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Feed efficiency and income over feed cost of Ettawa crossbred goats fed different quality of dry complete feed supplemented with mineral

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Abstract

This study aim was to evaluate the effect of different quality of dry complete feed and mineral (Zn-Se) supplementation on feed efficiency and income over feed cost of Ettawa crossbred goats. Sixteen weaned female goats aged 4-month-old were used in this study. The experiment was conducted in factorial 2x2 in a completely randomized design with 4 replications and 2 factors. The first factor was different levels of energy and protein in the diets: 14% CP + 63% TDN (T1); and 16% CP + 67% TDN (T2). The second factor was the Zn-Se supplementation (treatment and control). The concentration of Zn and Se in the supplement were 20 mg/kg and 0.2 mg/kg, respectively. Results showed that goats in T1 group lost the body weight (BW) by 11.07 g, whereas T2 group gained 10.48 g of BW within 6 weeks of experimental period. Supplementation of Zn-Se in the T2 diets prevented the BW lost and resulted in the highest BW gain (7.15 kg) within 14 weeks. Moreover, the T2 diets plus Zn-Se supplement also resulted in the highest feed efficiency (11.82%) as well as income over feed cost (IDR. 1,722 head/d). It is concluded that dry complete feed containing 16%CP and 67% TDN with Zn-Se supplementation (Zn 20 mg/kg + Se 0.2 mg/kg). It is recommended for female weaned-goat for the optimal growth and increase the income over feed cost. It is recommended for female kid goat at the growth phase.

1. Introduction

Indonesia is a tropical country which has relatively high temperature throughout the year. The high temperature during dry season (26-37°C) causes heat stress in livestock, resulting in increased water consumption and otherwise decreased feed intake. Furthermore, plants grown at high temperatures generally produce low quality forage, particularly low in protein content. In another hand, during dry season, forage production is limited. Therefore, dry complete feed might be a proper solution to overcome the low feed consumption and lack of feed resources in the dry season. Sufficient of nutrient intake for animal will increase animal productivity, and in turn maintained the economic sustainability of farmers.

Ettawa crossbred goats plays an important role in Indonesia as a source meat and milk. In order to grow and develop normally, the goat need sufficient intake of energy, protein and mineral. The adequacy of nutrients for young female goats is very important to ensure the goat productivity in the future. The protein-energy ratio influences nutrient intake and digestibility [1], as well as the performance of animal.

Zinc (Zn) is an essential micromineral required by young animal, mainly for the nucleic acid and protein synthesis during the growth period. Zinc contained with up to 300 enzymes [2,3], therefore



supplementation of Zn in the diets is required. Jia et al. [4] stated that the BW of Chasmere goats increased when the basal diets (containing 22.3 mg Zn/kg DM) is supplemented with 15 – 45 mg Zn/kg DM. Supplementation of both Zn inorganic and Zn organic 20 mg Zn/kg DM could increase daily gain compared with no supplementation, i.e 41.3 and 42.7 vs 35.7 g/day [5]. Selenium in the form of a physiologically as Gluthation peroxidase (GSH-Px) serves to protect the cell and sub-cell from oxidative damage, by reducing oxidative compounds into other compounds that are safe for cells [6]. The requirement of Se for goats and cows about 0.1 mg/kg, whereas in dairy cows is recommended at 0.3 mg/kg. Feed cost represents 70% of the total production cost in goat industry. As a necessary step to remain profitable, farmer should be monitoring and making decision based initially on the income over feed cost (IOFC). The IOFC is a gross margin concept that can be used as a preliminary indicator whether the feeding management is viable in the short run. It would be expected that the production of good quality dry complete feed with Zn-Se supplementation could optimized the animal growth, which in turn increase IOFC. Hence, this study aimed to evaluate the effect of different quality of dry complete feed and Zn-Se supplementation on feed efficiency and IOFC of Ettawa crossbred goats

2. Materials and Methods

This study was conducted in Laboratory of Nutrition and Feed Sciences, Department of Animal Science, Faculty of Animal and Agriculture Sciences, Diponegoro University, Semarang, Central Java, during dry season (June- October 2017). The experimental barn was located at altitude of 100 m above sea level and temperatures ranging from 30 to 33°C.

