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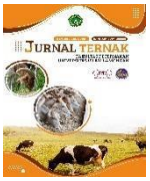

The Effect of Feeding *Indigofera zollingeriana* on Milk Production and Quality of Jawa Randu Goats in Kalukku District, West Sulawesi

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ABSTRACT

Jawa Randu goats are one of the local livestock breeds with considerable potential for milk production; however, both productivity and milk quality are highly influenced by feeding factors. This study aimed to evaluate the effect of *Indigofera zollingeriana* supplementation on milk production and quality of Jawa Randu goats in Kalukku District, West Sulawesi, Indonesia. The experiment was conducted from January to February 2026 using a Completely Randomized Design (CRD) with three treatments and five replications, involving a total of 15 goats. The treatments consisted of P1 (Pakchong Napier grass + 10% *Indigofera zollingeriana*), P2 (Pakchong Napier grass + 20% *Indigofera zollingeriana*), and P3 (Pakchong Napier grass + 30% *Indigofera zollingeriana*). The observed parameters included milk production and physical quality of milk (pH, specific gravity, and viscosity). Data were analyzed using analysis of variance (ANOVA) followed by Duncan's multiple range test. The results showed that supplementation with *Indigofera zollingeriana* had a significant effect ($P < 0.05$) on milk production of Jawa Randu goats, with the highest yield observed in treatment P2. However, the treatments did not significantly affect ($P > 0.05$) the physical quality of milk. The values of pH, specific gravity, and viscosity remained within normal ranges. In conclusion, the inclusion of *Indigofera zollingeriana* in the diet can improve milk production without adversely affecting the physical quality of milk.

Introduction

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Goat farming is one of the livestock subsectors that plays an important role in providing animal protein, particularly in the form of milk. Jawa Randu goats are one of the local dairy goat breeds with considerable potential for development due to their good adaptability to tropical environments and relatively high milk productivity. Jawa Randu goats are capable of producing milk throughout the year and often give birth to more than one offspring per kidding (Purbowati, 2015).

Fresh milk is one of the animal-derived food products that is rich in nutrients and easily digestible due to its liquid form. The quality of goat milk is not only determined by genetic factors but is also strongly influenced by management practices, particularly feeding. Feed is a crucial factor in supporting livestock productivity. High-quality feed affects both the composition and physical quality of milk, including color, aroma, and viscosity. Therefore, innovations in the provision of nutritionally rich and readily available feed resources for farmers are essential (Zein, 2013).

One of the potential sources of forage is the leguminous plant *Indigofera zollingeriana*, which belongs to a genus comprising approximately 700 species, with around 45 species distributed across tropical regions. *Indigofera* is a legume classified under the family Papilionaceae and has been cultivated for centuries due to its widespread use as a high-quality forage crop and its strong adaptability (Alagbe, 2021). This plant is characterized by its ability to grow up to 4–6 meters in height. It is known to contain high levels of crude protein (27.8%), crude fat (3.7%), crude fiber (14.96%), calcium (0.22%), and phosphorus (0.18%). In addition, it has good digestibility and tolerance to tropical environmental conditions. The use of *Indigofera zollingeriana* as an alternative feed source is expected to improve goat milk production, particularly in terms of its physical quality (Ali, 2015).

Feed provided to livestock should meet three essential components, namely basal feed (forage), concentrate, and supplementary feed. Forage is generally supplied at approximately 10% of body weight (BW), while concentrate, as a feed supplement, is provided at around 3% of dry matter (DM) based on body weight (Silvi, 2024).

Method

This study was conducted from January to February 2026 in Kalukku District, Mamuju Regency, West Sulawesi, Indonesia. A Completely Randomized Design (CRD) was applied, consisting of three treatments and five replications, involving a total of 15 Jawa Randu goats. The treatments were as follows: P1 = Pakchong Napier grass + 10% *Indigofera zollingeriana*; P2 = Pakchong Napier grass + 20% *Indigofera*

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zollingeriana; and P3 = Pakchong Napier grass + 30% *Indigofera zollingeriana*. The parameters observed included milk production and the physical quality of milk.

The feeding regimen was formulated based on 3% dry matter (DM) of body weight (BW), consisting of a basal diet supplemented with *Indigofera zollingeriana* and a balanced concentrate mixture. Drinking water was provided **ad libitum** to ensure optimal hydration and overall animal welfare.

