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Effect of Vitamin A and Magnesium Supplementation on Consumption and Digestibility of Dry Matter and Organic Matter in Lamb

J. Jalalludin, W. Suryapratama*, and C. H. Prayitno

[1]Animal Science Faculty, Jenderal Soedirman University, Purwokerto, Indonesia
*Corresponding author: wardhana.suryapratama@unsoed.ac.id
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ABSTRACT

A study to determine the effect of vitamin A and magnesium supplementation on Dry Matter Digestibility (DMD) and Organic Matter Digestibility (OMD) in lamb. The research was conducted experimentally using a Randomized Completely Block Design (RCBD) using 18 rams local aged 7 - 8 months with an average initial body weight of 20 kg ± 2.38 kg. The feed was given at 4% Dry Matter (DM) of body weight with a ratio of ammoniated rice straw and concentrate of 25%:75%. The treatments tested were T0 (control), T1 (25% ammoniated rice straw, 75% concentrate, plus 2000 IU of vitamin A), and T2 (25% ammoniated rice straw, 75% concentrate, plus 2000 IU of vitamin A, plus 1 gram of magnesium). The results of the variance of the analysis showed that the treatment of vitamin A and Magnesium administration had a real effect ($p<0.05$) on the digestibility of organic matter, while other variables were not accurate. The average digestibility of organic matter was T0 at 91.49%, T1 at 91.19%, and T2 at 92.24%. T2 was the treatment with the highest digestibility, with a difference of 2.75% from the control treatment. After the Randomized Completely Block Design (RCBD) and Variance of Analysis test, the next test used Honestly Significant Difference (HSD). Vitamin A and Magnesium supplementation affected the digestibility of organic matter by 2.75% higher than the control treatment.

Keywords: Digestibility, Dry Matter (DM), Lamb, Magnesium, Organic Matter (OM), Vitamin A.

INTRODUCTION

The productivity of smallholder lamb in Indonesia is still low (Azahari et al*.,* 2019). Lamb on smallholder farms have an average daily gain (ADG) of 30 grams/day, but this can be improved by the application of feed technology to be able to reach the normal ADG of lamb around 57 - 132 g/head/day (Prawoto and Winholtz*,* 2001). Ammonia rice straw is one of the feed technologies that can be applied because the potential of rice straw is enormous, especially as an alternative animal feed in certain conditions because the availability is sufficiently abundant. Most have not been adequately utilized (Yanuartono et al., 2019). The application of technology to rice straw is essential; besides the low and almost non-existent β-carotene content (Baliarti et al., 2000), rice straw also has low digestibility, nutritional value, and palatability. It is necessary to use ammoniated technology and add vitamin A supplementation to the feed.

Providing high-concentrate feed (75%) with a ratio of ammoniated rice straw (25%) is expected to increase feed consumption and digestibility. However, giving high-concentrate feed is feared to interfere with the need for magnesium as an enzyme cofactor in the urea cycle in liver cells. Apart from that, it is feared that giving high-concentrate feed will also reduce the pH of the rumen fluid so that rumen microorganisms digesting feed fiber will be disturbed. To anticipate this, magnesium (Mg) supplementation and sodium bicarbonate must be added to maintain the pH balance of the rumen fluid. It is hoped that the addition of sodium bicarbonate can help stabilize the pH of the rumen fluid so that the development of fiber-digesting bacteria can grow optimally (Subrata et al., 2012), and the lamb will consume and digest feed better. If feed consumption and digestibility are high, livestock can utilize the nutrients in the feed and produce better growth or production. On the other hand, low digestibility can indicate wasted nutrients because they cannot be used properly. Durand and Kawashima (1980) The effect of magnesium on lamb is very pronounced on the digestion of cellulose. Lack of magnesium in rations causes a decrease in voluntary intake and cellulose digestibility and affects the concentration of VFA. Based on the above, research is needed to examine vitamin A and magnesium supplementation on dry matter consumption and digestibility, as well as organic matter consumption and digestibility in lamb.

RESEARCH METHODS

The material used in this research was 18 local male lambs placed in individual pens with a size of 1 x 0.5 cm, aged around 7-8 months, with an average initial body weight of 20 kg ± 2.38 kg. The feed given consisted of ammoniated rice straw and feed concentrate in a ratio of 25:75 based on dry matter. Ammonia rice straw is made by mixing rice straw with urea. As much as 2%, and dissolved in water as much as 30% of the weight of the straw. Mixture It is then put into a drum, compacted, and incubated for 21 days. Ammonia rice straw to be given to livestock is aerated first, then sprayed with molasses (2 liters of water + 6 gauge lids jerry cans) and probiotics (1 bottle cap) to improve livestock palatability. The concentrate used in the form of feed consists of tofu dregs (7.5%), cassava by-product (35%), corn flour (5%), rice bran (2.5%), full-fat soybean (20%), and meal coconut (5%). Treating lamb by providing vitamin A and magnesium by mixing before feeding with the same ration formula. Feeding is carried out 2 times, namely at 08.00 am and 3.00 pm. Individual cages equipped with separate feed containers, drinking water, feces, and urine collection buckets were used in this study.

