Research Article

Physical Characteristics and Consumption Duration of Urea Molasses Mineral Blocks Enriched with Red Calliandra (*Calliandra calothyrsus*) Leaves

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Abstract | Urea Molasses Mineral Blocks (UMMB) are widely used as nutritional supplements for ruminants, and their physical quality influences intake and feeding effectiveness. This study investigated the effect of red calliandra (*Calliandra calothyrsus*) leaf meal inclusion as a filler material on the physical characteristics and consumption duration of UMMB. A completely randomized design consisting of four treatments and five replications was applied using different proportions of calliandra leaf meal and cassava flour. Physical characteristics evaluated included moisture content, density, specific gravity, water absorption capacity, color, texture, and aroma, while consumption duration was observed under field conditions. The results showed that inclusion level significantly affected moisture content, density, specific gravity, and water absorption capacity ($P<0.05$), whereas color and texture scores were not significantly affected ($P>0.05$). Aroma scores increased with higher inclusion levels of calliandra leaf meal. Among the tested formulations, UMMB containing 20% calliandra leaf meal showed the most favorable balance between physical stability and consumption duration. These findings indicate that red calliandra leaf meal has potential as an alternative filler ingredient in UMMB formulations.

Keywords | *Calliandra calothyrsus*, UMMB, Physical properties, Consumption behavior

Received | April 15, 2026; **Accepted** | June 05, 2026; **Published** | July 18, 2026
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Citation | Pramadani TE, Rosani U, Ramadhan RF, Darmayani DE (2026). Physical characteristics and consumption duration of urea molasses mineral blocks enriched with red calliandra (*Calliandra calothyrsus*) leaves. Adv. Anim. Vet. Sci., 14(7):1492-1495.
DOI | https://dx.doi.org/10.17582/journal.aavs/2026/14.7.1492.1495
ISSN (Online) | 2307-8316

INTRODUCTION

Sustainable dairy production in tropical smallholder systems is highly dependent on feed availability and quality, which often fluctuate seasonally, particularly during prolonged dry periods. Under these conditions, farmers commonly rely on low-quality fibrous feeds that are insufficient to support optimal productivity. Urea Molasses Mineral Blocks (UMMB) have been widely utilized as practical supplements for ruminants because they supply non-protein nitrogen, fermentable energy, and minerals that improve rumen microbial activity and utilization of low-quality roughages (Patil *et al*., 2017). Previous studies also reported that UMMB supplementation improved feed digestibility, animal performance, and milk production in ruminants (Lawania and Khadda, 2017; Mobashar

et al., 2023). In addition to nutrient composition, the effectiveness of UMMB is influenced by physical quality characteristics such as density, moisture stability, hardness, and rate of consumption.

Red calliandra (*Calliandra calothyrsus*) is a tropical legume with relatively high crude protein content and moderate fiber levels, making it a potential local ingredient for UMMB production (Zulfa *et al*., 2019). Its fibrous structure may contribute to improved compactness and slower consumption of the block. However, increasing inclusion levels may also alter moisture content, density, and organoleptic characteristics. Despite its potential, information regarding the use of calliandra leaf meal as a filler material in UMMB formulations remains limited.

Therefore, this study was conducted to evaluate the effects of different inclusion levels of red calliandra leaf meal on the physical characteristics, organoleptic properties, and consumption duration of UMMB. It was hypothesized that moderate inclusion levels would improve block physical quality while maintaining a more controlled consumption pattern in dairy cattle.

MATERIALS AND METHODS

This study was conducted from December 2025 to February 2026 at the Ruminant Nutrition and Feed Chemistry Laboratory, Faculty of Animal Science, Universitas Padjadjaran. A Completely Randomized Design (CRD) consisting of four treatments and five replications was applied. The treatments consisted of different proportions of calliandra (*Calliandra calothyrsus*) leaf meal and cassava flour as filler materials in UMMB formulations: P1 (10% calliandra leaf meal + 30% cassava flour), P2 (20% + 20%), P3 (30% + 10%), and P4 (40% + 0%).

Fresh calliandra leaves were oven-dried at 55°C for 24 h and ground into leaf meal. UMMB was produced using a modified heating method by mixing urea, molasses, mineral mix, salt, white cement, cassava flour, and calliandra leaf meal according to each treatment formulation. The mixture was homogenized, molded using a hydraulic press, and dried at 60°C until constant weight was achieved.

Parameters observed included moisture content, density, specific gravity, water absorption capacity, organoleptic properties (color, aroma, and texture), and consumption duration. Organoleptic evaluation was conducted by 20 semi-trained panelists using a hedonic scoring method. Consumption duration was observed under field conditions using dairy cattle at the Wargi Saluyu farmer group for two weeks. Data were analyzed using Analysis of Variance (ANOVA), followed by Duncan's Multiple Range Test at $P<0.05$.

