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Effect of rejected *Eucheuma cottonii* level in complete feed on nutrient intake and digestion, blood metabolites, and body weight gain of early weaning Bali calves

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ABSTRACT: Effect of rejected *Eucheuma cottonii* level in complete feed on nutrient intake and digestion, blood metabolites, and body weight gain of early weaned Bali calves was studied. Twelve Bali calves aged 4 months with average early body weight 40 kg and standard error 1.3 kg were used in this experiment. Completely randomized design was applied with four treatments and three replications. The treatments were CT0 (complete feed without *Eucheuma cottonii*, CT5 (complete feed plus *Eucheuma cottonii* 5%), CT10 (complete feed plus *Eucheuma cottonii* 10%), and CT15 (complete feed plus *Eucheuma cottonii* 15%). The results on nutrient intake indicated that there were no significantly differences (p>0.05) among treatments by Bali calves. There were also no significant differences (p>0.05) of treatments on crude protein and fiber digestibility, however, digestibility of DM, OM, EE, and NFE were same among 5, 10, and 15 % level of rejected *E. cottonii* in complete feed. There were significantly different (p<0.05) of treatments on blood urea, glucose, protein, Mg, and K of Bali calves. Providing rejected *E. cottonii* 15% in the complete feed produced generally the highest blood urea, glucose, protein, Mg, and K of Bali calves. There were no significantly different (p>0.05) of treatments on body weight gain and body linear measures of Bali calves. It was concluded that 1) dry matter and other nutrient intake were the same between early weaned Bali calves consumed complete feed with or without rejected *E. cottonii*, 2) digestibility of DM, OM, EE, and NFE of complete feed differed among treatments. The lowest digestibility of DM, OM, EE, and NFE were at early weaned Bali calves consumed complete feed without rejected *E. cottonii*. Digestibility of CP and CF were same among early weaned Bali calves consumed both with and without rejected *E. cottonii*, 3) blood urea, glucose, protein, Mg, and K concentration differed among treatments. The lowest blood urea, glucose, protein, Mg, and K concentration were at early weaned Bali calves consumed complete feed without rejected *E. cottonii*. The highest blood urea, glucose, protein, Mg, and K concentration were general at early weaned Bali calves consumed complete feed with 15% rejected *E. cottonii*, 4) daily body weight gain and linear body measures were same among early weaned Bali calves consumed both with or without rejected *E. cottonii*.

Keywords: Bali calves, blood urea, digestion, *Eucheuma cottonii*, nutrient intake.

INTRODUCTION

Early weaning is one of the strategies that could be applied to overcome the problem of low productivity of farm animals in dry land areas including East Nusa Tenggara Province, Indonesia (Jelantik et al., 2010). The main factor causing low cattle productivity is the rapid or extreme decrease of body score condition (BSC) of the cow during dry season caused by the scarcity of feed. The extreme decrease of the BSC impacted on the adjournment of the onset of post- partum estrus and birth rate reduction. Low BSC cow also have low milk production capacity (Jelantik, 2001). The low intake of milk from cow is the main contribution on high mortality rate of calf in the area (Jelantik et al., 2008). Consequently, early weaning is a strategy being often applied to prevent the decrease or maintain BSC of cow so that the time of the onset of post-partum oestrus and interval from parturition to conception may be shorter (Rasby, 2007). Moreover, early weaning calves grow faster and have higher body weight compared to those of normal weaning calves (Wirdahayati et al., 2010). Another advantage is to maximize the calf's genetic potency (Myers et al., 1999).

Various factors known influence the success of early weaned Bali calves included the exact age of weaning and the quality of the available diet for weaned calves (Rasby, 2007). A lot of researches have been conducted to evaluate the exact age to be early weaned on various beef cattle breeds. Wirdahayati et al. (2010) reported that the early weaning could be done on 3 to 6 months old for Bali calf with several advantages such as improvement of cow's reproduction rate and the increase of calf's body weight. However, until now there has not been yet available information about the ability of nutritive utilization of early weaned Bali calves, especially nutrient intake and digestibility, blood urea, glucose, and body weight gain when they were offered complete feed containing *E. cottonii*. Nikolaus et al. (2020) reported that *E. cottonii* has good prospect to be used as a complete feed. Thus, the objective of this study is to determine the effect of rejected *Eucheuma cottonii* level in complete feed on nutrient intake and digestion, blood metabolites, and body weight gain of early weaning Bali calves.

