**Utilization of *Sargassum* sp. to Improve Blood Plasma Minerals for Thin Tailed Weaning Ram**

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**ABSTRACT**

The study aimed to determine the level of sun-drying *Sargassum* sp. seaweed as a mineral source in blood plasma of male thin-tailed sheep after weaning. The *Sargassum* sp. powder with sun-drying was fed for 3 months on 16 weaned thin-tailed rams, aged 5-6 months with average initial body around 11.8 kg, using a 4x4 completely randomized design (CRD) with four treatments consisting of T1 = forage + concentrate + 0% minerals of concentrate, T2 = forage + concentrate + 0.38% cow booster minerals of concentrate, T3 = forage + concentrate + 5% *Sargassum* sp. of concentrate, T4 = forage + concentrate + 10% *Sargassum* sp. of concentrate. The observed research variables were feed intake dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen free extract (NFE), and total digestible nutrient (TDN), average daily gain (ADG), intake of macro minerals (Ca, Mg, K, and Na), intake of micro minerals (Cu, Fe, and Zn), the balance of macro minerals and micro minerals blood plasma before and after treatment with *Sargassum* sp. The results showed that the treatment did not effect on feed intake, but ADG had a significant effect (p<0.05) on mineral Ca intake, Mg, K, Na, Cu, Fe, and Zn. Blood plasma minerals before treatment did not differ on Mg, Na, Cu, Fe, Zn, but had a significant effect (p<0.05) on Ca and K. The treatment had a significant effect (p<0.05) on minerals Mg, Cu, and Fe in blood plasma, but did not effect on Ca, K, Na, and Zn. Based on the results, the use of 10% *Sargassum* sp. with sun-drying method on the concentrate method can increase the intake of macro and micro minerals as well as increase Mg, Cu, and Fe in the blood plasma of weaning rams.

Keywords: Seaweed, *Sargassum* sp, Thin-tailed sheep, Macro and micro minerals

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**Introduction**

The mineral is one of the nutrients that are necessary for sheep in the growth phase of hyperplasia and hypertrophy. Shumye (2021) states that hyperplasia is a growth process by multiplying cells and bone growth that occurs early in life from the embryo to the adult body, while hypertrophy is growth after the body matures. Minerals function as enzymatic cofactors, structurally or functionally play a role in increasing the activity of enzymes, hormones, and vitamins (Costa et al., 2021). Livestock growth requires complex nutrients other than minerals, specifically carbohydrates, protein, vitamins, and water, as well as hormones, genotypes, and the environment, where these components affect growth from the beginning, pre-weaning to post-weaning (Owens et al., 2014). Sheep after weaning are classified as a growth phase, in dire need of macro and micro minerals to multiply cells and bone growth (Costa et al., 2021). Lack of minerals in the growth phase causes abnormal growth, for example calcium deficiency. Calcium provides a strong framework to support muscles and protect delicate organs and tissues, including bone marrow, but is also jointed to allow movement, and malleable to allow growth (Suttle, 2010).

Mineral sources for sheep or livestock generally come from feed plants that live on land, but the highest mineral source is food or feed that comes from the sea. Seaweed contains 10 to 20 times more minerals than plants on land (Kumar et al., 2015). There are three types of seaweed, namely red seaweed, green seaweed, and blue seaweed (Van denHoek and Bayoumi, 2018) The highest mineral content is brown seaweed ranging from 14-35% DM (Makkar et al., 2016) *Sargassum* sp. is a species of brown seaweed. Paga et al. (2021) reported that the sun-drying method, 55°C oven and freeze dryer-20°C affected the mineral content of calcium and magnesium, *Sargassum* sp. with sun-drying, has calcium, and magnesium content is higher than oven drying and freeze dryer.
Magnesium sun-drying 13.20 g/kg DM, oven drying 10.89 g/kg DM, and freeze-drying 11.10 g/kg DM.

