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IMPROVING ETAWAH CROSSBREED GOATS MILK PRODUCTION AND QUALITY WITH LIQUID SMOKE FEED BLOCKS DIETARY SUPPLEMENTATION

Peningkatan Produksi dan Kualitas Susu Kambing Peranakan Etawah dengan Suplementasi Pakan Blok Asap Cair

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Abstract

Improving the productivity and milk quality of Etawah Crossbreed (PE) goats remains a challenge due to limited use of feed supplements that effectively support lactation performance. Liquid smoke contains antibacterial and antioxidant compounds that may enhance rumen fermentation when incorporated into block feed. This study aimed to evaluate the effects of liquid-smoke feed blocks dietary supplementation on feed intake, milk yield, and milk quality of lactating PE goats, as assessed by specific gravity, protein, fat, and lactose. This research using a Latin Square Design, with three PE goats were used in each treatment consisting of P0 (control), P1 (1% liquid-smoke block feed), and P2 (2% liquid-smoke block feed) and the experiment lasted nine weeks.. Results showed that block feed supplementation did not affect forage intake, which remained between 2.31–2.41 kg/head/day. Milk yield increased significantly in P1 and P2 compared to P0, with the highest production observed in P1 (773.81 ml/head/day). Milk quality parameters were not significantly affected by treatments, although all values remained within normal ranges. Based on research results, can be concluded that liquid-smoke block feed effectively improves milk yield without compromising milk quality in PE goats. Further studies with longer experimental periods are recommended to observe milk quality.

Keywords: Liquid smoke, Etawah grade goats, milk quality, block feed, milk yield

Abstrak

Peningkatan produktivitas dan kualitas susu kambing Peranakan Etawah (PE) masih menjadi tantangan akibat rendahnya pemanfaatan pakan tambahan yang mampu mendukung performa laktasi. Asap cair diketahui memiliki sifat antibakteri dan antioksidan yang berpotensi meningkatkan fermentasi rumen ketika diaplikasikan dalam bentuk pakan blok. Penelitian ini bertujuan untuk mengevaluasi efek pemberian suplementasi pakan blok berbasis asap cair terhadap konsumsi pakan, produksi susu, dan kualitas susu kambing PE laktasi yang ditinjau dari berat jenis, protein, lemak, dan laktosa. Penelitian menggunakan tiga ekor kambing PE dengan rancangan Bujur Sangkar Latin tiga perlakuan, yaitu P0 (kontrol), P1 (pakan blok asap cair 1%), dan P2 (pakan blok asap cair 2%). Pemeliharaan berlangsung selama sembilan minggu dengan pemberian hijauan, ampas tahu, dan pakan blok secara terukur. Hasil penelitian menunjukkan bahwa suplementasi pakan blok tidak memengaruhi konsumsi hijauan, yakni tetap berada pada kisaran 2,31–2,41 kg/ekor/hari. Produksi susu meningkat nyata pada P1 dan P2 dibanding P0, dengan produksi tertinggi pada P1 (773,81 mL/hari). Parameter kualitas susu tidak berbeda nyata antarperlakuan yang masihberada dalam kisaran normal. Dari hasil penelitian ini, dapat disimpulkan bahwa pakan blok asap cair efektif meningkatkan produksi susu tanpa menurunkan kualitas susu kambing PE. Disarankan penelitian lanjutan dengan durasi pemeliharaan lebih panjang untuk mengamati lebih lanjut perubahan kualitas susu.

Kata kunci: Asap cair, kambing pe, kualitas susu, pakan blok, produksi susu

INTRODUCTION

Etawah crossbred (PE) goats are classified as dual-purpose livestock, producing both milk and meat. In practice, cow milk production is far higher than goat milk production. However, in terms of quality, Dauda *et al.* (2025) and Yamauchi *et al.* (2010) reported that goat milk has a relatively high nutritional value, with a protein content of 4.38%, which is 0.84% higher than that of cow milk. In addition, goat milk has smaller and more homogeneous fat globules, making it easier to digest (Rahmadanti *et al.*, 2020).

Goat milk production in Indonesia shows significant potential to meet national milk demand. In 2023, goat milk production increased, with a focus on processing into value-added products such as powdered milk. PE goats have a higher milk-producing capacity than local goats, with yields ranging from 1.4 to 3.0 L/day. However, without proper management systems, optimal production cannot be achieved. Other limiting factors include low kid growth rates and suboptimal feeding practices (Adriani *et al.*, 2014).

