How to Cite
Cakra, I. G. L. O., Trisnadewi, A. A. A. S., Melati, N. P. Y., & Nuriyasa, I. M. (2024). Replacement of elephant grass with urea lime molasses straw mixed on rumen metabolite, digestibility, and blood chemistry of Etawah crossbred goat. *International Journal of Life Sciences and Earth Sciences*, *7*(1), 48-54. https://doi.org/10.21744/ijle.v7n1.2294

Replacement of elephant grass with urea lime molasses straw mixed on rumen metabolite, digestibility, and blood chemistry of Etawah crossbred goat

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Abstract---*This study aims to examine the level of use of Urea Lime Molasis Straw (ULMS) as a substitute for elephant grass in the Etawah crossbreed goat ration. The study used four female goats weighing 25 - 36 kg with a 4 x 4 Latin square design. Livestock were placed in the metabolism cage individually. The provision of ration was conducted according to the dry material requirement, which is 3% of body weight. Feeding was carried out twice daily in the mornings at 08.00 and afternoons at 16.00, and drinking water was provided ad libitum. The variables observed were consumption, coefficient of dry matter and nutrients, rumen metabolite products and blood chemistry propyl. The variables measured were the nutritional content, consumption, rumen metabolite products, digestibility coefficient, and blood chemistry levels. The replacement of elephant grass with ULMS up to 40% of the 60% forage in the ration did not significantly affect digestibility, rumen fluid pH, BUN, or total blood protein, but had a significant effect on the consumption of dry matter, and organic matter, rumen NH3, and VFA levels.*
Keywords---*digestibility, elephant grass, goats, ULMS.*

Introduction

Goat Farming business requires a continuous availability of sufficient forage feed in terms of quality and quantity. However, it can be hard to procure due to the reduced area of land for planting livestock food crops. To overcome the forage scarcity, farmers often utilize rice straw as a substitute feed (Abdelaziz et al., 2018). Rice straw (*Oriza sativa*) is a potential agricultural waste as well as a fresh forage alternative feed source. However, unprocessed rice straw is classified as a low-quality fiber feed with a crude fiber content of 30.85%, high levels of silica and oxalate, minerals (Ca, P, Mg, Cu, Zn, Mn, Fe and S) and vitamins (A, D3 and E) low (Xiumin et al., 2019).

Urea supplementation in rice straw can be carried out to increase the source of ammonia (nitrogen). However, it rapidly releases nitrogen (N) in the rumen, which forms ammonia, therefore, excessive doses result in poisoning and even death of cattle (Nururrozi, 2018). Cakra et al. (2015), found that the addition of 4% urea in concentrate combined with 50% cassava increases the growth and efficiency of the used feed. Furthermore, the synthesis of optimal microbial proteins requires a balance between energy (VFA) and nitrogen in the form of $N\text{-}NH_3$. The food ingredients commonly used in carbohydrate sources are called molasses. Cakra et al. (2018), stated that the use of

ISSN 2632-9425
Submitted: 27 May 2024 |Revised: 18 June 2024 | Accepted: 09 July 2024

25% molasses in a mixture containing urea and limestone molasses had the best nutrient content with crude protein of 12.81%, a dry matter digestibility of 54.25% and in vitro organic matter digestibility of 59.6%.

Finally, based on the potential nutrient content of rice, urea and molasses, this research aims to determine the effect of the replacement of elephant grass with urea, lime, molasses straw mixer (ULMS) in rations against digestibility, products of rumen metabolites and blood chemistry of etawah crossbred goat.