The use of seaweed for sheep has previously been carried out by several researchers. Kitta et al. (2019) in Tunisia reported the use of green seaweed (Ruppia maritima and Chaetomorpha linum) as much as 20% as a substitute for barley concentrates in 5-month-old sheep with a bodyweight of 21.1±2.7 kg, there was a decrease in dry matter intake of Ruppia maritima by 79 g/d and Chaetomorpha linum as much as 75 g/d and digestibility of dry matter, organic matter, and crude protein of Ruppia maritima of 3.5; 3.3; and 4.5% and Chaetomorpha linum 3.7; 2.5; and 5.4%. El-Waziry et al. (2015) reported that the use of green seaweed (Ulva latuca) as a substitute for 3% and 5% alfalfa hay in young rams weighing 22.78±0.24 kg on growth performance could increase feed conversion by 0.63 for 3% substitution and 0.67 for the 5% substitution and the low daily body weight gain was 2.17 kg for the 3% substitution and 1.50 kg for the 5% substitution. Muwel et al. (2018) in India reported that the use of brown seaweed as mineral supplementation in goats resulted in a decrease in methane gas production and an increase in crude protein digestibility, while Singh et al. (2017) in India reported that the use of brown seaweed (Sargassum wightii) 20% as a substitute for pollard and mustard cake in lactating cows resulted in an increase in calcium intake and a decrease in phosporus intake. Research on Sargassum sp. seaweed as mineral supplementation in weaned thin-tailed rams has not been conducted elsewhere. Based on this description, exploratory research on utilization has been carried out to study the blood plasma minerals of weaned thin-tailed rams before the administration of Sargassum sp. as a source of minerals.

Materials and Methods

Location
This research was conducted in teaching farm of the Faculty of Animal Science and the Integrated Research and Testing Laboratory, Gadjah Mada University, Yogyakarta Indonesia.

Design and treatment
Sixteen weaned thin-tailed rams were used with an average weight of initial around around 11.8 kg. This study used a 4x4 completely randomized design. Four treatments were given, consisting of T1 = forage + concentrate + 0% minerals from concentrate; T2 = forage + concentrate + 0.38% mineral booster cow of concentrate, T3 = forage + concentrate + 5% Sargassum sp. of concentrate, T4 = forage + concentrate + 10% Sargassum sp. of concentrate. Feed composition and nutrient composition are presented in Table 1.

Feed and management
Feed in the form of a total mixed ration (TMR) was given to the sheep twice a day, at 8 am, and 4 pm (Adiwinarta et al., 2018). The experiment lasted for 114 d. The sheep adaptation period to the new feed was 14 d and the next 90 d were the treatment period. The sheep blood collection was done at the beginning of entering the pen before treatment to find out how much mineral content in the blood and on the day 90th of the treatment period. Blood was collected from the jugular vein in the neck using a 10 mL vacuum venoject tube containing anticoagulant ethyl diamine tetraacetic acid (EDTA) (Ziehank et al., 2008; Pal et al., 2010). The blood was centrifuged at 3000 rpm for ± 30 min, to separate serum from plasma. The plasma that has been formed was aspirated using a dropper and then placed in a test tube, which then marked and stored in a cool box that has been added with ice cubes to be taken to the Gadjah Mada University Integrated Research and Testing Laboratory for analysis of plasma minerals. Laboratory analyses using the Atomic Absorbance Spectrophotometer (AAS) (Ziehank et al., 2008). Blood was also analyzed using the AAS (Ziehank et al., 2008).

Chemical composition analyses
Standard methods The Association of Official Analytical Chemists was (AOAC, 1984). Used to determine moisture, crude protein, fat, total ash and crude fiber content of each sample. The moisture content was determined by heating 2.0 g into the crucible as the standard weight of each fresh sample placed in an oven maintained at 105°C. Dry A thing was used to define another parameter. Crude protein (% total nitrogen x 6.25) was determined by the Kjeldahl method using 2.0 g samples; crude fat was thoroughly obtained extracting 5.0 g of each sample using a Soxhlet apparatus using petroleum ether (boiling point range 40-60°C) as extractive Ashes were determined by burning. The 10.0 g samples placed in the muffle furnace are saved at 550°C for 5 h. Crude fibre was obtained by digesting 2.0 g of sample with H2SO4 and NaOH and incinerating the residue in a muffle furnace maintained at 550°C for 5 h. Moisture content was determined by heating 2.0 g of each sample to a constant weight in a crucible placed in an oven maintained at 105°C. Every analysis was done in threes.

