Effect of Protein Supplementation from *Spirulina platensis* on Javanese Thin-tailed Sheep Weight Gain

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ABSTRACT
The study aims to assess the average daily gain (ADG) of Javanese thin-tailed (JTT) sheep with protein supplementation from *Spirulina platensis*. This study used ten female JTT sheep (5-months-old and average body weight of 13.66 ± 2.31 kg) and divided them into two groups. The first group (control) was fed with dried water spinach (*Ipomea reptans*) and concentrate (CP and TDN ration: 14.84% and 59.09%); the second group (treatment) was added with *Spirulina platensis* (8g/head/day) mixed with concentrate (CP and TDN ration: 15.33% and 59.43%). Water was given ad libitum. Results of the study showed the consumption of concentrates and dried water spinach (DWS) (based on the dry matter) in the control group were 347.75 and 488.80 g/head/day and treatment group were 347.75 and 490.49 g/head/day; ADG on control and treatment group were 153.80±40.31 and 148.60±31.45 g/head/day (P>0.05); Feed conversion was 6.00±1.85 and 6.16±1.67 (P>0.05). In conclusion, supplementation of 8 g/head/day *Spirulina platensis* in sheep feed did not improve ADG.

Keywords: *Javanese thin-tailed sheep, weight gain, Spirulina platensis, protein supplementation*

1. INTRODUCTION

Sheep potential as a substitute for beef livestock in Indonesia needs to get more attention, apart from supporting the rural community's economy. The sheep-raising method in smallholder farmers still using traditional methods, such as forage given as feed, was not necessarily a good quantity and quality. The feed is only native grass, not concerned about the nutrition adequacy, impacting the low ADG because native grass only contains crude protein (CP) 8.2 %. The optimal CP content in feed for sheep growth was 12% [1]. JTT sheep fed with 100% native grass with 19.56% dry matter (DM) and 10.05% CP yield ADG of 36 g/head/day [2]; and fed with 70% native grass and 30% consecrate, with total DM and CP of 87.55% and 14.17%, yield ADG of 43.95 g/head/day [3]. Protein from the feed is an essential macro-nutrient component that has a significant role in the body's growth process [4].

As a country located around the equator, Indonesia is well-known as the country with the high biodiversity of flora, growing various vegetation with various protein content, including one with high protein content, such as *Spirulina platensis. Spirulina platensis* proved to have a high protein content of 55% up to 70% with complete essential amino acid content, such as cysteine, lysine, methionine, and tryptophan. In addition, it can be consumed by ruminants [5]. The study was conducted to assess the consumption and ADG of JTT sheep given supplementation of *Spirulina platensis*.

2. MATERIALS AND METHODS

The research begins with a pre-study for 15 days for livestock adaptation to the cage and feeds used, followed by 30 days from November to December 2020 to collect data in the Mendo Galak Farm Yogyakarta. Ten female JTT sheep (fattening phase) with an average weight of 13.66±2.31 kg were placed in the two colonies pen; each pen contains 5 JTT sheep. During the study, control animals were given feed as was usually given by farmers daily, namely Dried Water Spinach (DWS) ad libitum and 400 g/head/day concentrate, given at 7:00 am and 2:30 pm. The treatment group received a *Spirulina platensis* supplement of 8 g/head/day, mixed with concentrate feed. The composition feed ingredients were listed in Table 1, and the nutrient content of the feed was listed in Table 2.

The data collected were feed consumption, initial body weight, and final body weight. The Feed consumption was analyzed descriptively. The ADG between the two groups was analyzed using statistical analysis independent sample t-Test.

3. RESULTS AND DISCUSSION

3.1. Feed consumption

The research found (Table 3) that the consumption of concentrate for both groups was the same because the amount was restricted. The difference in consumption of DWS was 1.69 g/head/day. DM Consumption/kg of MBW was more than another research that used ration with concentrate and forage of 60:40, with a CP content of 12% in DM consumption of 57.52 g/kg MBW [6]. Consumption of DM/kg of MBW in the study was bigger due to the better quality of the feed given (Table 2). Feed quality affects DM consumption, the higher the quality of feed given, the consumption will be more significant [7].

The control group consumes DM, CP, and TDN of 836.55 g, 111.51 g, and 486.16 g; and the treatment group consumes 845.34 g, 115.94 g, and 493. 67 g. The nutrients consumed have been fulfilled the standard requirement; every animal in the control group in one day requires DM, CP, and TDN of 382.17 g, 45.86 g, 240.77 g, and 464.69 g, 55.76 g, 292.75 g for the treatment group.