Materials and Methods

Livestock, ration and research draft

In this study, 4 female goats which were 15 months old with a body weight ranging between 25 – 36 Kg were randomly placed in the experimental cage, and then a 4 x 4 Latin square design randomization was applied to ascertain the effect of elephant grass with ULMS, on the consumption, dry material, digestibility coefficient, rumen metabolite and blood chemical propyl. Four test rations are made with iso-nitrogen, material composition and nutritional content presented in Table 3. The treatment rations include: T1 (elephant grass 60% + Concentrate 40%); T2 (Elephant grass 40% + ULMS 20% + Concentrate 40%); T3 (Elephant grass 30% + ULMS 30% + Konsentrat40%); T4 (Elephant grass 20% + ULMS 40% + Concentrate 40%). Concentrate is made with the composition of ingredients and nutrient content as in Table 1. ULMS is made from dried straw materials, prilled urea, lime, and molasses, and its composition and nutritional content are shown in Table 2. Livestock were placed in the metabolism cage individually. The provision of ration was conducted according to the dry material requirement, which is 3% of body weight. Feeding was carried out twice daily in the mornings at 08.00 and afternoons at 16.00, and drinking water was provided ad libitum. Furthermore, key measurements and sample collections were carried out which included the given feed, residual feed, concentrate samples, elephant grass, ULMS, feces and urine production daily at 07.00. All samples collected were placed in an oven at 60ºC for 72 hours except urine. Furthermore, samples of feces and feed were ground and stored in the lab for subsequent analysis.

Table 1
Concentrate composition and nutrient contains

Feed ingredients		Nutrients (%)				TDN
	Composition (%)	Dry Matter	Crude Protein	Crude Fat	Crude Fiber	
Yellow Corn	25	22.25	0.83	0.18	1.33	21.25
Molasses	5	2.51	0.43	0.00	0.00	3.15
Rice bran	50	45.63	4.98	1.16	9.26	27.76
Soybeans	17	15.20	8.85	0.17	4.34	6.85
$CaCO_3$ (Lime)	1	0.90	0.00	0.00	0.00	0.00
Salt	1.9	1.71	0.00	0.00	0.00	0.00
Pignox	0.1	0.09	0.00	0.00	0.00	0.00
Total	100	88.30	15.08	3.51	14.92	59.01

Table 2
Composition of Urea Lime Molasses Straw (ULMS)

Material			Nutrient (%)			TDN
	Composition	Dry Matter	Crude Protein	Crude Fat	Crude Fiber	
Molasses	15.0	7.535	1.275	0.000	0.000	9.450
Urea	2.0	1.800	5.620	0.000	0.000	0.000
Lime	1	-	-	-	-	-
Rice straw	82.0	76.360	4.325	0.968	24.435	42.742
Total	100	85.695	11.220	0.968	24.435	52.192

Table 3
Ration treatment

	Treatment			
Material /Nutrient	T1	T2	T3	T4
Concentrate	40	40	40	40
Elephant grass	60	40	30	20
ULMS	0	20	30	40
	Nutritional content			
Dry Matter	88.72	81.92	78.52	75.12
Crude Protein	11.97	11.23	10.86	10.49
Crude Fat	2.42	2.32	2.26	2.21
Crude Fiber	23.97	24.69	25.05	25.41
TDN	51.20	54.16	55.64	57.11

[1)] T1 = (Elephant grass 60% + Concentrate 40%), T2 = (Elephant grass 40% + ULMS 20% + Concentrate 40%), T3 = (Elephant grass 30% + ULMS 30% + Concentrate 40%), T4 = (Elephant grass 20% + ULMS 40% + Concentrate 40%).
[2)] SEM= Standard Error of Mean

Digestibility and sampling measurement

The experimental duration spanned 21 days, of which 15 involved feed and 1 day of blood sampling and rumen collection. At the end of each period, the rumen pH sample was measured with a pH meter (Orion Research Portable Meterdivided into two parts. A portion was used for the analysis of NH3-N and VFA where 3 were centrifuged at 16,000 × G for 15 minutes and the supernatant was stored at-20 °C (Methyl-green Formaline Salts (Ogimoto & Imahi, 1981), to calculate the rumen fluid 4 hours after feeding. Finally, the blood samples were centrifuged at 4 °C before analysis (Castro et al., 2007; Drew et al., 2007).

Laboratory Analysis

Parameters observed during the study included pH with a pH meter, total VFA with the Steam Distillation Technique (General Laboratory Procedure, 1969), and NH_3 rumen using the phenol-hypochlorite method with readings via a Spectrophotometer (Safitri et al., 2021). The feces and feed nutrient content analysis was carried out according to the procedure discovered by Kjeldahl AOAC (1990). The digestive coefficient was calculated using the formula given by Schneider & Flatt (1975). Meanwhile, Blood urea Nitrogen (BUN) was determined according to the Crocker Method (1967).