Mineral analyses
Samples were dissolved in 1 M HNO3 and H2O2 (Milestone, Ethos 1, Italy) using microwaves before digestion to remove macrominerals (calcium, magnesium, potassium, sodium, phosphorus) and trace minerals (iron, copper, zinc, cobalt, and manganese). Concentrations of inorganic elements in dried algae samples were determined using an atomic absorption spectrophotometer (FS95, Thermo, England) equipped with a hollow cathode lamp, following the method described in MOOPAM (1989) and (Ruperez, 2002). I did seaweed mineral concentration was calculated from the calibration curve of each standard element.
(2014) stated that they had given in the form of a total mixed ration (TMR) so could be due to the feed ingredients given as show nitrogen matter, crude protein, organic matter, sheep Feed between treatment means were analyzed using 23.0 (IBM Corporation, New York, USA), and way analysis of variance using Windows IBM SPSS Statistical analysis

The data obtained were analyzed by one-way analysis of variance using Windows IBM SPSS 23.0 (IBM Corporation, New York, USA), and significance was set at p<0.05. Differences between treatment means were analyzed using Duncan’s multiple range test (Steel et al., 1997).

Results and Discussion

Feed intake
Average feed intake and ADGADG treated with Sargassum sp. in weaning male thin-tailed sheep are presented in Table 2. Feed intake of dry matter, crude protein, organic matter, ether extract, nitrogen-free extract, and total digestible nutrients showed no significant difference (p>0.05). This could be due to the feed ingredients given as treatment in this study have the same level of preference or palatability. Feed ingredients were given in the form of a total mixed ration (TMR) so that they had the same scent and taste. Michael (2014) stated that the scent of rations with the same nutrient content and the flow in the digestive tract are also almost the same so that it does not affect feed intake. The rations in the form of TMR were of good quality with relatively nearly the same level of administration so intake levels did not differ either. The absence of effect on feed intake indicated that the rations given for each treatment had the same palatability value so the experimental livestock intake was almost the same amount of rations. Mokoboki et al. (2011) stated that feed with the same palatability provides stimulation to the same color, taste, smell and texture so it did not affect on feed intake. The treatment of Sargassum sp. as a mineral source in weaning male thin-tailed sheep had a significant (p<0.05) effect on ether extract intake. Significantly affected the crude fat intake, presumably the fat content of the ration treated with Sargassum sp. (T3 and T4) were higher than the treatment without Sargassum sp. (T0 and T1). In addition, it is suspected that minerals have an effect on the process of fat metabolism. Adawiah et al. (2006) stated that minerals affect the process of fat metabolism.

Statistical analysis

<table>
<thead>
<tr>
<th>Feed ingredients (%) (as fed)</th>
<th>Treatment(^a)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. purpureum cv. mott</td>
<td>38.09</td>
<td>38.09</td>
<td>38.09</td>
<td>38.09</td>
<td></td>
</tr>
<tr>
<td>pollard</td>
<td>23.81</td>
<td>23.81</td>
<td>23.81</td>
<td>23.81</td>
<td></td>
</tr>
<tr>
<td>pile</td>
<td>9.52</td>
<td>9.52</td>
<td>9.52</td>
<td>9.52</td>
<td></td>
</tr>
<tr>
<td>Oil palm meal</td>
<td>14.29</td>
<td>14.29</td>
<td>14.29</td>
<td>14.29</td>
<td></td>
</tr>
<tr>
<td>Soybean meal</td>
<td>14.29</td>
<td>14.29</td>
<td>14.29</td>
<td>14.29</td>
<td></td>
</tr>
<tr>
<td>Cow mineral booster</td>
<td>0</td>
<td>0.38</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sargassum sp.</td>
<td>0</td>
<td>0</td>
<td>1.14</td>
<td>2.28</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100.38</td>
<td>101.14</td>
<td>102.28</td>
<td></td>
</tr>
</tbody>
</table>

The mean values within rows without common superscript differ at p<0.05.

