Research Article

Impact of Various Fiber Sources in Ration Formulas on Feedlot Performance of Sheep in Indonesia

Efi Rokana[1], Iin Rohmatul Fatimah[1], Brilian Desca Dianingtyas[1], Niswatin Hasanah[2], Wulandari[3], Zein Ahmad Baihaqi[1,3*]

[1]Program of Animal Husbandry, Faculty of Agriculture, Universitas Islam Kadiri, Jl. Sersan Suharmaji 38 Kediri, 64128, Indonesia; [2]Department of Animal Science, State Polytechnic of Jember, Jl. Mastrip Sumbersari Jember, 68121, Indoensia; [3]Research Center for Animal Husbandry, National Research and Innovation Agency (BRIN), Jl. Raya Jakarta Bogor Cibinong, 16915, Indonesia.

Abstract | The phenomenon of feed ingredients to support fattening has become increasingly expensive in recent years. One potential breakthrough is utilizing waste from various agricultural fiber sources in remote villages. This study aimed to investigate the impact of feeding different types of forage in the ration formula on sheep feedlot performance. Twenty-seven female local sheep (fat tailed) were utilized as research subjects. The study involved sheep rations comprising various ingredients, with three distinct research factors: elephant grass, corn plants, and rice straw. Employing a completely randomized design (CRD) with three treatments and nine replications, the research examined dry matter intake, body weight gain, feed efficiency, and income over feed cost (IOFC). Results indicated that feeding with different types of forage did not significantly impact dry matter intake ($P>0.05$) but significantly affected body weight gain, feed conversion, feed efficiency ($P<0.05$), and IOFC ($P<0.01$). The ration formula containing corn plants (T2) emerged as the optimal treatment, exhibiting average values for body weight gain, feed conversion, feed efficiency, and IOFC of 25.1 ± 4.93 g/head/day, 15.71 ± 2.85, 53.02% ± 9.33, and IDR 217,716.29 ± 57,883.87 respectively. The study results show that including corn crop waste in the ration formula can effectively improve the performance of sheep feedlots.

Keywords | Agricultural waste, Feedlot, Fiber sources, Performance, Sheep

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***Correspondence** | Zein Ahmad Baihaqi, Research Center for Animal Husbandry, National Research and Innovation Agency (BRIN), Jl. Raya Jakarta Bogor Cibinong, 16915, Indonesia; **Email:** zein001@brin.go.id
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INTRODUCTION

Sheep, as ruminant livestock, play a crucial role as a widespread source of animal protein in society (Xu et al., 2023). The sheep fattening industry has evolved into a modern and relatively large-scale sector, driven by the increasing domestic demand for meat consumption, a trend that continues to rise annually (Kumar et al., 2023). According to the Ministry of Agriculture (2022), there has been a notable 10.8% decrease in the sheep population in Indonesia, estimated to be around 15,615,000, primarily due to an extraordinary percentage of slaughtering involving productive female sheep.

Projections for sheep meat production in Indonesia over the next five years, from 2019 to 2023, indicate an average annual increase of 1.85%. The Central Statistics Agency (BPS) recorded sheep meat production in 2019 at 91,039.37 tons, surpassing the 2018 figure of 82,274.38 tons, marking an 18.77% annual increase (Ministry of Ag-

riculture, 2022). Smallholder farms significantly contribute to developing the sheep population in Indonesia (Priyanto et al., 2023). Rasminati et al. (2017) stated that efforts to enhance sheep farming in Indonesia require careful attention to good production management, including selecting sheep breeds, husbandry methods, types of feed provided, and appropriate housing to achieve productivity targets. Furthermore, farmers must prioritize health management (Baihaqi et al., 2019, Baihaqi et al., 2020) and environmental management due to its association with global warming (Baihaqi et al., 2022; Baihaqi et al., 2023).

Abbas-Abadi et al. (2023) emphasized that feed constitutes the highest proportion, ranging from 60-70%, of the total production cost. Nkansah-Dwamena et al. (2023) added that the phenomenon of continuously rising prices of animal feed materials each year compels farmers to explore alternative feeds, including the use of agricultural waste. According to the Central Statistics Agency (2021), corn production reached 13,414,921.72 tons, and rice production amounted to 54,415,294.22 tons. Ngubane et al. (2023) added that about 65% of corn harvests result in corn kernels, while the remaining 35% becomes waste in the form of stalks, leaves, stover, and cobs. Additionally, Akshaya (2023) reported that rice straw production constitutes approximately 50% of the production of harvested dry paddy. Thus, agricultural waste such as corn stover and rice straw holds potential as an alternative feed.