Result and Discussion

Ingestion, production of feces and urine

Statistically, the results of the consumption of dry materials on T1, T2, T3 and T4 showed a noticeable improvement, (Table 4). This condition occurs due to the use of ULMS containing urea, lime, molasses and straw which increase ration palatability, therefore, it is more readily consumed. Increased consumption of dry materials affects the consumption of organic matter and crude fiber. The crude fiber consumption significantly increased in T2, T3 and T4. This increase can be attributed to a corresponding increase in consumption and crude fiber content due to the replacement of elephant grass with ULMS. The feces production was significantly higher in the T4 treatment compared with that of T1. This occurred due to the increased consumption of crude fiber in the T4 treatment, therefore it increased the feces production. Lastly, urine production in all four different treatments was not significantly different, which shows that increased consumption of urea resulting from ULMS consumption does not affect urine production (Alaneme et al., 2016; Machado et al., 2017).

Table 4
Effect of replacing elephant grass with ULMS against ingestion, feces defecation and urine production

Treatment Material (g DM)	T1	T2	T3	T4	SEM
Elephant grass	336.00 [a]	219.75 [b]	183.37 [c]	164.25 [d]	33.18
Concentrate	385.00 [a]	385.00 [a]	385.00 [a]	385.00 [a]	39.93
ULMS					
Dry materials	721.00 [c]	853.38 [b]	855.25 [b]	931.75 [a]	52.00
Organic matter	649.39 [c]	722.45 [b]	717.24 [b]	768.11 [a]	54.48
Crude Protein	88.33 [a]	96.39 [a]	95.95 [a]	101.38 [a]	10.36
Crude fiber	135.16 [d]	167.23 [c]	191.14 [b]	241.79 [a]	19.00
Crude Fat	77.41 [a]	100.10 [a]	103.16 [a]	112.48 [a]	10.66
Nitrogen-free extract fractions	85.89 [a]	83.02 [a]	86.57 [a]	82.82 [a]	1.33
Total Digestion Nutrient	83.64 [a]	78.79 [a]	77.25 [a]	74.98 [a]	1.90
Feces defecation	199.93 [b]	236.13 [a]	229.05 [a]	264.32 [a]	14.79
Urine production (ml/goat)	731.05 [a]	697.85 [a]	681.00 [a]	654.25 [a]	78.29

[1)] T1 = (Elephant grass 60% + Concentrate 40%), T2 = (Elephant grass 40% + ULMS 20% + Concentrate 40%), T3 = (Elephant grass 30% + ULMS 30% + Concentrate 40%), T4 = (Elephant grass 20% + ULMS 40% + Concentrate 40%).
[2)] SEM= Standard Error of Mean

Digestibility coefficient of dry matter and ratio nutrients

The average digestibility coefficient of dry and organic matter, protein and crude fiber extracts without N and crude fat had insignificant differences between treatments (Table 5). This shows that the use of elephant grass as a source of crude fiber in goat rations can be replaced with ULMS up to 40%. Moreover, the average digestibility coefficient of crude fiber between treatments was not statistically significant ($P < 0.05$). However, the average number tended to increase due to the presence of urea and molasses in ULMS which in turn increased the production of NH_3 and VFA in the predicted rumen (Table 7). The increase in rumen microbes, especially cellulolytic bacteria, resulted in a higher crude fiber digestibility coefficient, due to an increase in crude fiber content from T1 to T4. Moreover, Kartinaty et al. (2021), observed that NH_3 production has decreased and microbial protein synthesis has increased due to the increased addition of molasses.