1DM: dry matter; OM: organic matter; CP: crude protein; EE: ether extract; CF: crude fiber; NFE: nitrogen-free extract; TDN: total digestible nutrient; Ca: calcium; Mg: magnesium; K: potassium; Na: sodium; Cu: cuprum; Fe: iron; Zn: zinc.

<table>
<thead>
<tr>
<th>Variable (g/head/d)(^1)</th>
<th>Treatment(^a)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM (%)</td>
<td>642 ± 65.6</td>
<td>748.4 ± 90.6</td>
<td>697.1 ± 73.5</td>
<td>655.5 ± 117.5</td>
<td></td>
</tr>
<tr>
<td>OM (%)</td>
<td>516 ± 74.1</td>
<td>584.4 ± 76.1</td>
<td>544.6 ± 65.6</td>
<td>498.5 ± 113.10</td>
<td></td>
</tr>
<tr>
<td>CP (%)</td>
<td>89.0 ± 14.7</td>
<td>110.5 ± 13.7</td>
<td>98.6 ± 12.6</td>
<td>88.0 ± 20.9</td>
<td></td>
</tr>
<tr>
<td>EE (%)</td>
<td>6.90 ± 0.50(^b)</td>
<td>8.50 ± 1.10</td>
<td>13.4 ± 1.50</td>
<td>11.1 ± 2.20</td>
<td></td>
</tr>
<tr>
<td>CF (%)</td>
<td>116.2 ± 16.4</td>
<td>124.4 ± 17.2</td>
<td>124.2 ± 14.4</td>
<td>110.4 ± 23.5</td>
<td></td>
</tr>
<tr>
<td>NFE (%)</td>
<td>289 ± 38.7</td>
<td>341 ± 46.8</td>
<td>302 ± 38.3</td>
<td>283.2 ± 64.5</td>
<td></td>
</tr>
<tr>
<td>TDN (%)</td>
<td>374 ± 56.7</td>
<td>437.6 ± 56.6</td>
<td>385.5 ± 46.6</td>
<td>358.9 ± 83.8</td>
<td></td>
</tr>
</tbody>
</table>

The mean values within rows without common superscript differ at p<0.05. The same superscript letter to denote that there is no significant difference at p<0.05.
Average daily gain

The treatment of mineral Sargassum sp. in male thin-tailed sheep after weaning with the TMR diet did not show any significant difference with p<0.05 to daily body weight gain. It was the with the feed intake and chemical composition, might result a similar ADG. It was suspected that the feed ingredients given in the form of TMR had the same palatability so there was no difference in body weight gain, other than that the feed intake is also no different. Salido et al. (2016) stated that the level of feed intake was not significantly different between treatments, so it did not significantly affect the body weight gain.

Macro minerals intake

Data on the intake of macro minerals calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na), as well as micro minerals: copper (Cu), iron (Fe), and zinc (Zn) treated with seaweed Sargassum sp. in weaning rams, are presented in Table 3.

The results showed that the addition of the mineral Sargassum sp. in weaning male thin tails with TMR pattern feeding had a significant effect (p<0.05) on the intake of minerals Ca, Mg, K and Na. The results of the study of Ca intake showed that the T2 treatment was higher than the T1, T3, and T4 treatments. Mg intake in T2 treatment was higher than T1 and T3 treatments but did not differ from T4 treatment. Mg intake in T3 treatment was not different from T4. The high intake of Ca in T2 treatment was suspected to have the highest Ca content in the ration at 7.26 g/kg while T1, T3, and T4 were lower, respectively, at 1.35 g/kg; 4.67 g/kg, and 2.61 mg/kg. The high Ca intake in the T2 treatment was probably due to the high Ca content in the mineral booster cattle, which was 243.4 g/kg while in Sargassum sp. low Ca content of 38.5 mg/kg. Ca intake in experimental sheep has met the needs of livestock. Fujihara et al. (1995) stated that Ca intake in sheep ranged from 2.0 to 8.2 g/head/d with a tolerance of 20 g/head/d.

