gravimetric methods use moisture analyzer, Ash content with gravimetric methods use furnace, Fat content with soxhlet extraction methods, Protein content with Kjeldahl methods [11].

2.2 Total Lactic Acid Bacteria

Goat milk was taken as much as 1 ml using a micropipiter, put into 9 ml of MRS Broth solution in a test tube, then vortexed until homogeneous. This result is called 10-1 dilution. The result of 10-1 was taken 1 ml and put into a microtube containing 0.9 ml MRS broth, then vortexed until homogeneous. The result of this dilution is called dilution 10-2, and so on until dilution 10-7. From dilution 10-7, 100 μ l samples were taken and planted by the spread method on a petridish containing MRS Agar media, then flattened with a hockey stick previously sterilised with alcohol and burned with a bunsen and then aerated. The inoculum was stored in an anaerobic jar then incubated in an incubator for 48 hours at 37°C and petridish coding was done by marking each petridish [12].

2.3 Antioxidant Activity

Analysis using DPPH with concentration 0.2 mM, the sample was weighed 1 g then dissolved with methanol p.a up to 10 ml and sonicated for 30 minutes, do filtering and made several concentrations with methan p.a as a solvent, take 2 ml of sample added with 1 ml of DPPH 200 μ M, incubated for 30 minutes in a dark room do reading in UV Visual spectrophotometer maximum λ = 515 nm.

2.4 Statistical Analysis

This study used a group randomised design where the type of goat breed became a group and then the data obtained were statistically analysed using SPSS V.21 with DMRT further test.

3. Result and Discussion

3.1 Nutrition Analysis

Table 1. Goat Milk Nutrition Average

Groups	Water Content	Protein	Fat	Ash
A	85.47 ^{bc}	3.31 ^b	4.81 ^a	6.25 ^d
B	85.48 ^c	2.86 ^d	4.23 ^b	6.41 ^b
C	86.52 ^{ab}	3.15 ^c	3.96 ^d	6.21 ^e
D	86.87 ^{ab}	3.15 ^c	3.87 ^e	7.81 ^a
E	86.51 ^a	3.47 ^a	4.05 ^c	6.36 ^c

In Table 1, it can be seen that the water content, protein content, fat content and ash content of goat milk from various crossbreeds of dairy goats statistically had no significant effect between research groups ($p > 0.05$). In further tests, it can be seen that there are significant differences between research groups both in water content, protein content, fat content and ash content of goat milk. The results of this study showed that the highest value of water content was found in group D (86.87%), which is the sire derived from the crossing of Saanen and PE, as well as the highest protein content obtained in group E (3.47), which is the sire of PE, at the highest fat content value obtained by group A (4.81) with sire crossing Anggola and Nubian and at the highest ash content in group D (7.81%), which is the sire of Saanen and PE.

The results of this study are still relatively low when compared to the research of Melia et al., [13] 2017 where the protein content and fat content of goat milk obtained were 4.39 and

6.41. Based on Thai Agriculture Standard [10], the results of this study based on protein levels can be categorised in several groups for groups A, C and D into standard quality (3.1 -3.4), while group E is in the Good category (3.4-3.7). Likewise, the fat content of groups C and D is in the Good category (3.5-4) while groups A, B and E are in the Premium category (>4).

The quality and nutritional composition of milk in addition to being influenced by the breed and nation of livestock maintenance management such as the environment, forage feed and concentrates can also affect the quality of goat milk. Compositional differences have been linked to conditions associated with organic production such as breed, environment, health status, and feeding regime [14].

3.2 Total Lactic Acid Bacteria

Table 2. Total Lactic Acid Bacteria Average Goat Milk

Groups	Total LAB x10 ⁸ CFU/ml
A	40,67
B	42
C	55
D	47,67
E	56,33

The results of the research can be seen in Table 2, it is known that the total LAB colonies of goat milk from various types of sires from different crosses of the nation statistically did not have a significant effect. Total LAB obtained in the study ranged from 40.67 - 56.33 x10⁸ CFU/ml with the highest results in group D from PE sires. The results of this study are higher when compared to the research of Melia et al., [13] where the total LAB of goat milk obtained was 57.25 x 10⁷ CFU/ml. Goat milk from this research can be categorised as a functional food source of probiotics because it contains probiotics in accordance with the minimum limit [15].

The health benefits of milk are attributed to the various bioactives mentioned and can be direct, such as contributing to nutrient absorption, bone health and bone density development, as well as immunomodulatory potential with reported effects beginning in childhood [16], while other benefits can be indirect through the gut microbiota by providing probiotic potential.

3.3 Antioxidant Activity

Table 3. Antioxidant Average Goat Milk

Groups	Value IC ₅₀ (ppm)
A	15.7947,33 ^{ab}
B	15.9084,33 ^b
C	15.6757,33 ^a
D	15.8060,33 ^{ab}
E	15.8484 ^{ab}

In Table 3, it can be seen that the antioxidant value of goat milk in this study is classified in the weak category because it is above >200 ppm, this is because the material used in this study is still raw material from goat milk. Until now there are no standard rules of antioxidant standards in a food product. Antioxidant levels of dairy products differ from each animal

species, as shown in several studies [17, 18, 19, 20], animal species have a significant impact on the content of antioxidant components in milk. Based on the research conducted, it is known that the order of antioxidants from highest to lowest is buffalo milk, sheep milk, goat milk and cow milk [21].

The content of antioxidant components in milk and their antioxidant potential value can be modified through animal nutrition (e.g., the use of various natural additives to animal diets). Feed additives used in animal nutrition have protective functions and act as metabolic regulators. Consequently, they contribute to improving the immunity of animals exposed to stress (weaning, diet change, or transport), cause efficient absorption of essential nutrients, and enhance the antioxidant protection provided by milk [22].

Conclusion

The nutritional profile of goat milk in the study obtained results in groups A, C and D into standard quality, while group E is in the Good category. Likewise, the fat content of groups C and D is in the Good category, while groups A, B and E are in the Premium category. Meanwhile, the total lactic acid bacteria is best in group E and in antioxidant in group C. It is necessary to do more in-depth analysis related to peptide n micronutrient of goat milk from different breeds.

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