Feed blocks are an alternative approach to overcome feeding constraints and have been proven beneficial for livestock. Their advantages include improving feed nutritional quality, enhancing digestibility and feed efficiency in cattle, goats, and sheep, and increasing feed intake in ruminants. These effects can accelerate weight gain or improve production performance and reproductive efficiency, while reducing the risk of vitamin and mineral deficiencies. Feed blocks containing molasses and urea can stimulate rumen microbial growth (Mastuti *et al.*, 2019) and help stabilize rumen pH (Antwi, 2014). Feed blocks can be formulated using various ingredients depending on availability and cost (Mastuti *et al.*, 2019).

Livestock prefer Urea Mineral Blocks (UMB) due to their high palatability (Yanuartono *et al.*, 2015). UMB supplemented with liquid smoke significantly increases organic matter digestibility and reduces protozoal populations *in vitro* (Aulyani *et al.*, 2024). Liquid smoke contains antibacterial and antioxidant compounds, including organic acids, alcohols, phenols, and other bioactive substances that inhibit pathogenic microorganisms such as *Escherichia*

coli, *Staphylococcus aureus*, and *Candida albicans*, and function as natural antibiotics (Jiang *et al.*, 2005; Yamauchi *et al.*, 2010). This study aims to evaluate the effects of liquid smoke–based feed blocks on milk production and milk quality in PE goats.

MATERIALS AND METHODS

Location and Research Subjects

The production of liquid smoke feed blocks was conducted at Campus I of Polbangtan Gowa. Milk quality analysis of PE goats was carried out at the Faculty of Animal Science, Hasanuddin University, while animal rearing was conducted at Zaafira Goat Farm, Jl. M. Ali Gassing No. 58, Balang Toa, Binamu District, Jeneponto Regency, South Sulawesi, from March to May 2025. A total of three PE goats were used in this study, with relatively uniform body weights ranging from 30 to 35 kg and the same lactation stage, namely second lactation.

Experimental Design

The study employed a Latin Square Design consisting of three treatments and three replications, resulting in a total of nine experimental units. The treatments were as follows: P0, basal diet consisting of forage at 10% of body weight plus 3 kg of tofu by-product; P1, basal diet plus feed block containing 1% liquid smoke; and P2, basal diet plus feed block containing 2% liquid smoke. Each treatment was replicated three times.

Preparation of Liquid Smoke Feed Blocks

All ingredients were weighed according to the composition of each treatment and grouped into solid and liquid components. Ingredients used in small quantities were mixed first and then gradually combined with those used in larger amounts. Salt and urea were dissolved in the liquid ingredients, and the solution was then gradually mixed into the solid components. The mineral blocks were subsequently molded and dried until fully hardened.

Management of PE Goats

Three PE goats with uniform body weights of 30–35 kg and the same lactation stage were used and maintained for nine weeks. Each goat received 3 kg of tofu by-product per day, while forage was provided twice daily. Feed blocks and drinking water were supplied ad libitum. Feed offered and refusals were recorded to determine feed intake, and daily milk production was recorded throughout the study.

Data Analysis

Observed data and analytical results were evaluated using analysis of variance (ANOVA) with SPSS software. When significant differences were detected at $p < 0.05$, Duncan's multiple range test was applied for further comparison.

RESULTS AND DISCUSSIONS

Results

Based on the study results, forage intake and milk production of goats supplemented with liquid smoke feed blocks are presented in Table 2. Forage intake did not differ significantly among treatments. The average forage intake ranged from 2.31 to 2.41 kg/head/day. Milk production increased significantly in P1 and P2 compared to P0. Group P1 showed the highest mean milk production at 773.81 ± 211.36, while group P2 also exhibited higher milk production than the control, although lower than P1 (Table 3). Supplementation with liquid smoke feed blocks did not have a significant effect on all milk quality parameters of PE goats. However, all values remained within normal ranges. Normal milk specific gravity for goat milk ranges from 1.028

to 1.036. Crude protein content ranged from 4.50 to 4.75%, with P1 and P2 showing higher values than P0. Crude fat content was also within the normal range (3.95–4.67%), where supplementation with 1% liquid smoke feed blocks reduced fat content to 3.95%, while lactose levels remained stable at 4.16–4.31% (Hasry *et al.*, 2025).

Discussion

Forage intake did not differ significantly among treatments receiving feed block supplementation, with intake values ranging from 2.31 to 2.41 kg/head/day. This indicates that supplementation with feed blocks containing up to 2% liquid smoke did not reduce forage palatability. Combined with the provision of 3 kg/head/day of tofu by-product, several studies have reported that complete feed block supplementation does not reduce forage intake as long as molasses and mineral contents are not excessive (Dagaew *et al.*, 2021; Rana *et al.*, 2025).