The high intake of Mg in the T2 treatment was not different from T4 treatment, it is suspected that the Mg content of the ration in T2 treatment was almost the same as T4 treatment, specifically T2 Mg treatment was 4.43 g/kg while T4 Mg was 4.30 g/kg. High Mg intake in T2 treatment was due to the Mg content in the mineral booster cattle being high, namely 1.8 g/kg while the Mg content in Sargassum sp. was low, namely 13.2 mg/kg. Intake of Mg in experimental sheep has met the needs of livestock. Fujihara et al. (1995) stated that the intake of Mg in sheep ranged from 1.2 to 1.8 g/head/d with a tolerance of 4 g/head/d.

The results showed that the intake of K in the T4 treatment was higher than the T1 and T2 treatments but did not differ from the T3 treatment. The intake of high potassium minerals in the T4 treatment was suspected to have the highest K content in the TMR T4 ration, namely 1.51% from T1: 1.13%, and T2 0.92%, while the T3 treatment was almost the same, namely 1.30%. Na intake in T4 treatment was the highest from the T1, T2, and T3 treatments. The high intake of Na in the T4 treatment was thought to have the highest Na content in the T4 ration at 3.32 g/kg compared to Na in the T1, T2, and T3 treatments, respectively, which was 0.91; 2.15; 2.10 g/kg.

Micro minerals intake

The results showed that the addition of the mineral Sargassum sp. in weaning rams with TMR pattern feeding had a significant effect (p<0.05) on the intake of minerals Cu, Fe, and Zn. The results of DMRT Cu intake in T4 treatment were the highest from T3 treatment but did not differ from T1 and T2 treatments, while T3 treatment did not differ from T1 treatment. The high intake of Cu in the T4 treatment was suspected that the Cu content in the T4 ration was the highest at 5.15 mg/kg, while T1, T2, and T3 were lower, respectively, at 3.92; 4.08; 3.37 mg/kg.

The results showed that the intake of Fe was highest in treatment T2 compared to treatment T1, T3, and T4 and lowest in treatment T1. The high intake of Fe in the T2 treatment was suspected that the Fe content in the T2 ration was the highest compared to the Fe in the T1, T2, and T3 rations. The content of Fe in the T2 ration is 0.39 g/kg; while the Fe in the T1, T3, and T4 rations were 0.25; 0.29; and 0.29 g/kg. In addition, the Fe content in the cow booster mineral was 12.5 g/kg higher than the Fe in Sargassum sp. ie 1.0 g/kg. Fe intake in experimental sheep has met the needs of livestock. Fujihara et al. (1995) stated that Fe intake in sheep ranged from 0.03 to 0.05 g/head/d with a tolerance of 0.5 g/head/d.

Zinc intake was highest in treatment T2 compared to treatment T4 but did not differ from

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca</td>
<td>8.10 ± 1.11±</td>
<td>53.61 ± 6.57±</td>
<td>31.98 ± 3.48±</td>
<td>16.53 ± 3.29±</td>
</tr>
<tr>
<td>Mg</td>
<td>16.33 ± 2.75±</td>
<td>31.81 ± 4.02±</td>
<td>24.64 ± 2.86±</td>
<td>26.45 ± 5.69±</td>
</tr>
<tr>
<td>K (%)</td>
<td>6.51 ± 1.03±</td>
<td>6.41 ± 0.84±</td>
<td>8.51 ± 1.03±</td>
<td>9.26 ± 2.01±</td>
</tr>
<tr>
<td>Na</td>
<td>2.87 ± 1.91±</td>
<td>15.19 ± 1.96±</td>
<td>13.82 ± 1.60±</td>
<td>20.61 ± 4.31±</td>
</tr>
<tr>
<td>Cu</td>
<td>0.24 ± 0.003ab</td>
<td>0.029 ± 0.004b</td>
<td>0.022 ± 0.003a</td>
<td>0.030 ± 0.008a</td>
</tr>
<tr>
<td>Fe</td>
<td>1.40 ± 0.24±</td>
<td>2.79 ± 0.35±</td>
<td>1.91 ± 0.23±</td>
<td>1.70 ± 4.40a</td>
</tr>
<tr>
<td>Zn</td>
<td>0.24 ± 0.04±</td>
<td>0.31 ± 0.05±</td>
<td>0.25 ± 0.03±</td>
<td>0.22 ± 0.06±</td>
</tr>
</tbody>
</table>

± Mean values within columns without common superscript differ at p<0.05.