Data Analysis

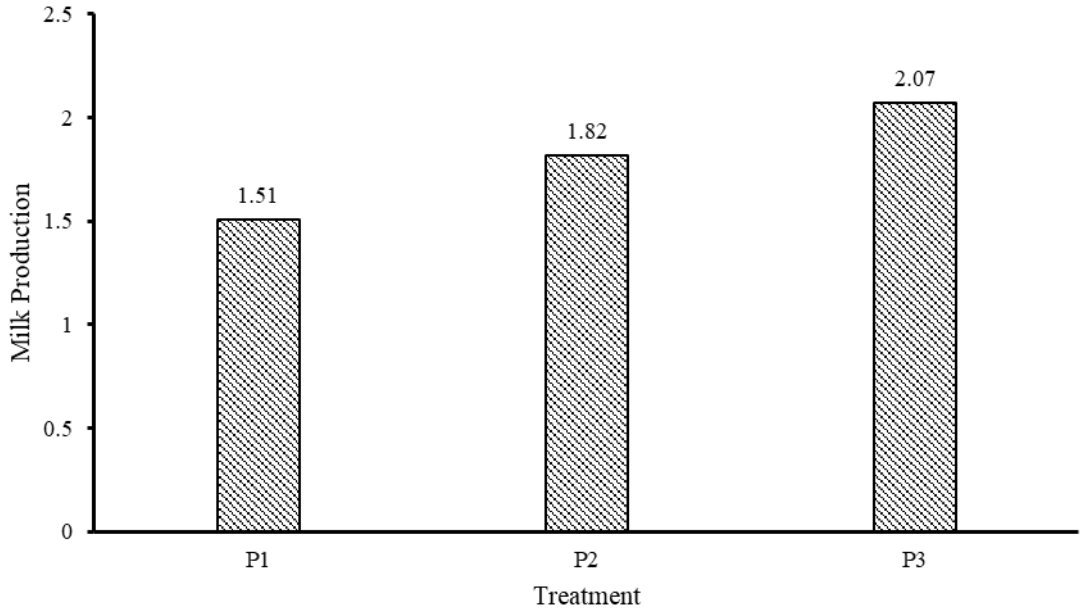
The data obtained were analyzed based on ANOVA using the software SPSS for Windows ver. 27. The experiment was conducted according to a completely randomized design with three treatments and five replications, and differences between treatments were tested using Duncan's test (Gaspersz, 1991).

Results and discussion

Data analysis and discussion

Milk Production

In general, goat milk production is strongly influenced by the quality of feed provided, as most of the precursors required for milk synthesis in the mammary gland are derived from the bloodstream, which is highly dependent on feed quality and nutrient absorption processes within the body. The results of feeding *Indigofera zollingeriana* on the milk production of Jawa Randu goats are presented in the following diagram.



Description: P1= Pakchong napier grass + 10% Indigofera Zollingeriana; P2= Pakchong napier grass + 20% Indigofera Zollingeriana; P3= Pakchong napier grass + 30% Indigofera Zollingeriana.

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The results of the statistical analysis indicated that the treatments had a significant effect ($P < 0.05$), suggesting that milk production is highly dependent on feed. High-quality feed provides greater nutrient availability in the bloodstream, which is closely associated with the process of milk synthesis in the secretory cells of the mammary gland, ultimately leading to increased milk yield and improved milk quality. Differences in milk production were also observed due to variations in milking intervals. This finding is consistent with the report of Adriani (2014), which states that milking interval is closely related to milk production; longer milking intervals tend to increase milk yield, whereas shorter intervals result in reduced milk production.

Livestock can achieve peak milk production at approximately 4–5 years of age. The amount of milk produced by individual animals varies, which may be attributed to factors such as genetic background, body size, pregnancy status, and overall health condition. Febriana (2018) reported that differences in milk production are influenced by genetic factors, including individual variation, heredity, length of lactation, lactation persistency, hormonal factors, pregnancy, and body size. The second group of factors is environmental, which includes feeding, milking management, animal care, diseases, and the use of medications.

Milk Quality

The physical quality of milk, including pH, specific gravity, and viscosity, showed that the treatments had no significant effect ($P > 0.05$) on all observed parameters. The pH values obtained were within the normal range, indicating that the milk remained stable and did not undergo significant changes in acidity. Similarly, the relatively uniform specific gravity across treatments suggests no differences in the concentration of dissolved solids in the milk. Milk viscosity also did not show significant variation, indicating that the consistency of the milk was relatively similar among all treatments.

