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Research Article

Molasses Multinutrient Soft (MMS): A Supplement for Ruminants Derived from Urea Molasses Multinutrient Block (UMMB)

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Abstract

This research was conducted to evaluate the effects of adding UMMB and MMS on feed consumption, weight gain, feed conversion and digestibility of crude fiber in Bali cattle (*Bos javanicus*). This study used 12 male Bali cattle (*Bos javanicus*) aged between 2 to 3 years, weighing between 150250 kg. The cattle were intensively reared using a completely randomized design, divided into 3 treatments with 4 replications each. The feed provided to the research animals consisted of forage, UMMB, and MMS. Parameters measured included feed consumption, weight gain, feed conversion and digestibility of crude fiber. The data obtained were then analyzed using ANOVA with the assistance of SPSS software Ver. 23. The results of the research showed Bali cattle (*Bos javanicus*) supplemented with MMS (P_2) tended to have a higher consumption rate of 17.98 ± 5.48 kg/head/day compared to the control and those supplemented with UMMB (P_1). Bali cattle (*Bos javanicus*) supplemented with MMS (P_2) tended to have a higher daily weight gain of 0.39 ± 0.06 kg/head/day compared to the UMMB treatment (P_1). The treatment with MMS supplementation (P_2) demonstrated the highest feed efficiency compared to the other treatments, because only 47.93 kg of feed was required to produce 1 kg of meat. Nevertheless, Supplementation of UMMB and MMS showed no significant difference ($p > 0.05$) in terms of weight gain, feed intake, and feed conversion ratio in Bali cattle (*Bos javanicus*). However, there is a significant difference ($p < 0.05$) in the parameter of crude fiber digestibility.

Introduction

Indonesia has great potential in developing Bali cattle (*Bos javanicus*) as one of the leading national livestock assets [1]. This cattle is known for its high adaptability to tropical environments, reproductive efficiency, and good meat quality [2]. Due to their high reproductive ability, Bali cattle (*Bos javanicus*) have good meat quality and carcass characteristics [3].

The majority of the local community still practices traditional husbandry methods, which involve allowing the cattle to roam freely in the environment without considering their nutritional needs for basic survival, production, and reproduction [4]. Indonesia is a country located on the equator, which means it experiences only two seasons, wet and dry [5]. To enhance the utilization of low-quality forages such as rice straw, feed supplements are used, especially during the dry season when cattle often rely solely on crop residues or low-quality grazing, both of which are low in crude protein and high in fiber [6].

Feed supplements are intended to address protein deficiencies in low-quality forages and providing other necessary elements for livestock [7]. One of the supplements that is widely known to improve the quality of animal feed in Indonesia is Urea Molasses Multinutrient Block, hereinafter abbreviated as UMMB [8], first created by the National Nuclear

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Energy Agency (BATAN) [9], as a source of protein, minerals, and other trace elements, has been reported to effectively improve performance [7,10-12]. The increased digestibility and nutrient utilization efficiency in the metabolic processes within the livestock's body tissues are influenced by the improved quality of the feed consumed by the animals [8,13-15].

Another feed supplement is Molasses Multinutrient Soft, hereinafter abbreviated as MMS, first introduced by researchers from Bosowa University, Makassar, Indonesia. Syarifuddin in [16] stated that MMS is a livestock feed supplement composed of ingredients such as molasses, rice bran, coconut meal, mineral salt, beneficial minerals, and tofu waste. MMS is a feed supplement that utilizes various by-products and industrial waste materials that have little or no value and can become environmental issues if disposed of improperly. MMS can complement the deficiencies in digestibility of forage feed by promoting the growth of rumen microorganisms, thereby improving the digestibility of high-fiber forage. The preparation of MMS involves mixing all the ingredients in varying proportions.

The use of feed supplements such as UMMB and MMS has been introduced as an alternative solution. Both types of supplements are designed to improve digestive efficiency and livestock productivity by providing the necessary sources of energy, protein, and minerals. UMMB has a dense texture designed for slow consumption, supporting optimal rumen fermentation. Meanwhile, MMS which has a softer texture is designed to meet additional energy and nutrient needs quickly.

Therefore, this study aims to compare the performance of Bali cattle (*Bos javanicus*) fed UMMB and MMS, especially in terms of body weight gain and feed efficiency. The results of this study are expected to provide practical recommendations on more effective feed supplements to increase the productivity of Bali cattle (*Bos javanicus*), especially in environments with limited high-quality forage.