Table 3. Effect of Sargassum sp. in the ration on mineral intake in thin-tailed weaning ram

T1: forage + concentrate + 0% minerals of concentrate; T2: forage + concentrate + 0.38% cow booster minerals of concentrate; T3: forage + concentrate + 5% Sargassum sp. of concentrate; T4: forage + concentrate + 10% Sargassum sp. of concentrate.
treatment T1, and T3. T1 treatment was not different from T3 and T4. The high intake of Zn in the T2 treatment is thought to have the highest Zn content in the T2 ration compared to Zn in the T1, T3, and T4 rations. The content of Zn in the T2 ration is 48.67 mg/kg; while Zn in T1, T3, and T4 rations was 43.17; 40.98; 38.36 mg/kg. In addition, the Zn mineral booster content of cows was higher, namely 439 mg/kg compared to Zn in Sargassum sp. ie 29.29 mg/kg. Intake of Zn in experimental sheep has met the needs of livestock. Ji et al. (2014) stated that the Zn requirement for sheep was 22.1 – 23.8 mg/kg. Fujihara et al. (1995) stated that Zn intake in sheep ranged from 0.02 to 0.03 g/head/d with a tolerance of 0.75 g/head/d.

Sheep blood plasma minerals before treatment

Macro minerals

The research data of macro and micro minerals in the blood plasma of pre-treated sheep are presented in Table 4. The results showed that the plasma minerals of weaned rams before treatment had no effect on Magnesium (Mg) and Sodium (Na) but had a significant effect (p<0.05) against Calcium (Ca) and potassium (K). The results showed that Ca T1 was the highest compared to T3 treatment, but did not show any difference with T2 and T4. BBlod plasma of Ca levels in T3 were not different from T2 and T4 treatments. For K levels, the results showed that T3 was the highest compared to T1 and T4 treatments but did not differ from T2. T2 blood plasma K levels were not different from T1 and T4 treatments.

There was no significant difference in the Mg and Na content. It is possible that the weaned thin-tailed rams used in this study came from the same area, namely from Temanggung Regency, Central Java Province, Indonesia so they may have consumed the same forage, both grass and legumes. Mineral Mg blood plasma of rams weaned off before treatment was in normal condition. Widiyanto et al. (2017) stated that sheep plasma Mg minerals were in a critical status, namely 1-2 mg/100 mL. The feed intake is the same so the minerals in the blood plasma are also no different. Forage minerals are influenced by several factors, namely soil, plant species, maturity stage, results of pasture management and climate (Khan et al., 2008). Significantly (p<0.05) on Ca and K content, the possibility of weaning rams used in this study came from areas with different heights and the seeds and feed intake were also different so that the content of Ca and K in blood plasma was also different. Different Brouček et al. (2009) stated that the factors that affect the mineral content of sheep blood plasma are different, namely the altitude of the place of rearing, season, seeds and management of maintenance and feed. Khan et al. (2008) stated that forage minerals are influenced by several factors, namely soil, plant species, maturity stage, results of pasture management and climate. The Ca content of sheep blood plasma before treatment was still in normal condition. Widiyanto et al. (2017) stated that sheep plasma Ca minerals were in a critical status, namely 8 mg/100 mL.

Micro minerals

The results showed that plasma minerals from weaned rams before treatment did not affect copper (Cu), iron (Fe) and zinc (Zn). There was no difference between the treatments for the levels of Cu, Fe and Zn before the treatment, it is possible that the weaning male thin tailed sheep used in the study came from the same area so that they feed intake the same forage, both grass and legumes. Khan et al. (2008) stated that forage minerals are influenced by several factors, namely soil, plant species, maturity stage, results of pasture management and climate.