MATERIALS AND METHODS

Twelve early weaning Bali calves aged around 4 months and body weight of 40 kg with standard error 1.30 kg were used in this experiment. The experiment was conducted at the Field Laboratory of Animal Science Faculty, Nusa Cendana University, Kupang, Indonesia. A completely randomized design with four treatments and three replications was applied in this experiment. The treatments were CT0, CT5, CT10, and CT15 containing 0, 5, 10, and 15% *E. cottonii* in complete feeds, respectively. *E. cottonii* were obtained from an agar factory located in Kupang subdistrict, Kupang regency, Indonesia. The complete feed was made iso protein and energy consisting of 40% natural grass and 60% concentrate containing corn, rice brand, fish meal, *E. cottonii*, and urea. The composition of the complete feed is given in Table 1. The feed was offered *ad libitum* twice in the morning and afternoon. Free choice water was made available to calves throughout the day. The parameters measured in this experiment were nutrient consumption and digestibility, concentration of urea, glucose, protein, Mg, and K of blood, body weight gain, and body linear size.

Dry matter and nutrient intake and digestion

Feed intake was measured by calculating the difference between feed offered and residue in the dry matter form. The residue was collected and weighed every morning before next feed offered and 10% of the weight was taken as a sample. After five days or the end of the data collection, samples were pooled by calf and homogenized and subsamples were taken. Samples of the feed and subsamples of the residue by calf were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fibre (CF), and nitrogen free extractives (NFE) according to standard method (AOAC, 1990). The digestibility was measured by calculating the difference between intake and faeces. Faeces were collected and weighed daily and 10% of the weight was taken as sample and dried at 105°C for 20 hours to measure the daily faeces DM production and stored by calf. After five days samples of faeces were homogenized and subsample were taken, 10% of the sample weighed to analyze for OM, CP, EE, CF, and NFE according to standard method (AOAC, 1990).

Concentration of urea, glucose, protein, Mg, and K of blood

Blood samples were collected at the end of the data collection. Blood was taken before offering feed and from the jugular vein in heparinized tubes and put in the refrigerator. Then it was centrifuged for 15 minutes at 1500 g at 2°C, and plasma was stored at -20°C for analysis of urea, glucose, protein, Mg, and K.

Body weight gain and linear body measurements

Body weight gain was obtained by weighing calves before and after data collection period before consume feed and water. Body weight gain was calculated by the difference between weight before and after data collection (Bogart and Taylor, 1983). Body weight was determined by using weighing scale. The linear body measurements measured in this experiment were body length, heart girth, and height at wither which were measured using caliper.

RESULT AND DISCUSSION

Intake and digestibility

The effect of rejected *E. cottonii* level in complete feed on nutrient intake and digestion which influence calf production level such as body weight gain could be seen in Table 2. There was no significant difference ($p>0.05$) between treatments on intake of DM, OM, CP, CF, EE, and NFE of Bali calves (Table 2). The intake of DM in this experiment was 2.407 to 2.707 kg/day. Marsetyo et al. (2010) reported DMI 3.13 to 4.46 kg/day. The different intake between these two experiments was caused by the different in diet, initial body weight, age, and location. Marsetyo et al. (2010) used Bali calves age 11 months with

Table 1. The composition and nutritive content of complete feed containing different level of *E. cottonii*.

Fed substances (%)	Treatments			
	CT_0	CT_5	CT_{10}	CT_{15}
Grass	40	40	40	40
Corn	27	30.1	27.1	27.1
Rice brand	25.1	17.05	15	10.1
Fish meal	7	7	7.2	7.1
ECOT	0	5	10	15
Urea	0.9	0.85	0.7	0.7
Chemical composition				
Crude protein (%)	16.089	16.075	16.079	16.023
ME (Mcal/kg)	2.635	2.625	2.596	2.588

Table 2. The effect of rejected *E. cottonii* level in complete feed on nutrient intake and digestibility of Bali calves.

Parameters	Treatments				MS	Sig.
	CT0	CT5	CT10	CT15		
DM Intake (kg)	2.707	2.473	2.580	2.407	0.052	0.78
OM intake (kg)	1.976	2.008	2.052	1.838	0.026	0.83
CP intake (kg)	0,343	0.301	0,305	0,270	0.003	0.36
CF intake (kg)	0,372	0.301	0.305	0.266	0.006	0.12
EE Intake (kg)	0.093	0.089	0.088	0.079	0.001	0.42
NFE intake k(g)	1.304	1.239	1.303	1.243	0.004	0.95
DM digestibility (%)	84.53^a	90.54^b	88.89^b	89.20^b	20.48	0.04
OM digestibility (%)	84.92^a	92.11^b	90.82^b	90.58^b	30.67	0.001
CP digestibility (%)	89.04	90.24	87.57	86.07	9.77	0.19
EE digestibility (%)	96.12^b	95.48^b	93.18^a	91.77^a	12.23	0.04
CF digestibility (%)	74.00	77.72	72.60	67.42	76.69	0.075
NFE digestibility (%)	87.74^a	94.86^b	95.30^b	96.57^b	47.68	0.001

Superscripts in the same row indicates differ significantly (p<005).

initial body weight of 115 kg in Central Sulawesi and offered mulato grass or mulato grass plus gliricidia or mulato grass plus rice brand.

