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Effect of Feeding Duration with Different Levels of Culled *E. Cottonii* on Consumption, Nutrient Digestibility, Growth and Body Composition of Early Weaned Balinese Calves

Jalaludin[1], T.T. Nikolaus[2], Y.R. Noach*[3]
[1,2,3] Faculty of Animal Science Marine and Fisheries, Nusa Cendana University, Indonesia.

ABSTRACT: The study aimed to evaluate the duration of complete feed containing culled red seaweed (*E. cottonii*) with different levels on nutrient utilisation, growth and body composition of early weaned Bali cattle calves. A total of 24 Bali cattle calves (initial BW ± 30-40 kg; 2-3 months old) were used in this study. Bali cattle calves were randomly grouped by initial body weight and placed in 4 different treatments following a group randomised design pattern. The 4 treatments were: CT_0 = complete feed containing no cull ECOT; CT_5 = complete feed containing 5% cull ECOT; CT_{10} = complete feed containing 10% cull ECOT and CT_{15} = complete feed containing 15% cull ECOT. The data obtained were analysed by analysis of variance followed by Duncan's Multiple Range Test using SPSS 24 software. Feeding ECOT culls with different lengths of time and levels had a significant effect ($P<0.05$) on increasing consumption and nutrient digestibility of early weaned Balinese calves, but there was no interaction effect ($P>0.05$) between the length of time and level of ECOT culled on body weight gain and linear body size of early weaned Balinese calves. The same was true for body composition (meat and fat). The treatment also significantly ($P<0.05$) influenced the increase in bone weight in cattle treated with 5% cull ECOT and 10% cull ECOT. It was concluded that the use of culled ECOT up to 15% in complete feed could not increase the consumption and digestibility of nutrients but the duration of feeding affected the dry matter consumption and bone development of early weaned Bali cattle calves.

KEY WORDS: *E. cottonii* rejected, feeding duration, growth and body composition

INTRODUCTION

Early weaning is a widely applied strategy to prevent the decline or maintain the mother's Body Condition Score (BCS) so that she can cycle again after calving and become pregnant in a shorter time after calving (Arthington and Minton, 2004; Rasby, 2007). In addition, early weaned calves also have a faster growth rate so that they have a heavier body weight compared to normal weaned calves at the same age (Myers et al. 1999; Wirdahayati, 2010). Another advantage is maximising the calf's genetic potential to produce intermuscular fat (marbling) (Myers et al. 1999). The success of early weaning in cattle is determined by the appropriate age of the calf to be weaned and the quality of feed provided (Rasby, 2007). Myers et al. (1999) reported that weaning can be done at 3 months of age in Simental, Angus and Hereford crossbred cattle. According to Wirdahayati (2010), early weaning of Bali cattle calves aged 3 to 6 months will have a positive impact on improving the reproductive capacity of the mother and increasing calf weight gain. The feed provided must be of high quality so that the structure and function of the rumen develops faster and can reduce stress in livestock.

Seaweed is a potential source of biomass as a feed supplement because it has high levels of protein, minerals and vitamins with low crude fibre content. One species that is widely cultivated in Indonesia, especially in NTT, is Eucheuma cottonii. The nutritional content of crude protein (PK) ranges from 4 - 7%, fat ranges from 0.36 - 0.89%, carbohydrates range from 18.63 -69.9% and ash ranges from 14.81 - 43.49% (Agusman, et al. 2014; Safia, et al., 2020). The carbohydrate content is more polysaccharides which are important for the development of rumen structure and function and act as probiotics for ruminants (Pandey et al. 2021). the content of essential amino acids in red algae is quite high (Angell et al. 2016) and digestibility is close to 85% (Tibbetts et al. 2016). In addition, E. cottonii also contains antioxidants, provitamin A, and can reduce pathogenic microorganisms (Diler et al. 2007; Chojnacka et al. 2012; Burtin, 2003; Braden et al. 2004). With such a composition, seaweed has the potential as an energy and mineral supplement for Bali cattle calves. In addition, its peak production occurs during the dry season (Becker, 2007; Siddhanta et al. 2001), making it available at the time of early weaning of Bali cattle as births are concentrated in the middle of the dry season

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where feed difficulties occur (Bamualim, 2011). However, there is no information on the use of Eucheuma cottonii afkir seaweed with different levels in the rations of early weaned Bali cattle calves and the duration of feeding on consumption and digestibility of food satellites as well as growth and body composition.