Agricultural waste is characterized by high fiber content and low feed digestibility (Abid et al., 2023). The processing of agricultural waste using feed fermentation technology can significantly enhance feed quality (Huang et al., 2023). Ahamed et al. (2023) stated that fermented feed technology not only addresses the issue of rising feed prices but also provides green fodder during the dry season. Therefore, the utilization of corn stover and rice straw as alternative feed in the form of fermented feed can contribute to sheep productivity. This research aims to investigate the influence of different fiber types in the ration formula on the feedlot performance of sheep. The optimal ration formulation results from this study are expected to be applicable and beneficial for sheep feedlot farmers.

MATERIAL AND METHODS

Ethical Approval

The study received ethical clearance from the Animal Care and Use Committee at Universitas Brawijaya with the reference number: 207-KEP-UB-2023.

Study Period And Location

This research was conducted for 3 months from October 4, 2023, to January 2, 2024, in Wonorejo Trisulo Village, Plosoklaten Sub-district, Kediri Regency, Indonesia. The livestock used in the study consisted of 27 local female sheep (fat tailed) aged 6-7 months, with a body weight range of 20 kg. The feed materials included elephant grass, corn leaves, rice straw, copra meal, soybean meal, pollard, dried water spinach, corn cobs, molasses, napier grass, and EM-4 (Effective Microorganism-4).

Research Design

The research method employed was an experimental design using a completely randomized design (CRD) with 3 treatments and 9 replications. The research treatments involved different forage types in the ration formula:
P1 = ration formula with elephant grass
P2 = ration formula with corn stover
P3 = ration formula with rice straw

The research variables included Dry Matter Consumption (DM), Average Daily Weight Gain (ADG), Feed Conversion, Feed Efficiency, and Income Over Feed Cost (IOFC). An adaptation period was carried out for 1 month before the actual research and the research treatment period lasted for 2 months. The feed used was fermented complete feed utilizing 3 different fiber sources according to the research treatments. The feed was provided at 5% proportional to the sheep's body weight (% BW) per day. Feeding was conducted twice a day, in the morning at 06:00, in the evening at 16:00 and water was provided ad-libitum.

Research materials, such as beer dregs and a variety of feed ingredients, were sourced from PT., Sumber Pangan Kediri. The complete feed was formulated using a combination of copra, palm oil meal, corn gluten feed, white pollard, cassava cobs, soybean klecepan, and corn slamper. The formulation and analysis results of the research ration are presented in Table 1, while the nutritional content of each concentrate feed treatment is presented in Table 2. Observational parameters included consumption, feed digestibility, average daily gain (ADG), feed conversion, and income over feed cost (IOFC), following the methodology outlined by Suwignyo et al. (2017).

Statistical Analysis

The research data were subjected to analysis using ANOVA, and in the presence of significant or highly significant differences, further analysis was conducted using the Tukey's Honestly Significant Difference (HSD) test at a 5% significance level, employing the SPSS software version 24.

RESULT AND DISCUSSION

The provision of different forage types in the ration did not exhibit a significant difference (P>0.05) in feed consumption (DM), although it did have a significantly different

Table 1: Formulation of treatment rations

Feed ingredients	P1*	P2*	P3*
	(%)	(%)	(%)
Corn Cob	28	25.5	29
Pollard	2	3	6
Copra Meal	2	2.5	1.5
Molasses	1	2	1
Dried Water Spinach	7.9	5.5	2.5
EM-4	0.1	0.1	0.1
Elephant Grass	28	30.9	28.9
Soybean Meal	3	2.5	3
Elephant Grass	28	0	0
Corn Stover	0	28	0
Rice Straw	0	0	28
	100	100	100

*Treatments: P1= elephant grass, P2= corn stover, P3= rice straw

Table 2: The results of the proximate analysis of the concentrate

Treatments	CP (%)	DM (%)	CF (%)	EE (%)	TDN (%)
P1	12	46.80	26.32	2.51	68
P2	13	64.41	24.84	2.68	67
P3	12	51.37	23.24	2.51	67

Treatments: P1= elephant grass, P2= corn stover, P3= rice straw. CP = Crude Protein, DM = Dry Matter, CF = Crude Fiber, EE = Extract Ether, TDN = Total Digestible Nutrients. Proximate analysis conducted at the Laboratory of Animal Nutrition, Universitas Brawijaya.