Table. 2 Physical Quality of Milk from Jawa Randu Goats Fed *Indigofera zollingeriana*

Parameters	Treatment			*P-Value*
	P1	P2	P3	
Physical Quality of Milk				
pH	6.68±0.13	6.67±0.05	6.64±0.05[a]	0.28
Specific gravity (g ML^{-3})	1.03±0.00	1.02±0.00[b]	1.02±0.00[b]	0.32
Viscosity (cP)	1.53±0.02[a]	1.39±0.07[c]	1.43±0.07[b]	0.00

Description: P1= Pakchong napier grass + 10% Indigofera Zollingeriana; P2= Pakchong napier grass + 20% Indigofera Zollingeriana; P3= Pakchong napier grass + 30% Indigofera Zollingeriana. The average

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data of the parameter ± standard deviation. [a,b,c]Different superscripts on different lines show different influences.

pH of Goat Milk

The results of the analysis showed that the treatments had no significant effect on the pH of goat milk ($P > 0.05$). Each treatment exhibited pH values within the Indonesian National Standard (SNI) range of 6.3–6.8. Several factors may influence milk pH, including the milking environment, sanitation of housing and milking equipment, milking duration, and diseases caused by milk-borne bacteria, as well as the use of medications. Silvi (2024) reported that fluctuations in milk pH are associated with the conversion of lactose into lactic acid by microorganisms, along with enzymatic activity.

According to Ma et al. (2023), the pH value of goat milk was reported to be 6.76. Variations in goat milk pH may be attributed to several factors, including genetic differences and environmental influences, particularly the type and quality of feed provided. Other contributing factors include differences in chemical composition, lower concentrations of lactic acid, bacterial growth, and variations in mineral ratios. This is in line with the findings of Puspitarini (2015), who stated that changes in chemical composition may result from enzymatic activity in milk, particularly protease and lipase enzymes, which produce fatty acids and amino acids. Another contributing factor is the fermentation of lactose into lactic acid by lactic acid-producing microorganisms, such as *Streptococcus lactis*, as well as a decrease in carbon dioxide (CO_2) levels.

An increase in milk acidity results in a decrease in pH value. The pH value indicates the acidity of a substance; fresh milk exhibits amphoteric properties, meaning it can behave as both an acid and a base, with a typical pH range of 6.45 to 6.80. The pH was measured using a pH meter calibrated with standard buffer solutions at pH 4 and 7 prior to use. A 10 mL milk sample was collected, and the electrode was rinsed with distilled water. The electrode was then dried using tissue paper before being immersed in the sample. The electrode was allowed to equilibrate for a few moments, and the recorded value was taken once the pH meter reading had stabilized. Changes in milk pH are attributed to the activity of microorganisms capable of metabolizing acids naturally present in milk or those introduced during handling (Disa, 2017).

Specific Gravity of Goat Milk

The results of the statistical analysis showed that the treatments had no significant effect on the specific gravity of milk ($P > 0.05$). This condition may be influenced by the fat content of the milk, which has a negative relationship with specific gravity. Ratya (2017) stated that the specific gravity of milk depends on its fat content and total solids, as the

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density of fat is lower than that of water or milk plasma. An increase in the specific gravity of goat milk may also occur due to the release of dissolved gases such as carbon dioxide (CO_2) and nitrogen (N_2) from freshly milked milk.

Goat milk has certain advantages compared to cow milk, including smaller fat globules, which contribute to higher digestibility and lower allergenic potential (Disa, 2017).

Viscosity of Goat Milk

The results of the statistical analysis indicated that the treatments had no significant effect on milk viscosity ($P > 0.05$). The viscosity of goat milk ranged from 1.44 to 1.62 cP, with an average value of 1.53 cP. Viscosity refers to the degree of thickness or fluidity of milk. The viscosity value is associated with the coagulation of casein due to increased acidity resulting from the activity of bacterial cultures. Differences in viscosity values may also be attributed to variations in lactose content among milk samples. Lactose, when converted into lactic acid by lactic acid bacteria (LAB) producing the enzyme lactase, contributes to an increase in viscosity. This is consistent with Wibawanti and Rinawidiastuti (2018), who reported that higher lactic acid content in milk leads to increased viscosity. Furthermore, Park et al. (2007) reported that lactose content in cow milk is approximately 4.7%, whereas in goat milk it is around 4.1%.

Conclusion

The inclusion of *Indigofera zollingeriana* in the diet of Jawa Randu goats had a significant effect on increasing milk production, with the best results observed at the 20% inclusion level. However, the dietary treatment did not significantly affect the physical quality of milk, including pH, specific gravity, and viscosity. In general, the physical quality of the milk remained within normal ranges. Therefore, *Indigofera zollingeriana* can be recommended as an alternative feed resource to enhance milk production without compromising milk quality.

Conflict of Interest

This research has been approved by all authors and there is no conflict of interest either in funds or other matters concerning the interests of researchers.

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