MATERIALS AND METHODS

This study used 24 early-weaned Bali cattle calves, approximately 2 months old with a body weight range of 30-40 kg. The animals were purchased from Lili livestock market, Camplong, Kupang Regency. The calves were divided into 4 groups of 6 animals each with an equal ratio of males to females and the feeding period was extended to 60 days. The number of replicates in period 2 (30-60) days was half the number of animals in period 1 (1-30) days. The research was conducted at the Integrated Dryland Field Laboratory of Nusa Cendana University for 3 months.

Consumption was measured in the last two weeks of the study. Meanwhile, nutrient digestibility and metabolism were measured during the last 5 days. In addition, production parameters including body weight gain, linear body measurements (body length, shoulder height and chest girth) and body composition (meat, fat and bone growth) were measured. Calves slaughtered at 5 months of age were fabricated to determine carcass percentage, percentage of meat, fat and bone, and carcass parts. Body length was measured by extending a yardstick from the elbow to the bump on the tapis bone; shoulder height was the distance from a flat surface to the highest part of the shoulder past the scapula perpendicularly; chest girth was measured around the chest cavity behind the shoulder joint. Measurement of body weight gain by calculating the difference between body weight at the beginning of the study and body weight at the end of the study.

Body composition includes carcass weight obtained by weighing using a hanging scale all meat and bones after deducting blood, head, skin, internal organs and the four legs. Carcass percentage was obtained by comparing carcass weight with slaughter weight then multiplied by 100%.

The data obtained were analysed by analysis of variance followed by Duncan's Multiple Range Test using SPSS 24 software.

The composition of the complete feed could be seen in Table 1. The feed was offered *ad libitum* twice a day, in the morning and in the afternoon. Water was available *ad libitum.*

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

	Treatments			
Fedd substances (%)	CT0	CT5	CT10	CT15
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

RESULTS AND DISCUSSION

Consumption and Digestibility of Food Substances of Early Weaned Bali Calves

Feed consumption of early weaned Balinese calves at different lengths of feeding is shown in Table 2. The results showed that there was an interaction effect ($P<0.05$) of length of feeding and level of culled ECOT in complete feed on consumption, except grass consumption. In this study, ration BK consumption decreased significantly ($P<0.05$) with the use of culled ECOT in complete

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feed, but the decrease only occurred in the first period (30 days of feeding). Meanwhile, in period 2 (60 days), early weaned Bali calves had relatively equal consumption when fed diets with different levels of cull ECOT. The difference in total BK consumption occurred mainly due to differences in concentrate consumption patterns according to the length of ration feeding. Meanwhile, grass consumption was relatively not different among cattle that received rations with different cull ECOT content at both 30 days and 60 days of feeding. The reduction in consumption in the second period indicates the possibility that livestock have adapted.

Table 2. Effect of feeding duration with cull ECOT level on feed consumption of early-weaned Bali cattle calves at different feeding durations

Parameters	Feeding lenght 30 days				Feeding lenght 60 days				SEM	P-value		
	CT0	CT5	CT10	CT15	CT0	CT5	CT10	CT15		Period	Level	Period* Level
Consumption (g/day)												
Grass	242,78	214,47	219,69	230,56	217,14	175,78	216,30	212,26	8,95	0,000	0,027	0,473
Concentrate	425,57	447,15	411,48	333,94	1702,6	1586,2	1315,74	1560,29	45,0	0,000	0,010	0,016
Total	668,35	675,75	631,16	564,50	1922,3	1764,6	1528,6	1775,13	47,59	0,000	0,011	0,030
Dry Matter cons ($g/kg_{BB}0,75$)	44,03	44,07	41,94	36,952	122,39	116,36	97,95	117,86	3,079	0,000	0,015	0,017
Organic Matter	608,71	602,74	571,41	509,65	1755,9	1611,17	1388,9	1601,52	42,56	0,000	0,007	0,028
Crude Protein	95,035	94,131	83,105	67,603	346,61	307,64	243,0	276,16	8,111	0,000	0,000	0,002
Crude Fat	24,28	24,41	21,83	18,266	80,71	73,88	59,13	66,31	1,911	0,000	0,000	0,006
Crude Fiber	130,76	112,46	109,28	104,04	237,64	176,83	164,66	156,82	4,733	0,000	0,000	0,000
Nitrogen Free Extract	336,49	351,52	335,18	298,89	1052,17	1019,8	883,3	1061,78	28,01	0,000	0,000	0,034
Gross Energy	10,77	10,70	10,11	8,960	31,68	29,11	24,98	28,77	0,771	0,000	0,088	0,027
Digestibility (%)												
Dry Matter	60,87	60,27	57,14	50,97	75,59	61,12	58,90	60,15	4,293	0,003	0,488	0,094
Organic Matter	53,74	64,42	65,96	49,51	72,24	75,85	64,88	76,20	3,874	0,005	0,593	0,093
Crude Protein	71,53	67,34	64,78	40,03	81,29	82,06	70,75	78,09	4,775	0,001	0,028	0,052
Crude Fat	88,43	82,46	79,26	65,81	90,46	89,60	80,66	84,69	2,549	0,006	0,001	0,038
Crude Fiber	45,76	49,95	48,64	28,23	52,31	45,05	31,85	46,45	5,321	0,882	0,246	0,079
Nitrogen Free Extract	65,27	80,63	85,97	79,50	81,40	88,14	86,92	92,13	2,421	0,001	0,001	0,097