Materials and methods

Research material

This research used 12 Bali cattle (*Bos javanicus*) with an age range of 2-3 years weighing between 150 - 250 kg. The basal forage used in this study was rice straw obtained from abundant agricultural waste in the vicinity of the research site. The feed supplements provided as additional feed to all research animals according to the treatments were UMMB and MMS.

The tools used in the research included 12 individual pens (with dimensions of 3 meters width, 4 meters length, and 2.5 meters height), an electronic cattle scale, a feed scale, buckets, tools for UMMB and MMS production, writing utensils, sanitation equipment for the pens (broom, shovel), a cart for transporting grass, and chopper.

Ethical approval

Ethical approval was obtained from the Bosowa University Ethics Committee, Indonesia for this study because it only measured the weight gain of cattle according to a certain time frequency of the cattle being raised and therefore did not pose any risk to the subjects (animals). Thus, our study did not involve any experimental animals directly.

Experimental diets design

The feed was provided twice a day in the morning and afternoon. The daily dry matter feed requirement for each research animal was calculated based on 10% of their body weight. For the treatment feed, UMMB was given in the morning and afternoon along with the basal feed. Meanwhile, MMS was given in the morning and afternoon before the basal feed. The basal feed in this study was rice straw, which consisted of approximately 0.53% calcium, 0.24% magnesium, 0.12% P, 0.13% sodium, 0.07% Fe, and 0.07% manganese [17]. The research feed was determined according to the following 2 treatments:

a. Treatment 0 (P_0): Basal Feed (10% BW)

b. Treatment 1 (P_1): Basal Feed (8% BW) + UMMB (2% BW)

c. Treatment 2 (P_2): Basal Feed (8% BW) + MMS (2% BW)

Meanwhile, water was provided ad libitum. UMMB and MMS supplements were produced in the livestock nutrition and feed laboratory, Department of Animal Husbandry, Bosowa University, Makassar. The composition and formula of UMMB and MMS supplements are presented in Tables 1,2.

Chemical analysis

The feed samples, were sent to the Laboratory of Animal Feed Chemistry, Faculty of Animal Husbandry, Hasanuddin

Table 1: UMMB Composition and Formula.

No	Ingredients	Formula (Kg)
1	Urea	6
2	Molasses	30
3	Rice bran	30
4	Coconut meal	12
5	Salt	8
6	Cement	5
7	Agricultural lime	6
8	Mineral Mix	3
Total		100

Table 2: MMS Composition and Formula.

No	Ingredients	Formula (Kg)
1	Molasses	10
2	Soybean dregs	37
3	Rice bran	30
4	Coconut meal	20
5	Salt	1
6	Mineral mix	2
Total		100

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University, for proximate analysis. The representative samples were analyzed for moisture content, Crude Protein (CP), Crude Fat (CF), Crude Fiber (CF), Calcium (Ca), Phosphorus (P), and Metabolizable Energy (ME). The proximate analysis data of the two feed supplement materials are presented in Table 3, below.

Recorded measurable parameters

The research period lasted for 30 days following a 7-day adaptation period. The total feed intake by the animals was recorded daily during the research period. Individual body weights of the cattle were measured at the beginning and end of the experiment. The parameters measured in this study are as follows [16]:

1. Body Weight Gain (BWG) To calculate the body weight gain in this study, the formula is as follows:

   BWG = Final Weight - Initial Weight

2. Feed Intake To calculate the feed intake in this study, the formula is as follows: Feed Intake = Amount of feed given - Feed refusal

3. Feed Conversion Ratio (FCR) To calculate the feed conversion ratio in this study, the formula is as follows:

$$FCR = \frac{\text{Feed Intake}}{\text{Body Weight Gain}}$$

$$\text{Crude Fiber Digestibility} = \frac{crude\ fiber\ consuption - fecal\ crude\ fiber}{crude\ fiber\ consuption} \times 100\%$$

Whereas, the calculation for Crude Fiber Consumption is determined by the formula:

Crude Fiber Consumption = Total crude fiber provided – Crude fiber refused.

These parameters were recorded and calculated to evaluate the growth performance and feed efficiency of the cattle in response to the different feed treatments.