Sixteen weaned female goats aged 4-month-old with initial BW of 12.13±0.23 kg were used in this study. The experiment was conducted in factorial 2x2 in a completely randomized design with 4 replications and 2 factors. The first factor was different levels of energy and protein in the diets: 14% CP + 63% TDN (T1); and 16% CP + 67% TDN (T2). The second factor was Zn-Se supplementation (treatment and control). The Zn and Se were supplemented into the diet at 20 mg/kg and 0.2 mg/kg DM, respectively. The complete feed ingredients were corn straw, gliricedea leaves and concentrate. The feed ingredients were dried and finely grounded, then formulated as dry complete feed. The ingredient and nutrient content of the experimental diets is shown in Table 1.

Table 1. Nutrient content in dietary treatment

Feed Ingredient, %	T1	T2
Concentrate	65	70
Corn straw	20	17.5
Gliricedea leaves	15	12.5
Nutrien content, %		
Crude protein, CP	14.2	16.2
Total Digestible Nutriens, TDN	64.6	67.3
Zn (mg/kg)	15.3	18.5
Se (mg/kg)	0.0132	0.0176

Mineral Zn and Se used were in the formed of Zn-Se-proteinate, produced by Nutrition and Feed Laboratory of the Faculty of Animal and Agriculture Sciences, Diponegoro University. The Zn proteinate containing Zn 1501.3 mg/kg was given in the amount of 6 g/head/day, whereas Se proteinate containing 27.5 mg/kg was given in the amount of 4 g/head/day (estimation of dry matter intake was 500g/day).

2.3. Feeding Trial

Experiments were conducted over 18 weeks, ie 2 weeks of preliminary and 16 weeks of collecting data. Within the preliminary period, the initial forages and concentrates were replaced gradually with dry complete feed. Started from the third week all experimental animals were fed with dry complete feed. Parameters measured were nutrient intake, body weight gain, feed efficiency, feed conversion and income over feed cost. Feed intake measured by weighing the amount of feed offered and the feed remained in feed bucket. Body weight was measured every two-week during the experimental period. Body weight gain was calculated by subtracting the initial weights by the final weights.

2.4. Data analysis

The effect feeding of dry complete feed on consumption and weight gain is explained descriptively, while the data due to treatment effect were analyzed statistically using analysis of variance, and if there were a difference between treatments was analyzed by Duncan Multiple Range Test [7].

3. Results and Discussion

3.1. Effect feeding dry complete feed

Dry matter (DM) intake of female goats for 16 weeks presented in Table 2. It appears that DM intake decreased in the fourth weeks, then began to increase started from the eighth week. Based on this study, feed requirement for goat weighing 10 kg and 20 of BW (with the BW gain 50 g/d) were 0.51 kg and 0.75 kg DM or equal with 3.75% and 5.10% BW, respectively.

Dry feed could promote the rumen development, both physically and chemically. Calves fed concentrate diets showed an increased ratio of mucosa to serosa length compared with calves fed milk replacer [8]. Rumen volatile fatty acid concentrations also affect rumen development. However, the ability of young goat to digest fiber was still limited, thus causing slower rumen emptying and lower DM intakes.

Table 2. Effect of feeding dry complete feed on dry matter intake of goats

Experimental diets	Experimental period (week)							
	2	4	6	8	10	12	14	16
	Dry matter intake (g /day)							
T1	362	213	281	363	484	560	562	606
T1+ (Zn and Se)	475	378	391	408	511	529	530	628
T2	486	432	408	500	593	592	614	643
T2+ (Zn and Se)	449	392	435	472	596	633	676	671
	Average daily gain (g /day)							
T1	10.4	-62.1	-11.1	38.6	83.9	73.2	49.6	79.3
T1+ (Zn and Se)	7.86	-26.1	52.0	38.8	46.4	74.3	50.7	47.5
T2	52.9	-14.8	10.5	53.3	52.4	88.1	71.9	67.4
T2+ (Zn and Se)	46.1	10.0	65.4	48.9	75.7	75.4	88.9	110

T1 = ration containing 14% CP and 63% TDN; T2 = ration containing 16% CP and 67% TDN ; Supplement Zn 20 mg/kg and Se 0.2 mg/kg

Body weight for initial 6 weeks decreased gradually, thus producing minus on average daily gain. However, started from the eighth week, body weight was increased and resulted in good daily gain (38.6 to 110 g/day). Supplementation of Zn + Se in the ration containing 16% CP and 67% TDN could prevent the weight loss during adaptation period of the application of dry complete feed (Table 2). The average daily gain of Indonesian goats ranged between 41.3 - 65.3 g /day (47.1 ± 24.9 g/day) [9]. It was previously

reported that female goat weighing 18-19 kg, which fed with an additional form of cacao and Gliricidia leaves produce body weight gain between 52.3 and 70.4 g / day [10].