Randomized Completely Block Design (RCBD) was used in this study by grouping based on body weight, and then the analysis was continued according to RCBD procedures. The initial body weight of the lamb was used as a group; each treatment was repeated 6 times. There were three kinds of feed treatments tested in the study, namely:

T0 : Basic Feed (Ammoniated rice straw (25%) + Concentrate feed (75%) (Control)
T1 : Control + Vitamin A (2000 IU)
T2 : Control + Vitamin A (2000 IU) + Magnesium (1 gram)

The composition and nutrient content of the feed in each treatment are listed in Table 1

Table 1. Feed Composition and Nutrient Content

Feed Material Composition	Treatment		
	Control	Vitamin A	Vitamin A+Mg
Material			
Ammoniated rice straw (%DM)	25	25	25
Tofu Dregs (%DM)	7.5	7.5	7.5
Cassava by-product (%DM)	35	35	35
Corn Flour (%DM)	5	5	5
Rice Bran (%DM)	2.5	2.5	2.5
Full Fat Soya (%DM)	30	30	30
Coconut Meal (%DM)	5	5	5
Total	100	100	100
Nutrient Content			
Moisture, (%)[1]	5.57	5.57	5.57
Dry Matter, (%)[1]	94.43	94.43	94.43
Crude Protein, (%)[1]	11.57	11.57	11.57
Total Digestible Nutrient, (%)[2]	66.32	66.32	66.32
Extract Ether, (%)[1]	4.02	4.02	4.02
Crude Fiber (%)[1]	20.34	20.34	20.34
Nitrogen Free Extract, (%)[1]	45.24	45.24	45.24
Ash, (%)[1]	13.27	13.27	13.27
Sodium Bicarbonate, (%DM)	2.5	2.5	2.5
Vitamin A, (IU)	0	2000	2000
MgO, (gram)	0	0	1

Description:
[1]Analysis of Feedstuffs Laboratory, Faculty of Animal Science, Jenderal Soedirman University 2023;
[2]TDN = 70,6 + 0,259 Pr + 1,01 EE -0,76 CF + 0,091 NFE (Sutardi, 1979).

RESULTS AND DISCUSSION

Dry Matter Consumption

The average dry matter consumption of T0 was 797.70 ± 86.69 grams/head/day, T1 was 857.19 ± 83.96 grams/head/day, and T2 was 914.75 ± 113.62 grams/head/day. These results are very different from the research of Sayekti et al. (2015), which reported that dry matter consumption in local male lamb averaged 1,107.9 grams/head/day. The results of the calculation of average dry matter consumption are presented in Table 2.

Table 2. Average consumption and digestibility of dry matter and organic matter in lambs

Variables	Treatments		
	T0 Control	T1 Vitamin A	T2 Vitamin A+Mg
Dry Matter Intake, g/head/d	797.70 ± 86.69	857.19 ± 83.96	914.75 ± 113.62
DM Digestibility, %	88.54 ± 0.02	88.84 ± 0.01	89.70 ± 0.01
Organic Matter Intake, g/head/d	776.88 ± 68.93	783.52 ± 77.11	878.40 ± 106.80
OM Digestibility, %	91.49 ± 1.17^{ab}	91.19 ± 0,85^{a}	92.24 ± 1.02^{b}

Description:
^{A,b} Different superscripts on the same row indicate a difference of P<0.05.

This is supported by research by Liu and Orskov (2000), who state that the capacity of the stomach and digestive organs of livestock can affect the consumption of dry matter because the condition of the stomach that can accommodate feed can digest feed ingredients optimally. Dry matter consumption with vitamin A and Magnesium supplementation in male lamb was 4.28% of body weight of 20 kg ± 2.38 kg.

Liu and Orskov's (2000) research report states that the capacity of the stomach and digestive organs of livestock can influence dry matter intake because the condition of the stomach, which can accommodate feed, can digest feed ingredients optimally. Dry matter intake with vitamin A and magnesium supplementation in rams was 4.28% of body weight 20 kg ± 2.38 kg. Dry matter intake in the T2 treatment was higher than in T0 and T1, although statistically, there was no significant effect. According to Geogievskii (1982), the need for magnesium in growing animals is almost absolute because there are no cations that can replace magnesium. In the T2 treatment, adding vitamin A and Magnesium increases feed consumption. Based on research by Durand and Kawashima (1980), in vivo experiments on bulls and rams showed a very real effect of magnesium on cellulose digestion. Magnesium deficiency in the diet causes a decrease in voluntary intake and digestibility of cellulose, and it affects VFA concentrations.

