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Effect of Dietary Supplementation with Protected Lemuru Fish Oil on Nutrient Intake and Average Daily Gain of Thin-Tailed Sheep

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ABSTRACT
This study aimed to determine the effect of dietary supplementation with protected lemuru fish oil (*Sardinella longiceps*) on nutrient intake and the average daily gain of thin-tailed sheep. This study was conducted from September to October 2020 in Dumbira Farm, Kalasan, Yogyakarta. Twelve sheep were divided into three treatment groups with 4 replicates each and fed total mixed ration (TMR) supplemented with 0% (T0), 5% (T1), and 10% (T2) protected lemuru fish oil. Data collected were analyzed by one-way analysis of variance, and differences between treatment means were further analyzed using Duncan's multiple range test. The findings showed that 5% and 10% protected lemuru fish oil supplementation in the TMR feed had a significant effect ($P<0.05$) on the intake of crude fiber and crude fat, but daily weight gain and the intake of dry matter, organic matter, and crude protein were not affected by treatments. However, the highest average daily gain was observed in the 5% supplementation group.

Keywords: *protected lemuru fish oil, nutrient intake, average daily gain, thin tailed sheep*

1. INTRODUCTION

Energy is an essential nutrient for ruminants. The primary source of energy is fat, which can be in the form of fatty acids. The energy content of fatty acids is high compared to other sources, such as carbohydrates and proteins when they are metabolized in the body [1]. Therefore, fat can be used as a dietary supplement to increase energy intake in ruminants. Fish oil, a source of fat, can be extracted from Lemuru (*Sardinella longiceps*) canning by-products, which contains high levels of unsaturated fatty acids and omega-3 as the valuable fatty acid for their health. However, lemuru fish oil cannot be supplemented directly in a diet due to hydrogenation process in the rumen, which converts unsaturated fatty acids into saturated fatty acids [2,3]. Therefore, a protective treatment is required to gain a beneficial effect from fish oil supplementation as a source of energy in the diet. This protection is needed to prevent unsaturated fatty acids from double bond biohydrogenation by ruminal microbes [4]. In this study, a total mixed ration (TMR) method was used to protect lemuru fish oil supplementation. An advantage of feeding TMR is that to prevent animals from being able to choose certain feeds and consequently, each bite consumed by an animal is a nutritionally balanced diet. A TMR that contains energy and protein sources can beneficially improve animal performance [5]. Nutrient intake and daily weight gain as the representatives of productive performances of sheep were evaluated in this study. Generally, the performance of an animal is associated with its performance during the experimental period, which is directed to achieve particular goals of interest [6].

The purpose of this study was to evaluate the effect of lemuru fish oil supplementation on the productive performances of sheep. To achieve this objective, the fish oil was protected by saponification, so that it can be further utilized in the post-rumen digestive tracts.

2. MATERIALS AND METHOD

2.1. *Materials*

This study involved 12 female thin-tailed sheeps (aged less than one year old with an average initial body weight of 18 kg/head), and was conducted from September to October 2020. All the experimental animals were reared in Dumbira Farm, Tamanmartani, Kalasan, Yogyakarta. Dried water spinach and concentrate were

used as feed ingredients. The concentrate which consisted of coffee husk, cocoa husk, copra meal, palm cake, and pollard was given as a TMR. The experimental sheep were reared in stage cages with plank floors, which were divided into 12 individual plots (50cm x 100cm each). Each cage contained TMR feed, which was placed in a wooden tub. The drinking water was placed in a plastic bucket.

2.2. *Method*

The adaptation period was carried out for 7 days to adjust the experimental animals with the dietary treatments and to eliminate the effect of the previous diets consumed by the animals. This study used an experimental method. Twelve animals were alloted in a randomized block design with three treatments and four replicates each. The treatments contained diets as total mixed ration (TMR) supplemented with 0% (T0), 5% (T1), and 10% (T2) protected lemuru fish oil.

The adaptation period continued for 7 days, followed data collection period for 8 weeks. The rations were given twice a day at 8:00 a.m. and 4:00 p.m. Feed was given as TMR, while drinking water was provided ad libitum. Before feeding, the feed was weighed. The feed residue was also weighed in the next day morning. During the experimental period, sheep were weighed every 7 days to determine daily weight gain. At the final collection period, the rations as TMR were weighed. Feces were collected and weighed every morning. Feed samples, orts, and feces were collected daily for 14 days (total collection period). At the end of the collection period, all the feed samples, feed residues, and feces were composited and then taken their sub samples for nutrient intake analyses, including dry matter, organic matter, crude protein, crude fat, and crude fiber.