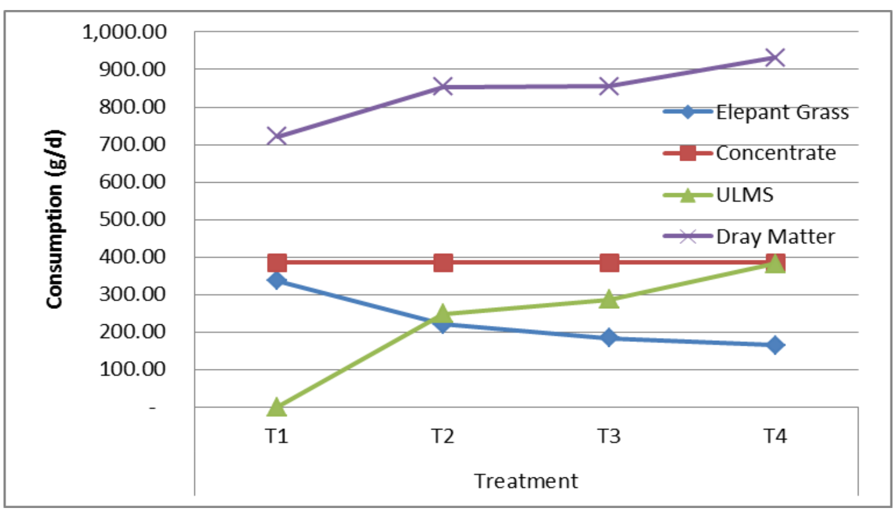

Table 5
Effect of Replacing Elephant Grass with ULMS on Dry Matter Digestibility Coefficient and Ration Nutrient

	Treatment				
Digestibility Coefficient (%)	T1[1)]	T2	T3	T4	SEM[2)]
Dry Material	72.34 [a]	72.06 [a]	72.73 [a]	70.88 [a]	2.53
Organic Ingredients	75.23 [a]	74.19 [a]	75.27 [a]	73.25 [a]	2.23
Crude protein	75.04 [a]	72.68 [a]	70.82 [a]	70.39 [a]	2.41
Crude Fiber	66.41 [a]	69.39 [a]	70.58 [a]	69.53 [a]	9.09
Nitrogen-free extract fractions	85.89 [a]	83.02 [a]	86.57 [a]	82.82 [a]	1.33
Total Digestible Nutrients	83.64 [a]	78.79 [a]	77.25 [a]	74.98 [a]	1.90
Crude Fat	62.20 [a]	66.82 [a]	66.20 [a]	66.90 [a]	3.67

[1)] T1 = (Elephant grass 60% + Concentrate 40%),
T2 = (Elephant grass 40% + ULMS 20% + Concentrate 40%), T3 = (Elephant grass 30% + ULMS 30% + Concentrate 40%), T4 = (Elephant grass 20% + ULMS 40% + Concentrate 40%).
[2)] SEM = Standard Error of Mean

The results of the blood chemistry examination showed that the levels of triglyceride acid, glucose, cholesterol, bread and total protein were still within the normal ranges and blood urea concentrations generally reflected the level of N balance in the rumen.

Urea is the final product of protein metabolism in the animal body and it is excreted in urine. Blood urea originates from ammonia and amino acid catabolism residues in the rumen (Tillman et al., 1998). According to Rachmat et al. (2023), blood urea levels in lactating goats range between 29 - 39 mg/dl. Tahuk *et al*. (2021), discovered that the average blood urea level in lactating goats was 40.87 mg/dl. High blood urea levels indicate that the conversion of rumen NH_3 to amino acids for microbial protein synthesis is not optimal. In contrast, a low blood urea level indicates the conversion of NH_3 to amino acids for maximum microbial protein synthesis. The results of this study found that the content of blood urea between treatments was not significantly different, which indicates that giving ULMS containing urea did not affect blood urea levels (Kholif et al., 2021; Solaiman et al., 2009). Dissolved proteins in the blood are called blood proteins, and feed is a source of blood protein. The level of total protein concentration in the blood is highly dependent on the amounts of amino acids absorbed through the intestinal wall (Takarini et al., 2023). Blood protein levels in lactating goats ranged from 6.109 to 6.891 g/dl according to Sam *et al*. (2019). However, Sidik & Rachmawati (2018), discovered that blood protein levels in lactating goats ranged between 5.98 and 9.10 g / dl. Furthermore, according to, it ranges between 5.9 and 7.8 g/dl. The analysis of the total blood protein levels between various treatments showed no significant difference (Table 6). Conclusively, in terms of blood protein content, ULMS can replace elephant grass up to 40% of the 60% forage in goat rations.