Blood plasma minerals after treatment

The effect of treatment on macro and micro minerals in blood plasma is presented in Table 5.

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1</th>
<th>Treatment</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: forage + concentrate + 0% minerals of concentrate; T2: forage + concentrate + 0.38% cow booster minerals of concentrate; T3: forage + concentrate + 5% Sargassum sp. of concentrate; T4: forage + concentrate + 10% Sargassum sp. of concentrate. *Animal were grouped based on each treatment and analyzed blood plasma minerals before feeding period.</td>
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</tr>
</tbody>
</table>
content of Ca, K and Na in plasma is almost the same as the mineral treatment. The concentration of mineral Ca in blood plasma as a result of the research T1, T2, T3 and T4 were 50.11; 66.53; 61.52; 55.31 mg/kg lower than the standard mineral Ca in sheep blood, which ranges from 115 – 128 mg/L. Fujihara et al. (1995) reported that the low concentration of mineral Ca in blood plasma is thought to have not been optimally absorbed, although the intake of Ca mineral in T1 treatment was 8.10 mg/kg according to the standard requirement, while T2, T3 and T4 exceeded the standard requirement. The need for Ca for sheep is 2,000 – 8,000 mg/L (Fujihara et al., 1995).

The results of the study showed that the concentration of Mg in T3 treatment was higher (P<0.05) than T1, T2 and T4 treatments. The concentration of Mg in T1 treatment was not different from T2 and T4 treatments. The high concentration of Mg in T3 treatment was suspected by the addition of Sargassum sp. 5% Mg content in the plasma is increased and is optimal for sheep. The Mg concentrations from this study were T1, T2, T3 and T4 respectively, namely 44.78; 49.65; 58.94; 50.42; mg/kg is almost the same as the results of Fujihara et al. (1995) ranged from 30.4 to 67.1 mg/L and exceeds the standard Mg in sheep blood plasma. Fujihara et al. (1995) stated that the standard of Ca in plasma hens was 22-28 mg/L.

Micro minerals

The results showed that the addition of Sargassum sp. in weaning male thin tails. TMR pattern feeding did not affect the plasma mineral concentration of Zn, but significantly (p<0.05) on the concentration of Cu and Fe minerals. There was no difference in the concentration of Zn in plasma between treatments. It was assumed that the concentration of Zn was almost the same as T1, T2, T3 and T4 treatments, respectively, namely 4.83; 5.02; 4.05; 4.13 mg/kg higher than the results of research by Fujihara et al. (1995) which ranged from 0.2 - 1.6 mg/L and the standard of Zn in sheep blood plasma. Fujihara et al. (1995) stated that the standard of Zn in sheep blood plasma was 0.02 – 0.2 mg/L.

The Cu concentration showed that the T3 treatment was higher (p<0.05) than T4 treatment, but did not show any difference with the T1 and T2 treatments. The high concentration of Cu in T3 treatment is thought to have good absorption of Cu in the blood. Cu concentrations in blood plasma for T1, T2, and T3 treatments were in the normal range for sheep. McDowell (2003) reported the normal range of sheep plasma Cu Cu is 0.6 – 1.5 mg/L. The concentration of Fe in the T1 treatment was higher than the T3 and T4 treatments but did not differ from the T2 treatment; The concentration of Fe in T2 treatment was not different from T3 and T4.

Conclusion

The use of 10% Sargassum sp. powder to improve blood plasma minerals for Thin Tailed treatment received funding from the Directorate of Research and Community Service, Ministry of Education and Culture, Research and Technology through a grant Penelitian Disertasi Doktor.

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Author’s contribution

The contribution of each author is to provide corrections to the contents of the journal.

Ethics Approval

This research has met the ethical requirements of the Research Ethics Commission of the Faculty of Veterinary Medicine, Universitas Gadjah Mada. Statement of Ethical Clearance Number: 0145/EC-FKH/Eks/2019.
References