No significant difference between treatments on intake of DM, OM, CP, CF, EE, and NFE of Bali calves in this experiment may be caused by diet (ration). This ration was made iso protein and energy with CP content high enough, 16%. CP influence feed intake. Diet containing higher CP content generally have higher nutrient intake, for instance DMI and OMI (Mayulu and Suhardi, 2016). They showed that local sheep fed complete feed based on palm leaves and palm by product with different crude protein content (10.63 to 15.90%) increased DMI, however until certain level (14%) and decreased again. The decrease of DMI may also be influenced by the increase in CF, 25%, and low energy content. The high CF may decrease intake because of high lignin content which link with other nutrients. On the other hand, Mayulu et al. (2013) indicated that the increase of CP (9.98 to 13.65 %) did not influence DMI of Simmental offspring fed complete feed based on fermented ammonization (amofer) rice straw. The content of CF was high enough (24.57 to 31.92%) that may influence feed intake. There was a relationship between CP, CF, and energy content of the ration with feed intake.

Digestibility determine the amount of nutrients that could be absorbed and utilized for maintenance and production. Nutrient digestibility in this experiment is quite high generally above 80% except for CF which was between 67 to 77% (Table 2). Marsetyo et al. (2010) reported that DM digestibility of the early weaned Bali calves was 56 to 64%. The main cause of the difference may be the diet used in the experiment.

The treatments increased significantly ($p<0.05$) on digestibility of DM, OM, and NFE, however, they decreased significantly ($p<0.05$) on digestibility of EE, but did not influence ($p>0.05$) on CP and CF digestibility. The increase in the digestibility of DM, OM, and NFE may indicate that microorganism in the rumen of the calves

Table 3. The effect of rejected *E. cottonii* level in complete feed on blood urea, glucose, protein, Mg, K, body weight gain, and body linear measurements, of Bali calves.

Parameters	Treatments				MS	Sig.
	CT0	CT5	CT10	CT15		
Blood urea (mg/dl)	29.35[a]	43.09[b]	51.39[c]	55.89[d]	407.95	0.0001
Blood glucose (mg/dl)	58.55[a]	72.61[b]	78.36[b]	87.57[c]	456.57	0.0001
Blood protein (g/dl)	7.23[a]	7.40[b]	7.51[b]	8.02[c]	0.35	0.0001
Mg (mg/dl)	1.93[a]	2.14[b]	2.38[c]	2.42[c]	0.16	0.002
K (mg/dl)	8.60[a]	9.12[b]	9.56[c]	10.01[d]	1.09	0.0001
Body weight gain (g)	40.00	37.33	38.83	37.50	4.69	0.92
Heart girth (cm)	86.00	82.00	84.67	83.33	8.89	0.75
Body length (cm)	67.00	69.00	67.67	68.00	2.08	0.93
Height at wither (cm)	78.33	76.67	77.00	77.00	1.64	0.92

Superscripts in the same row indicates differ significantly (p<005).

started functioning. The higher the activity of the micro-organism, the higher digestibility of the feed. Mayulu et al. (2013) indicated that there was different in digestibility of DM, OM, and CP although there was not different in intake of DM, OM, and CP.

Blood urea, glucose, protein, Mg, and K

Blood urea, glucose, protein, Mg, and K concentration may indicate number of nutrients of feed/ration digested and absorbed by animal. Blood urea of Bali calves in this experiment varied between 29.35 to 55.89 mg/dl (Table 3). Blood urea concentration in this experiment does not differ widely as reported by Umar et al. (2015). They reported that blood urea concentration of Madura cattle fed low, middle, and high energy ration range between 39.50 to 56.93 mg/dl. It was also stated that the normal concentration of blood urea range of 26.6 to 56.6 mg/dl, however Bondi (1987) stated a maximum limit of 80 mg/dl.

The treatments increased significantly ($p<0.05$) for blood urea concentration of Bali calves. Treatment with 15% of rejected *E. cottonii* in the complete feed gave the highest blood urea concentration of Bali calves and the lowest blood urea concentration was recorded in treatment with no rejected *E. cottonii* (Table 3). Blood urea has closely related with rumen ammonia concentration which indicated crude protein degradation in the rumen (Tiba, 1996). Although the treatments were made iso-protein, the increase of rejected E*. cottonii* level boosted urea blood concentration. This indicated that rejected *E. cottonii* contain high proportion of degraded crude protein. Rejected *E. cottonii* contain 4 to 5% crude protein with *in vitro* digestibility of 40 to 50% (Nikolaus, et al., 2020).