RESULTS AND DISCUSSION

The inclusion of red calliandra (*Calliandra calothyrsus*) leaf meal significantly affected several physical characteristics of UMMB ($P<0.01$). Moisture content increased from 7.718% in P1 to 11.498% in P4, indicating greater water retention at higher inclusion levels. This response was likely related to the fibrous structure of calliandra leaves, which can retain moisture within the block matrix (Setyawati *et al*., 2019; Taiyeb, 2023). In contrast, density and specific gravity decreased progressively with increasing calliandra inclusion, with density values declining from 1.408 g/cm^3 in P1 to 0.990 g/cm^3 in P4 and specific gravity decreasing from 1.098 to 0.887 g/mL. The reduction in compactness was likely associated with the lower proportion of cassava flour, which contributed binding properties through starch gelatinization during heating.

Water absorption capacity also increased significantly ($P<0.01$), ranging from 0.637% in P1 to 27.142% in P4. Higher fiber content likely produced a more porous structure that absorbed water more easily (Setyawati *et al*., 2019; Taiyeb, 2023). Excessive water absorption may reduce block durability and accelerate erosion during feeding or storage under humid tropical conditions (Patil *et al*., 2017). These findings suggest that excessive substitution of cassava flour with calliandra leaf meal may negatively affect the physical stability of UMMB.

Organoleptic evaluation showed that color and texture scores were not significantly affected by treatment ($P>0.05$), whereas aroma scores increased significantly with higher levels of calliandra inclusion ($P<0.01$). The stronger aroma was likely associated with phenolic and secondary compounds naturally present in calliandra leaves (Setyawati *et al*., 2019). The relatively similar texture among treatments indicated that binder ingredients such as cassava flour, molasses, and cement contributed more strongly to the perceived texture of the blocks.

Differences in physical characteristics were also reflected in consumption behavior under field conditions. Treatments P1 and P2 tended to persist longer and were consumed more gradually than P3 and P4, likely due to their higher density and lower water absorption capacity. More compact blocks are generally less susceptible to breakage and excessive erosion during feeding. Controlled consumption of UMMB is desirable because it may help regulate supplement intake and reduce the risk of excessive short-term urea consumption (Lawania and Khadda, 2017; Kerketta *et al*., 2017). Based on the combined evaluation of physical quality and observed consumption duration, treatment P2 containing 20% calliandra leaf meal showed the most favorable balance among the tested formulations.