Organic Matter Consumption

The average consumption of organic matter T0 was 776.88 ± 68.93 grams/head/day, T1 was 783.52 ± 77.11 grams/head/day, and T2 was 878.40 ± 106.80 grams/head/day. These results are more minor than the research of Jamila et al. (2020). The average consumption of organic matter ranges from 1.018 grams/head/day to 3.347 grams/head/day in livestock given feed rations. The analysis of variance showed that the treatment had no significant effect on organic matter consumption. Amtiran et al. (2018) stated that dry matter consumption is significantly positively correlated with organic matter consumption because organic matter is part of dry matter; if dry matter consumption decreases, organic matter consumption decreases. The decrease in consumption of organic matter is thought to occur due to the acidic pH atmosphere of the rumen fluid as a result of the provision of high concentrates. Acidic rumen fluid pH conditions disrupt microbial activity in degrading crude fiber feed ingredients. This follows the statement of Subrata et al. (2012) that the provision of high concentrates can reduce the pH of rumen fluid so that it is in an acidic state. The decrease in pH impacts the disturbance of rumen microorganisms responsible for digesting crude fiber feed, so it can disrupt the balance of rumen microbes and potentially cause digestive disorders in livestock. Humer et al. (2018) explained in detail that the provision of high concentrates 90%: 10% can damage the digestive system and stimulate chewing less, have an impact on salivary buffer production, rumen wall motility, and less rumen mixing, and have the effect of rumen pH dropping significantly.

Dry Matter Digestibility

The average dry matter digestibility ranged from 88.54 ± 0.02% (T0) to 89.70 ± 0.01% (T2) (Table 2). These results indicate that high dry

matter digestibility supports livestock growth. The research average is higher when compared with Sutardi's (1979) statement that dry matter digestibility can be said to be good if it reaches 50 – 60%. High dry matter digestibility indicates high food substances that livestock can utilize. The higher the percentage value of digestibility of feed ingredients, the better the quality (Alia, 2015). Factors influencing dry matter digestibility are microbial activity in the rumen, rumen fluid quality, percentage of lignin in feed ingredients, rumen pH, physical condition of feed ingredients, and nutrients. The average results of dry matter digestibility are presented in Table 2; however, the results of the variance analysis for each treatment did not significantly affect dry matter digestibility.

Vitamin A is administered to lamb with at least 470 IU (International Unit) (Green and Fascetti, 2016). The results of Amaliya's research (2014) show that using vitamin A can significantly increase the digestibility of dry matter compared to the author's research. Although the study's results aligned with Amaliya (2014), the treatment tended to increase dry matter digestibility. Statistically, it was not significantly different. This difference is thought to be due to the use of rice straw, which is different from fresh grass, so the role of rumen microbes is not optimal. Dry matter digestibility is also thought to be influenced by the proportion of protein as a source of N for rumen microbes and the proportion of carbohydrates used to support rumen microbial protein synthesis and as an energy source for the host animal. If dry matter digestibility is high, the development of microbial protein synthesis increases. Thus, dry matter digestibility is also determined by the growth of microbial protein synthesis (Syapura et al., 2013).

Organic Matter Digestibility

The average digestibility of organic matter was 91.49±1.17% (T0), 91.19±0.85% (T1), and 92.24±1.02% (T2); these results were higher compared to research by Nugroho et al. (2020) who reported an average digestibility of organic matter of 54.78% - 58.45%. Vitamin A administration based on Green and Fascetti (2016) states that lamb's minimum vitamin A requirement is 470 IU. Magnesium administration based on Georgievski et al. (1982) is 5 grams/100 kg of lamb body weight. Sudirman (2013) stated that the digestibility of organic matter is closely related to feed intake, meaning that if the digestibility value of a feed ingredient is higher, there is a tendency to consume more feed ingredients, or conversely if the digestibility value of feed ingredients is low, feed ingredient consumption tends to be low. The pattern of organic matter digestibility follows the dry matter digestibility. The study results showed that the organic matter digestibility was highest in the T2 treatment, namely 92.24±1.02%, following the dry matter digestibility in T2, 89.70±0.01%. Differences in the digestibility of a feed ingredient are greatly influenced by the digestibility of organic ingredients, such as the components of the nutrient, processing techniques, and ration composition (Pambarep, 2014). The effect of ammoniated rice straw treatment supplemented with vitamin A and Magnesium is that it provides the highest digestibility of organic matter compared to other treatments. The analysis of variance showed that vitamin A and Magnesium supplementation in ammoniated rice straw and concentrate feed had a significant effect ($P<0.05$) on the digestibility of organic matter. According to Widodo et al. (2012), vitamin A supplementation functions to increase the digestibility and palatability of ammoniated rice straw, while Magnesium can help as a buffer to keep the pH of the rumen fluid stable due to the provision of high concentrate feed. Further tests using the Honestly Significant Difference (HSD) showed that Magnesium supplementation could increase organic matter digestibility by 1.15% ($P<0.05$) (T2 vs T1) in lamb feed.

CONCLUSIONS

The additional supplementation of vitamin A 2000 UI and Magnesium 1 gram affected the digestibility of organic matter by 2.75% higher than the control treatment. The average digestibility of organic matter was obtained with the highest average in T2 treatment, 92.24%. The T2 treatment was carried out by a follow-up test of Honestly Significant Difference (HSD) with the results of T1 and T2 significantly different ($T<0.05$) compared to T0.

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