The supplementation of *Spirulina platensis* as a protein supplement in the concentrate increases the CP content in the concentrate. The increase in CP concentrate has an impact on increasing the quality of the feed. The group of sheep given *Spirulina platensis* has a higher daily feed consumption than control groups. The higher quality of feed given, the feed consumption of the livestock will be increased [7]. The protein content in feed given to the livestock has positive correlations with livestock consumption [8].

Table 1. Nutrient composition of feed ingredients

Feed Type	Nutrient Content (%)		
	DM	CP	TDN
Spirulina platensis	88.97	60.10	74.54
Concentrate	88.80	19.50	87.68
Dried water spinach (DWS)	84.45	9.40	54.39

Table 2. The nutrient content of the ration

Group	Nutrient Content (%)		
	DM	CP	TDN
Control	659.22	14.84	59.09
Treatment	666.34	15.33	59.43

Table 3. Total DM feed consumption (g/head/day).

Feed ingredients	Group	
	Control	Treatment
Concentrate	347.75	347.75
DWS	488.80	490.49
Spirulina platensis	-	7.10
Total	836.55	845.34

Table 4. Percentage of sheep consumption per head.

Group	DM Consumption (% BW)
Control	5.52
Treatment	4.75

Table 5. Average daily gain of JTT sheep (g/head/day)

Variable	Group	
	Control	Treatment
Initial body weight (kg)	12.330±1.690	14. 990±2.163
Final body weight (kg)	16.940±2.058	19.450±1.855
ADG^{ns} (g/head/day)	153.80±40.31	148.60±31.45

^{ns} Non significant (P>0.05)

Table 6. Feed conversion

Group	Feed conversion
Control	6.00±1.85
Treatment	6.16±1.67

3.2. Percentage of feed consumption

Percentage of feed consumption (Table 4) were higher compared to standard (2.5% to 4%) [9]; and 2.6% to 3.3% [10]. The percentage of DM consumption for the control group was slightly higher (0.77%) because the sheep in the control group were smaller.

3.3. Average daily gain

Based on the statistical analysis, the ADG of the control and the treatment group (Table 5) did not differ due to the slight difference in the feed consumption (Table 3). The increase in body weight was greatly influenced by the quality and quantity of feed consumed [11]. The rapid growth rate of livestock requires higher protein in the rations. Total protein consumed affects the growth rate and increases livestock weight [12].

The average daily gain in this research was higher than reported on another research; sheep that were given feed in 75% concentrate and 25% forage showed the increase in the ADG of 64.49 g/head/day. Sheep were given concentrates 25% and forage 75%, producing an average daily gain of 24.80 g/head/day [13].

Based on the data obtained, supplementation of *Spirulina platensis* as much as 8 g/head/day cannot significantly change in ADG of JTT sheep. ADG in the *spirulina* supplemented group was not significantly different from the control group, presumably because the feed in the control group had met the requirement to achieve maximum ADG, so only a small increase in protein did not significantly affect the effect of ADG. This study is similar to another study, using the JTT sheep aged 3-5 months old fed with 15.09% and 17.42% CP, produce ADG of 154.92 g/head and 152.09 g/head. In this report, the difference in ADG was also not significant [14]. The optimal CP for sheep growth was 12% [1]. Livestock with protein consumption exceeds its needs, and it will be converted into energy. If the protein is too excessive and the energy requirement has been fulfilled, then the protein cannot be stored in the body, so the protein will be lost [15].

3.4. Feed conversion

Table 6 showed that the feed conversion of the two groups was not significantly different (P>0.05), maybe due to supplementation *spirulina* given on the ration that was already good.

Feed conversion in this study was better than other research that yielded a feed conversion of 7.63 [16]. One of the main factors affecting feed conversion was the ration quality. The increase in feed comversion in terms of feed efficiency was an increase in protein content in the ration [17].

4. CONCLUSION

In conclusion, the supplementation of *Spirulina platensis* as much as 8 g/head/day in concentrate feed for sheep has not increased the ADG.

AUTHORS' CONTRIBUTIONS

EB prepared a research proposal, was responsible for laboratory tests, and was involved in data analysis, results, and discussion. YTF was researching the field. LMY prepared a research proposal, was responsible for laboratory tests, and was involved in data analysis, results, and discussion. IGSB was involved in data

analysis, results, and discussion. MAA was involved in data analysis, results, and discussion.

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