Table 6
The effect of replacing elephant grass with ULMS on the chemical profile of blood 4 hours after eating

	Treatments				
Variables	T1[1)]	T2	T3	T4	SEM[2)]
Triglyceride Acid	25.75 [a]	19.25 [c]	21.25 [b]	26.00 [a]	1.3901
Glucose	80.86 [a]	66.74 [b]	62.63 [c]	63.16 [c]	1.2520
Cholesterol	162.31 [c]	250.59 [a]	249.87 [a]	226.74 [b]	16.4421
BUN	16.15 [a]	18.65 [a]	17.25 [a]	15.20 [a]	0.9809
Protein Total (g/dl)	9.02 [a]	8.84 [a]	9.37 [a]	8.81 [a]	0.2622

[1)] T1 = (Elephant grass 60% + Concentrate 40%),
T2 = (Elephant grass 40% + ULMS 20% + Concentrate 40%), T3 = (Elephant grass 30% + ULMS 30% + Concentrate 40%), T4 = (Elephant grass 20% + ULMS 40% + Concentrate 40%).
[2)] SEM = Standard Error of Mean

The analysis of variance (Table 7) showed that the rumen concentration of ammonia between treatments was not significantly different. This shows that elephant grass feed and ULMS possess quite similar abilities to produce ammonia in the rumen. Its concentration is influenced by the protein content in feed, rumen pH, protein solubility, and time after feeding (Suriani & Darmadi, 2019). Rumen microbes work optimally to break down amino acids into ammonia at pH 6-7 conditions. About 82% of these microbes break down amino acids into ammonia, which is a major source of the body's protein. Furthermore, Table 7 showed that the pH of the rumen fluid between treatments was not significantly different. This is because the two ingredients, both elephant grass and ULMS produce quite similar products. Additionally, an acidic (low) pH in the rumen reduces the microbial activity here (Sam et al., 2019).

The VFA concentration in the rumen is an illustration of the feed fermentation rate efficiency level in the rumen of ruminants (Suherman et al., 2013). VFA production in the rumen is highly dependent on the type of microbe, the absorption rate in its wall, and the type of feed given (Ismartoyo et al., 2023). The relationship between protein and carbohydrate sources greatly affects the final product of the VFA produced. The analysis of variance (Table 7) showed that the VFA levels of the rumen fluid significantly increased ($p>0.05$) from the T1, T2, T3 and T4 treatments. This shows that ULMS produces the highest VFA compared to other treatments. This can be caused by the presence of molasses in ULMS as a soluble carbohydrate. Therefore, it produces high microbial protein due to the presence of NH3 availability which is significantly higher in T3 and T4 treatments.

Table 7
Effect of replacing elephant grass with ULMS against rumen metabolite products 4 hours after eating

	Treatment				
Variables	T1	T2	T3	T4	SEM
pH of rumen fluid	6.88 ^{a}	6.76 ^{a}	6.78 ^{a}	6.76 ^{a}	0.04
NH_3 rumen (mM)	7.90 ^{c}	10.37 ^{b}	14.52 ^{a}	17.06 ^{a}	0.84
Total VFA (mM)	90.97 ^{d}	114.83 ^{c}	112.88 ^{b}	131.97 ^{a}	4.58

Conclusion

The replacement of elephant grass with ULMS with about 40% of the 60% forage in the ration has no significant effect on digestibility, rumen fluid pH, BUN, and total blood protein. Conversely, it has a significant effect on the consumption of dry and organic matter, NH_3 levels as well as VFA in the rumen.

Suggestion
ULMS can be used as a feed source and fiber substitute for elephant grass, up to 40% of the total feed composition.

Acknowledgement
The authors express their gratitude to the chancellor of Udayana University through LPPM for financially supporting this research.

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