Analysis data

The data obtained from this research were analyzed using the t-test and *Analysis of Variance* (ANOVA) method [18], with the following formula:

$$Y_{ij} = \mu + T_i + \varepsilon_{ij}$$

Y_{ij} is the observation value in treatment i, replication j. While μ is the general mean value. The value of T_i is the magnitude of the effect of treatment i. And ε_{ij} is the random effect on treatment i and replication j. If the treatment in the study shows an effect, it will be continued with the SRD (Smallest Real Difference) test to determine the differences between treatments. Data analysis was carried out using the SPSS program ver. 16.

Results

Based on the conducted research, the data on feed intake of Bali cattle (*Bos javanicus*) are obtained as shown in Table 4.

The results of the analysis of variance (ANOVA) showed that the treatment of UMMB and MMS supplements did not have a significant effect ($p > 0.05$) on the consumption of Bali cattle (*Bos javanicus*). Statistically, the treatment had no effect ($p > 0.05$); however, the measured data suggest, it was seen that Bali cattle (*Bos javanicus*) with MMS supplements (P_2) tended to have a higher consumption rate of 17.98 ± 5.48 kg/head/day compared to the control and those receiving UMMB supplements (P_1) had a consumption rate of 15.67 ± 3.96 kg/head/day.

Meanwhile, the results of the analysis of variance (ANOVA) showed that the treatment of supplementation, both UMMB and MMS, had no significant effect ($p > 0.05$) on the weight gain of Bali cattle (*Bos javanicus*) in this study. However, from direct measurements in Table 5, it can be seen that Bali cattle (*Bos javanicus*) given MMS supplements (P_2) tend to have higher daily weight gain, namely 0.39 ± 0.06 kg/head/day compared to the control (Po), namely 0.23 ± 0.08 kg/head/day and treatment with UMMB (P_1), namely 0.31 ± 0.03 kg/head/day.

Table 3: Average Proximate Analysis Results of UMMB and MMS.

Component	UMMB	MMS
Crude protein	–	–
Crude fat	2.85	6.63
Crude fiber	12.09	10.38
Calcium (ca)	6.29	0.35
Phosphorus (p)	0.75	0.42
Metabolizable energy (kcal/kg)	3576	3497

Source: Laboratory of Animal Feed Chemistry, Faculty of Animal Husbandry, Hasanuddin University (UMMB 2019 and MMS 2019).

Table 4: Average feed consumption, body weight gain and feed conversion of Bali cattle (*Bos javanicus*) during the study.

Parameter	Mean ± SD		
	P_0	P_1	P_2
Basal feed (rice straw) (kg/head)	533,25 ± 160,99	376 ± 95,16	431,6 ± 131,41
UMMB (kg/head)	-	94 ± 23,79	-
MMS (kg/head)	-	-	107,9 ± 32,85
Average feed consumption (kg/head)	533,25 ± 160,99	470 ± 118,95	539,5 ± 164,26
Average daily feed consumption (kg/head/day)	15,67 ± 3,96	17,76 ± 5,37	17,98 ± 5,48
Average initial body weight (kg/head)	157 ± 170,75	178,50 ± 53,88	180 ± 54,75
Average final body weight (kg/head)	185,25 ± 51,95	166,25 ± 179,81	191 ± 75
Average body weight gain (kg/head)	6,75 ± 2,22	9,25 ± 0,96	11,75 ± 1,71
Average daily body weight gain (kg/head/day)	0,23 ± 0,08	0,31 ± 0,03	0,39 ± 0,06
Feed conversion ratio	93,04 ± 57,74	51,43 ± 14,19	47,93 ± 19,19

Source: Research Results Data, 2024.

Table 5: Average consumption and digestibility of crude fiber of Bali cattle (*Bos javanicus*) during the study.

Elements	Mean	
	Treatment 1	Treatment 2
Consumption of crude fiber (kg/head/day)	1,63	1,73
Digestibility of crude fiber (%)	62,85	77,63

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Discussion

Feed intake

The MMS supplement offered to the cattle possessed a fresh and sweet aroma from molasses, without any rancid taste, making it appealing to the cattle. This is thought to enhance palatability, which directly increases feed intake in the animals. According to [19], Feed palatability is influenced by factors such as taste, form, and odor.

Based on the field measurements as stated in Table 5, it can be reported that animals supplemented with MMS tend to have higher daily feed intake compared to animals without MMS supplementation. As reported by Bruno [16], MMS serves as a high-quality feed supplement to provide the necessary nutrients for livestock to meet their basic needs, reproduction, and production. Specifically, its benefits for ruminant livestock include improving palatability towards high-fiber roughage, stimulating rumen microbiota, and enhancing the digestibility of high-fiber forages, and supplying nutrients that may be lacking in the basal feed [14].