Many factors contribute to the increase in feed consumption with increasing age of livestock, especially during the transition period from pre-ruminants to ruminants. These factors include the development of the physical structure of the rumen (Van Ackeren et al. 2010). This transitional phase is a crucial period for the development of the digestive tract and immune system in calves. Consumption of palatable solid feed, especially easily digestible carbohydrates, will spur the growth and formation of rumen microbes, especially starch-digesting bacteria. The increase in fermentation products and microbial biomass results in modification of rumen structural and physiological characteristics (Amin et al. 2021). Thus, when consumption increased with age in this study, it is suspected that the increase was due to one or more of these factors. It is suspected that the positive effect of adding cull ECOT will intensify during the 60-day feeding period after the animals have adapted to the complete feed containing cull ECOT.

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The increased consumption in this study may also be due to the decreased effect of stress on feed consumption. Early weaned calves generally experience intensive stress. Several negative effects of stress due to the early weaning transition on feed consumption and growth have been previously reported by many researchers. Calves weaned at 6 weeks of age rapidly change their rumen and microbial composition and experience reduced growth rates during weaning compared to calves weaned late. In contrast, calves weaned at 8 weeks gradually underwent microbial changes, indicating a gradual increase in concentrate feed consumption and progressive rumen development compared to early weaned calves (Amin et al. 2021). It was further explained that the progressive development of the rumen to maturity occurs with age and the transition phase at weaning. Consumption of solid feed initiates the rumen fermentation process which generally modifies the microbial composition in the rumen.

In this study, feeding cull ECOT is expected to reduce stress levels in Bali cattle calves weaned at around 3 months of age. Culled ECOT contains antioxidants, provitamin A, and can reduce pathogenic microorganisms (Diler et al. 2007; Chojnacka et al. 2012; Burtin, 2003; Braden et al. 2004). In addition, seaweed is reported to contain vitamins (C, B1, B2 and E) and micro minerals such as Se, Cu, Zn, and Fe that act as enzyme cofactors capable of stimulating immune responses through antioxidant status, increasing phagocytosis (Samarasinghe et al. 2020). With such a composition, seaweed can function as energy and mineral supplementation for Bali cattle calves so that it is very potential as a feed for early weaned Bali cattle calves so that it can also function to reduce stress levels which have an impact on increasing the consumption of early weaned Bali cattle calves.

The digestibility of DM and nutrients in this study increased significantly ($P<0.05$) with increasing length of feeding and the increase appeared to be independent of the increase in body weight as the increase did not disappear or decrease when consumption was expressed per kg $BW^{0.75}$. Thus the increase was an expression of an increase in the physical structure and/or fermentation capacity of the rumen with increasing age of the animals.

Body Weight Gain and Linear Size of Early Weaned Bali Calves

Body weight gain and linear body size of Balinese calves fed diets with different levels of culled ECOT are shown in Table 3. The results showed that there was no interaction effect ($P>0.05$) between the level of culled ECOT and the duration of feeding on body weight gain and linear size of early weaned Bali calves. In this study, body weight gain during the 60-day ECOT feeding period was higher ($P<0.05$) compared to the 30-day feeding period. Meanwhile, there was no statistical difference in the weight gain of calves fed complete diets with different levels of cull ECOT in both the 30-day and 60-day periods. However, in the second period (60 days) there was an increase in body weight gain with the same level of cull ECOT in the first period (30 days). This illustrates that the addition of ECOT in the complete feed began to have an impact on body weight gain even though compared to the control ration the body weight gain rate is still lower.