Blood glucose concentration of Bali calves in this experiment varied between 58.55 to 87.57 mg/dl (Table 3). Umar et al. (2015) reported that blood glucose concentration of Madura cattle varied between 62.67 to 78.33 mg/dl. Mitruka et al. (1977) stated that normal blood glucose of cattle was between 43 to 100 mg/dl. The treatments significantly ($p<0.05$) increased blood glucose concentration of Bali calves (Table 3). The highest blood glucose concentration occurred in a treatment with 15% concentration of rejected *E. cottonii* and the lowest when no rejected *E. cottonii was* provided. Blood glucose generally come from feed both degradation in the rumen and small intestine. Degradation of feed in the rumen that form blood glucose is from propionate which will be converted to glucose in heart**.** Carbohydrate content of rejected *E. cottonii* was 6 to 10% (Nikolaus et al., 2020).

Blood protein concentration in this experiment ranged from 7.23 to 8.02 g/dl. Blood protein was provided by feed and microbial protein. Total protein plasma of male Baladi rabbits when supplemented with seaweed was 5.2 to 7.2 g/dl (El-Banna et al., 2005). The difference was caused by the difference of diet and species. The treatments significantly ($p<0.05$) influenced blood protein concentration of Bali calves. Treatment with 15% of rejected *E. cottonii* in the complete feed gave the highest blood protein of Bali calves and the lowest occurred when no rejected *E. cottonii* was provided. There were no different in the blood protein concentration when provide 5 and 10% of rejected *E. cottonii* in the complete feed. This may indicate that true protein content of rejected *E. cottonii* was high enough. In addition, it was estimated that the growth of microorganism was quite good.

Blood Mg and K concentrations of Bali calves in this experiment were 1.93 to 2.42 mg/dl and 8.60 to 10.01 mg/dl, respectively. Suttle and Field (1969) reported that blood Mg and K of sheep were 2.87 ± 0.43 mg/dl and 18.8 ± 0.5 mg/dl, respectively. The difference of the value was caused by the difference of diet and species. The treatments significantly influenced ($p <0.05$) blood Mg and K of Bali calves (Table 3). There was no significantly different of blood Mg between CT10 and CT15, but there was significantly different of blood K between CT10 and CT15. The lowest blood Mg and K of Bali calves occurred when there was no rejected *E. cottonii* in the complete feed. It indicated that rejected *E. cottonii* could be used as mineral supplement in the diet of Bali calves. Nikolaus et al. (2020) reported that Mg content of rejected *E. cottonii* was 0.2%.

Body weight and linear body measures

Body weight gain varied from 37.33 to 40 g/day. The weight gain was less than what was reported by Wirdahayati et al. (2000) that was 190 g/day for supplemented and 150 g/day for non-supplemented calves at ages 0 to 3 months. This difference may be caused by different management where the calves in this experiment have been weaned so that they did not have access to milk from their mother. There was no effect of treatments ($p>0.05$) on body weight gain. Body weight gain indicate that there are growth and development of bone and muscle. The higher the growth and development, the higher body weight gain. Body weight gain is influenced by several factors such as feed and energy intake (Mayulu and Suhardi, 2016; Marsetyo et al., 2010).

Mayulu and Suhardi (2016) reported that sheep intake higher organic matter and energy (TDN) had higher body weight gain. In this experiment, organic matter and nutrient intake of the Bali calves were the same among treatments. This might also indicate that the intake of energy of the calves among treatments were the same which caused that body weight gain of calves among treatments were no difference. The growth and development of bone and muscle might be seen from heart girth, body length, and height at wither. This means that organic matter and energy intake influence body linear measure of calves. Because of the same organic matter and nutrient intake, there were no difference of heart girth, body length, and height at wither of Bali calves.

Conclusion

It can be concluded that: (1) DM and other nutrient intake were the same between early weaned Bali calves consumed complete feed with or without rejected *E. cottonii*, (2) digestibility of DM, OM, EE, and NFE of complete feed differed among treatments. The lowest digestibility of DM, OM, EE, and NFE were at early weaned Bali calves consumed complete feed without rejected *E. cottonii*. Digestibility of CP and CF were same among early weaned Bali calves consumed both with and without rejected *E. cottonii*, (3) blood urea, glucose, protein, Mg, and K concentration differed among treatments. The lowest blood urea, glucose, protein, Mg, and K concentration were at early weaned Bali calves consumed complete feed without rejected *E. cottonii*. The highest blood urea, glucose, protein, Mg, and K concentration were general at early weaned Bali calves consumed complete feed with 15% rejected *E. cottonii*, and (4) daily body weight gain and linear body measures were same among early weaned Bali calves consumed both with or without rejected *E. cottonii*.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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