2.3. *Variables observed*

2.3.1. *Nutrient intake*

Nutrient intake is the amount of nutrients consumed by animals during a certain period, which can be calculated by multiplying the nutrient content of the feed with the amount of feed given to the animal, then subtracting it by the result of multiplying the nutrient content of the feed residues and the amount of feed residues. The nutrient intake observed in this study included dry matter, organic matter, crude protein, crude fiber, and crude fat. Average daily nutrient intake is the amount of feed consumed during the collection period divided by the length of the collection period (days). The animals were weighed weekly.

2.3.2. *Daily weight gain*

Daily weight gain was calculated based on the difference between the initial body weight and the final body weight divided by the length of the experimental period (days).

2.4. *Data Analysis*

Data on nutrient intake and daily weight gain were analyzed by one-way analysis of variance, and differences between treatment means were further analyzed using Duncan's multiple range test (DMRT).

3. RESULT AND DISCUSSION

3.1. *Nutrient Intake*

The average dry matter and nutrient intakes of the experimental ewes are presented in Table 1. The intake of dry matter, organic matter, and crude protein between the two treatments (T1 and T2) did not differ significantly, but the treatments had a significant ($p<0.05$) effect on the intake of crude fiber and crude fat. The protected fish oil supplemented homogeneously in the diets did not affect palatability and appetite. Palatability is influenced by physical and chemical parameters of the feed. Physical parameters include hardness, color, form, and texture, while chemical parameters consist of nutrient contents in feed ingredients. Since the physical form of the experimental diets in all treatments (T0, T1, and T2) were the same (as TMR), it can be expected that the physical form of a diet has no effect on nutrient intake [7].

Sheep fed diets containing 5% and 10% protected lemuru fish oil showed a higher fat intake ($P<0.05$) than those in the control group. Moreover, crude fiber intake in T1 was higher than that in T0 and T2. The supplementation of fish oil in the diet can potentially disturb fiber fermentation in the rumen. For that reason, the fish oil must be protected in order to reduce the negative effect of fat supplementation and thus, this supplement does not reduce the intake of crude fiber and crude fat. [8] reported that the inhibition of fiber degradation can be related to a coating that inhibits the direct contact of microbes or cellulolytic enzymes with feed particles. If the condition of the rumen is disturbed, digestion, especially forage, is also disrupted, which further results in a decreased intake.

3.2. *Daily Weight Gain*

As shown in Table 2, the daily weight gain in T1 was the highest (86.61 g/head/day), though it was not significantly different compared to T0 (52 g/head/day). The higher daily weight gain in T1 than in T0 and T2 can be due to a higher dry matter intake. Daily weight gain in T2 was higher than 66.5 g/head/day (supplemented with 4.5% of protected oil) reported by [3]. According to [9], ewes that were extensively reared without dietary supplementation have body weight gain ranging from 47 g/head/day to 69.9 g/head/day. In this study, the supplementation of 5% protected oil in the TMR ration

was more effective in increasing daily weight gain of the experimental animals compared with the 10% supplementation.

Table 1. Average dry matter and nutrient intakes of the experimental sheep

Intake	Treatment (g/head/day)		
	T0	T1	T2
Dry matter	653.70± 60.79	724.22± 95.31	583.63± 90.74
Organic matter	586.36± 54.84	637.84± 83.58	509.75± 78.82
Crude protein	83.63±8.05	88.10±11.48	67.68±13.72
Crude fiber	164.66± 14.40^{b}	201.57± 27.27^{a}	157.72± 18.02^{b}
Crude fat	28.89±3.03^{a}	38.38±4.83^{b}	37.12±6.69^{b}

^{a,b} Means values bearing different superscripts in the same row differ significantly (P<0.05)

Table 2. Dry matter intake and daily weight gain

Parameter	Treatment		
	T0	T1	T2
Dry Matter Intake	653.70± 60.79	724.22± 95.31	583.63± 90.74
Average Daily Gain	52.23± 8.00	86.61±11.87	77.23± 29.49

4. Conclusion

The supplementation of protected fish oil in the TMR ration up to 5% level has a beneficial effect on crude fiber and crude fat intakes, and has a tendency to enhance daily weight gain. However, the supplementation of protected fish oil did not significantly affect dry matter, organic matter, and crude protein intakes.

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