Milk production increased significantly in P1 and P2 compared to P0. Group P1 had the highest average milk production (773.81 ± 211.36), while group P2 also showed increased production compared to the control, although not as high as P1. This may be due to excessive liquid smoke supplementation reducing metabolic efficiency. Feed blocks generally contain molasses, minerals, bypass protein, or additional energy sources that enhance rumen microbial activity, improve fiber digestibility, and increase the supply of energy and amino acids for milk synthesis. These findings are consistent with previous studies reporting that feed block supplementation can increase goat milk production by 10–25% (Rahman *et al.*, 2025; Suharyono *et al.*, 2014).

Normal milk specific gravity for goat milk ranges from 1.028 to 1.036 (Arifin *et al.*, 2016). Statistical analysis showed that feed block supplementation did not significantly affect milk specific gravity among treatments. Specific gravity values in P1 and P2 remained within the normal range, whereas P0 was slightly higher than the normal range. This variation may be influenced by higher concentrations of dissolved nutrients (protein and fat), differences in water content, and physiological conditions of the animals. Supplementation with liquid smoke feed blocks appeared to stabilize milk specific gravity within the range of 1.030–1.033.

Statistical analysis indicated that liquid smoke feed block supplementation did not significantly affect milk protein content; however, supplemented groups showed higher values than the control. The greatest increase was observed in P1, with a crude protein content of 4.75%. This increase may be attributed to improved availability of glucogenic amino acids and enhanced rumen fermentation, leading to increased bypass protein. Recent studies have shown that feed blocks supplemented with protein and minerals can increase milk protein content by 5–12% (Rahman *et al.*, 2025; Suharyono *et al.*, 2014; Arifin *et al.*, 2016).

Supplementation with liquid smoke feed blocks did not result in significant differences in milk fat content among treatments. However, a reduction in milk fat content was observed in P1, possibly due to increased propionate fermentation reducing acetate and butyrate availability as fat precursors. According to Christi *et al.* (2024), moderate to high levels of energy supplementation can increase milk fat content, which was observed in P2. This suggests that increasing the level of liquid smoke in feed blocks up to 2% may provide additional energy for milk fat synthesis.

Lactose content was more stable than fat and protein, with no significant differences among treatments. Lactose concentration is primarily determined by glucose metabolism rather than feed type. This finding is consistent with previous reports indicating that feed supplementation rarely causes significant changes in milk lactose content. Christy *et al.* (2024) reported that

goat milk lactose levels typically range from 4.1 to 4.7% and remain relatively stable despite changes in ration composition.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the results of this study, forage intake remained stable across all treatments, as indicated by the absence of decreased palatability. Milk production increased significantly with supplementation of feed blocks at 1% and 2%. Milk quality parameters did not differ significantly after feed block supplementation. However, the P1 group showed the highest protein content and the lowest fat content compared with all treatments, although these differences were not statistically significant. Overall, the results indicate that liquid smoke feed blocks can be used as a supplementary feed with potential to improve milk quality in lactating PE goats.

Recommendation

A longer feeding and data collection period is recommended, as feed metabolism requires more time to exert measurable effects on milk quality.

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Tables

Table 1. Composition of Mineral Feed Blocks

Feed ingredients	Composition	
	1%	2%
Coconut water	29	28
Urea	5	5
Rice bran	30	30
Corn	10	10
Soybean meal	10	10
Tapioca	10	10
Mineral mix	2	2
Salt	3	3
Liquid smoke	1	2

Table 2. Forage intake and milk production of Etawah crossbred (PE) goats

Parameter	Group		
	P0	P1(1%)	P2(2%)
Forage intake (kg/head/day)	2.31±0.22	2.41±0.24	2.37±0.24
Day milk production (mL)	650±232.03[a]	773.81±211.36[b]	704.76±133.64[b]

Note: Different superscripts within the same row indicate significant differences ($p<0.05$)

Table 3. Milk quality of PE goats supplemented with liquid smoke feed blocks

Parameter	Group		
	P0	P1(1%)	P2(2%)
Milk specific gravity	1.06±0.04	1.03±0.00	1.03±0.00
Crude protein content (%)	4.50±0.10	4.75±0.44	4.65±0.32
Crude fat content (%)	4.42±0.47	3.95±1.03	4.67±0.07
Milk lactose content (%)	4.20±0.57	4.31±0.38	4.16±0.79