Table 3. Effect of length of ECOT feeding on body weight gain and linear body size of early weaned Balinese calves

Parameters	30 days				60 days				SEM	P-value		
	CT_0	CT_5	CT_{10}	CT_{15}	CT_0	CT_5	CT_{10}	CT_{15}		Feeding lenght	Level	Period* Level
Body Weight (kg)	0,014	0,035	0,024	0,014	0,136	0,114	0,088	0,110	0,023	0,001	0,255	0,795
Body Lenght (cm)	0,021	0,021	0,028	0,065	0,121	0,055	0,045	0,050	0,032	0,184	0,718	0,443
Chest Girth (cm)	0,125	0,090	0,049	0,019	0,060	0,028	0,073	0,044	0,028	0,391	0,326	0,285
Shoulder High (cm)	0,063	0,049	0,042	0,028	0,037	0,061	0,030	0,046	0,021	0,461	0,251	0,203

Bittar et al. (2020) state that the main goal of weaning calves is the ability to maintain growth and other physiological functions with energy from dry feed. Early in the calf's life, this ability is small and increases with the accumulation of nutrients from concentrate feed. Klopp et al. (2019) found that high liquid feed consumption in early calf life improved feed efficiency, but

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increased starter feed consumption is essential to maintain feed efficiency through high fibre digestibility as a result of rumen development.

Beiranvand et al. (2014) reported that feeding alfalfa hay and sodium propionate had no effect on body length gain, shoulder height or hip width. This is in line with the results of this study that giving the level of E. Cottonii in complete feed with a period of 30 days and 60 days has no effect on body weight gain, body length, chest width or shoulder height. The same thing was also reported by Pazoki et al. (2017) reported the results of research conducted on dairy cattle calves given feed with different physical forms had no effect on body length, shoulder height and height.

Body Composition of Early Weaned Balinese Calves

The effect of feeding ECOT afkir in complete feed with different levels on body composition of early weaned Balinese calves is shown in Table 4. The analysis showed that the treatment did not significantly affect (P>0.05) the body composition of meat and fat. Similarly, there was no effect of treatment on (P>0.05) meat and fat composition on body composition (%BB). However, there was an increase in bone development (P<0.05) in cattle treated with CT5 and CT10. This may be due to the increase in structure and mass changes that occur due to minerals contained in E. cottoni that affect growth and tissue in response to the feed given. Honig et al. (2022) reported that changes in bone tissue related to feed minerals were indicated by an increase in ash content by 12.1% from 120 to 780 kg live body weight of bulls fed feed with different energy content. Furthermore, it was also reported by Herliatika et al. (2017) that E. Cottonii seaweed has a fairly high mineral content such as Mg, K and Na.

Table 4. Effect of ECOT afkir on body composition of early-weaned Bali calves

Parameter	Treatments				SEM	P-value
	CT0	CT5	CT10	CT15		
Body Composition (g)						
Meat	6326,5	6090,5	7374,0	5850,0	657,453	0,425
Bone	3042[a]	3929,5[c]	3550,5[b]	3113[a]	108,204	0,001
Fat	64,50	15,50	73,00	17,00	24,256	0,268
Body Composition (%)						
Meat	16,351	15,127	17,060	16,496	1,835	0,896
Bone	7,830[a]	9,821[b]	8,153[a]	8,775[ab]	0,350	0,017
Fat	0,169	0,040	0,161	0,048	0,056	0,278

Means followed by different superscripts indicate significant differences (P<0.05).

Meanwhile, the absence of differences between treatments on fat composition may be due to the fact that the cattle used were 3-4 months old calves with body weight ranging from 30-40 kg, so consequently there is no fat deposition as in adult cattle. Many factors influence the growth process of organs and tissues including genetics, nutrition, and environmental factors.

CONCLUSIONS AND SUGGESTIONS

Conclusion

1. Length of feeding with the addition of cull ECOT in the complete diet increased consumption and nutrient digestibility of feed fibre body weight gain and body composition of early weaned Balinese calves.
2. The addition of 5 and 10% cull ECOT in the complete feed can increase the bone weight of early weaned Balinese calves.

Suggestions

Further studies need to be conducted on the use of E. Cottonii afkir in ruminant feed, especially early weaned Bali cattle calves.

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