Weight Gain (WG)

The physical form of MMS, resembling porridge, has higher water content and nutritional value, making it more palatable to the cattle compared to the solid form of UMMB [8]. This likely explains the greater weight gain observed in Bali cattle (*Bos javanicus*) receiving MMS supplementation. Feed with high water content is easily digested in the digestive tract, which means that nutrients are absorbed more quickly, allowing the feed to pass through the digestive system faster and providing more space for additional feed [20].

The management of MMS supplementation, given every morning before consuming forage, indirectly ensures the even consumption of MMS. This is likely another reason for the significant weight gain observed in cattle consuming MMS compared to the other treatments.

Feed Conversion Ratio (FCR)

This research proves that the use of MMS leads to feed efficiency, even though the statistical results do not show significance. This is in line with the opinion of [21] that efficient feed utilization requires minimal dry matter to achieve weight gain. The larger the feed conversion ratio, the less efficient the feed utilization is in promoting weight gain [12].

Feed conversion ratio is influenced by the quality of the feed [10]. The improvement in digestibility and nutrient utilization efficiency in the metabolic processes within the animal's body is influenced by the better quality of the feed consumed [22]. This is accompanied by high weight gain, resulting in a lower feed conversion ratio and more efficient use of feed [23].

Digestibility of crude fiber

The average consumption of Crude Fiber in this study is 1.63 kg/head/day for the treatment with the addition of UMMB, while for the MMS treatment, it is 1.73 kg/head/day. Statistical analysis using ANOVA indicates that the consumption of crude fiber in the UMMB addition treatment is not significantly different ($p > 0.05$) from the MMS treatment. The relatively similar crude fiber content results in no significant difference in crude fiber consumption between the UMMB and MMS treatments. As the opinion conveyed by [24], the content of crude fiber in the feed significantly affects the intake of crude fiber. If the composition of crude fiber is too high, it can reduce the consumption rate, whereas if it is too low, it can adversely affect fermentation activities in the rumen.

The average digestibility of crude fiber in this study is 62.85% for the group receiving the UMMB treatment and 77.63% for the group receiving the MMS treatment. Statistical analysis using ANOVA indicates a significant difference ($p < 0.05$) in the digestibility of crude fiber between the MMS and UMMB treatments. The crude fiber content in the feed for the MMS treatment is lower by 10.33% compared to the UMMB treatment, which has a crude fiber content of 12.09%. Consequently, this results in a higher level of crude fiber digestibility in the group receiving the MMS treatment compared to the group receiving the UMMB treatment. The reduced amount of crude fiber makes it easier for rumen microbes (bacteria, protozoa, and fungi) to penetrate and digest the feed nutrients [25]. In other words, a lower crude fiber content in the feed corresponds to an increased digestibility of crude fiber. In this study, it is hypothesized that the supply of energy and protein from MMS feed is sufficient to directly stimulate the growth of fiber-digesting bacteria. However, as mentioned by [25], fiber-digesting microbes do not solely consume fiber substrates; they also require other metabolites produced from the degradation of other microbes. The increased availability of easily digestible energy and protein will expand the growth of amylolytic, proteolytic, and other bacteria. These bacteria will contribute the necessary metabolites for cellulolytic bacteria. This explains that the ability of fiber-digesting bacteria (cellulolytic bacteria) dominates the bacterial population in the rumen, leading to synergistic interactions among different microorganisms in the rumen, including non-cellulolytic bacteria [26].

Conclusion

Supplementation of UMMB and MMS showed no significant effect ($p > 0.05$) in terms of weight gain, feed intake, and feed conversion ratio in Bali cattle (*Bos javanicus*). However, there is a significant difference ($p < 0.05$) in the parameter of crude fiber digestibility.

Author contributions

S, conceptualization; S, A.M., and A.S., conceived the study; S, A.M., L., and A.S., established the study; S, A.M., L., and A.S., processed the data; A.S., and L., contributed to materials/methods/analysis tools; S, and A.M., analyzed the data; L., and A.S., contributed to data checking; S, A.M., L., and A.S., wrote and revised the draft. All authors have read and approved the published version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest with any financial organization regarding the material discussed in the manuscript and the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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