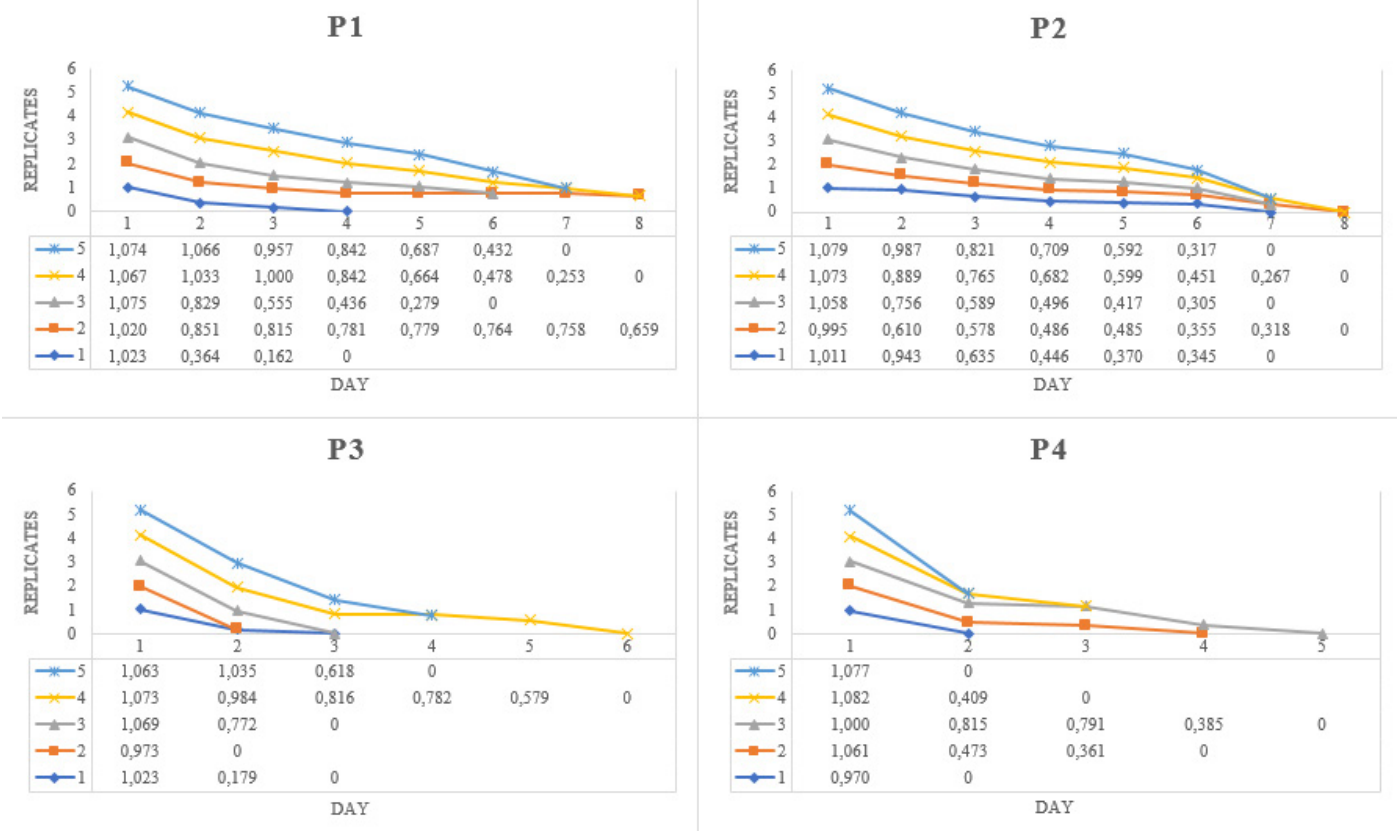

Figure 1: Consumption duration of UMMB.

Table 1: Physical characteristics of UMMB.

Parameters	P1	P2	P3	P4	P-value
Moisture content (%)	7.718 ± 0.099^{c}	7.917 ± 0.541^{bc}	8.757 ± 1.449^{b}	11.498 ± 1.591^{a}	P < 0.001
Density (gram/cm^{3})	1.408 ± 0.023^{a}	1.316 ± 0.039^{a}	1.147 ± 0.117^{b}	0.990 ± 0.097^{c}	P < 0.001
Specific gravity (gram/ml^{3})	1.098 ± 0.016^{a}	1.059 ± 0.034^{a}	0.982 ± 0.053^{b}	0.887 ± 0.038^{c}	P < 0.001
Water absorption (%)	0.637 ± 0.158^{c}	1.494 ± 0.028^{c}	7.586 ± 1.605^{b}	27.142 ± 6.258^{a}	P < 0.001

Different superscripts show very real differences (P<0.01).

Table 2: Physical characteristics organoleptics of UMMB.

Treatment	Average		
	Color	Aroma	Texture
P1	2.91 ± 0.91^{a}	2.02 ± 0.29^{c}	3.19 ± 0.30^{a}
P2	3.31 ± 0.70^{a}	2.35 ± 0.26^{bc}	3.14 ± 0.44^{a}
P3	3.37 ± 0.63^{a}	2.53 ± 0.29^{ab}	2.92 ± 0.66^{a}
P4	3.66 ± 0.36^{a}	2.72 ± 0.17^{a}	2.94 ± 0.24^{a}
Significancy	0.398	0.004	0.606

Different superscripts show very real differences (P<0.01).

CONCLUSION

The inclusion of red calliandra (*Calliandra calothyrsus*) leaf meal affected the physical characteristics and consumption behavior of Urea Molasses Mineral Blocks (UMMB). Higher inclusion levels increased moisture content and water absorption capacity while reducing density and specific gravity of the blocks. Among the tested formulations, the inclusion of 20% calliandra leaf meal provided the most favorable balance between physical stability and gradual consumption under field conditions. These findings suggest that moderate inclusion of red calliandra leaf meal has potential as an alternative local filler ingredient in UMMB formulations for ruminants.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Universitas Padjadjaran, PT Fenanza Putra Perkasa for providing the mineral mix, and Haurngombong Village for permitting the palatability test on dairy cows.

NOVELTY STATEMENT

Novelty of this study lies in the utilization of red calliandra (*Calliandra calothyrsus*) leaf flour as a local filler ingredient in UMMB formulation and the effects on

physical characteristics and consumption duration. The study demonstrates that incorporating 20% red calliandra leaf flour can produce UMMB with balanced physical characteristics and acceptable intake by dairy cattle, providing a promising strategy for developing locally sourced feed supplements.

AUTHOR'S CONTRIBUTION

Tahta Ersi Pramadani conducted the experiment, collected the data, performed data analysis, and drafted the manuscript. Urip Rosani contributed to the conceptualization, methodology, supervision, critical revision of the manuscript, and funding acquisition through the "UNPAD BERMANFAAT" Community Service Grant (Hibah Pengabdian pada Masyarakat Universitas Padjadjaran Tahun 2025) under Contract Number: 2625/UN6.J/PM.01/2025. Rahmad Fani Ramadhan contributed to supervision and data validation. Dian Eka Darmayani contributed to editing the manuscript.

Generative AI and AI assisted technology statement

The authors declare that generative artificial intelligence (AI) tools were used solely to assist in language refinement and improving the clarity of the manuscript. The AI did not contribute to the study design, data collection, analysis, or interpretation of results. All content has been reviewed and validated by the authors, who take full responsibility for the integrity and accuracy of the work.

Conflict of interest

The authors have declared no conflict of interest.

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