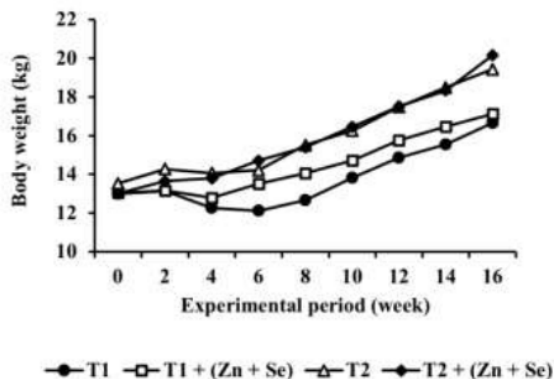


Figure 1. The body weight of goats during experiment

16. Average Daily Gain (ADG) and Feed Efficiency Income Over Feed Cost 4

The effects of protein and energy levels in the diets were significant on the average daily gain and feed efficiency ($P < 0.05$). However, no effect was observed regarding to the mineral supplementation (Table 3). The ADG was greater in goat fed diets containing 16% CP and 67% TDN compared with those fed diets containing 14% CP and 63% TDN.

In accordance with current findings, Negesse et al. [11] previously reported that the ADG in Saanen kids increased with the diet containing 17.6% CP compared with 14.4, 11.4 and 8.70% CP levels. The higher ADG is related with the higher CP intake. Protein is an essential nutrient for animal growth and plays an important role in muscle growth and animal development. Present findings showed that the ADG values were not significantly affected by Zn-Se supplementation. However, another study reported that supplementation of Zn-bio complex improved the ADG from 65.2 to 94.6 g/day [12]. Increasing ADG with Zn supplementation also reported previously by Jia et al. [4,5]. The results of current study were in agreement with those reported by Aditia et al. [13] and Garg et al. [14]. The feed conversion ratio (FCR) in current study ranging from 8.55 to 14.4. Our finding on FCR was better than other studies which reported that the FCR of goats ranging from 15.8 to 16.8 [15]. Nonetheless, the previous study by Hwangbo et al. [16] resulted a better FCR (6.54 to 7.11) than present study. Feed conversion is the number of kilograms of feed required to produce 1 kilogram of meat. The smaller feed conversion showed the less feed required to produce meat; it means better feed quality. The feed efficiency in this study is similar to 6,99 - 9,90% [17].

3.2.2. Income Over Feed Cost.

Feeding with good quality ration (T2) caused an increase in feed costs, but resulted in a higher body weight gain, so the income generated was increased. The effect of increasing protein and energy contents in the diets significantly influenced income over feed cost ($P < 0.05$), but the effect of mineral supplementation had no significant effect. Feed with 16% CP level and 67% TDN supplemented with mineral Zn 20 mg / kg and Se 0.2 mg / kg produced the highest income over feed cost of IDR. 1722 / day. This income was relatively low, because the goats used in the experiment were still in the growth phase (4 months). Goat fattening business will be profitable if using goats with a minimum age of 8 months or a minimum body weight of approximately 20 kg.

Table 3. Effects of different protein and energy contents in the diets and Zn-Se supplementation on ADG and feed efficiency of goats

	T1		T2		Significancy		
	0	Zn+Se	0	Zn+Se	T	M	TxM
13 Initial live weight (kg)	13.0	13.1	13.5	13.0			
Final live weight (kg)	16.7	17.1	19.4	20.2		2	
ADG (kg/14 week)	3.67	4.04	5.90	7.2	*	ns	ns
Dry matter intake (kg/14 week)	47.2	52.9	58.7	59.5	ns	ns	ns
Feed conversion	13.7	14.4	10.4	8.55	*	ns	ns
Feed efficiency (%)	7.6	7.5	9.77	11.8	*	ns	ns
ADG (g/ day)	37.5	41.2	60.2	73.5			
Feed cost (IDR/head/ day)	1385	1485	1851	1951			
Income (IDR)	1872	2061	3010	3673			
Income over feed cost (IDR/head/ day)	487	576	1159	1722	*	*	ns

T= Main effect ration (energy and protein level); M = Main effect mineral (Zn+Se); TxM =

Interaction between ration and mineral supplementation

* Differ significantly ($p < 0.05$); ns = not significant

4. Conclusion

Dry complete feed containing 16% CP and 67% TDN with Zn-Se supplementation (Zn 20 mg/kg + Se 0.2 mg/kg) is recommended for female weaned-goat for the optimal growth and increase the income over feed cost. It is recommended for female kid goat at the growth phase.

Acknowledgement

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