Table 3: Mean values of feed consumption (DM), daily weight gain, and feed conversion of local female sheep during the study (g/head/day)

Variable	Treatments		
	P1	P2	P3
Dry Matter Intake (g/head/day)	499.18 ± 78.29	425.63 ± 35.03	444.77 ± 83.99
Average Daily Gain (g/head/day)	20.00 ± 3.73^{a}	25.10 ± 4.93^{ab}	19.80 ± 3.92^{a}
Feed Conversion	22.62 ± 5.40^{b}	15.71 ± 2.85^{a}	21.23 ± 6.78^{b}

Notes: Different superscripts in the same row indicate significantly different effects (P<0.05).

Table 4: Average feed efficiency and income over feed cost (IOFC) of local female sheep during the study

Variable	Treatments		
	P1	P2	P3
Ration efficiency (%)	36.83 ± 8.43^{a}	53.02 ± 9.33^{b}	41.42 ± 11.29^{ab}
IOFC (IDR)	102,351.42 ± 52,596.53^{a}	217,716.29 ± 57,883.87^{c}	162,213.28 ± 54,835.69^{b}

Notes: Different superscripts in the same row indicate significantly different effects (P<0.01). IDR: Indonesian Rupiah (currency)

effect (P<0.05) on weight gain and feed conversion. The mean values for feed consumption (DM), daily weight gain, and feed conversion are presented in Table 3.

Feed consumption is the ability of livestock to consume a given amount of feed. Table 3 shows that the highest mean feed consumption is found in treatment P1 with elephant grass forage, with an average of 499.18 ± 78.29 g/head/day, while the lowest consumption is observed in treatment P2 with corn stover forage, averaging 425.63 ± 35.03 g/head/day. The results of this study indicate that the average dry matter consumption in this research is higher compared to Sitepu's et al. (2020) findings ranging from 311.36 to 325.21 grams/head/day, and Mahesti et al. (2010) with 422.35 grams/head/day, while lower than Suparjo (2011) research, which reported 434–560 g/head/day.

The analysis of variance results indicates that the type of

fiber source treatment in the ration does not significantly affect (P>0.05) the consumption of local female sheep. This may be due to the nearly identical quality of the feed given to the animals, resulting in no significant difference in their consumption. All three types of feed have relatively similar crude protein (CP) and total digestible nutrient (TDN) content. Crude protein ranges between 12-13%, while TDN is around 67-68%. Therefore, it is assumed that the three types of rations provided meet the needs of the sheep. Cabrita (2023) states that the level of consumption difference is influenced by several factors such as body weight, age, feed digestibility, and palatability. The non-significant difference in feed consumption can be attributed not only to the quality and palatability of the feed but also to the small particle size or softer texture of the three forages in Zhao (2023) adds that a smaller feed conversion value indicates more efficient feed utilization. This conversion is influenced by the climatic differences in Indonesia, which has a tropical climate, while the NRC standard (1985), based on a subtropical climate, is one of the causes of differences in standard feed conversion values. The nutritional needs in tropical regions tend to be higher than in subtropical regions.

The average feed efficiency and income over feed cost (IOFC) of local female sheep are presented in Table 4.

The analysis of variance results indicates that the provision of different types of fiber sources in the ration has a significantly different effect (P<0.01) on feed efficiency and IOFC. The lowest feed efficiency was observed in treatment P1 with the addition of grass hay, with an average of 36.83 ± 8.4%. Zhang et al. (2023) stated that an increase in dry matter consumption affects feed efficiency. Low feed consumption and high weight gain can enhance feed efficiency. Cost reduction in the production and support of ruminant animal health can be achieved through the utilization of alternative agro-industrial waste such as fruit peels, seeds and bark (Baihaqi et al., 2020; Baihaqi et al., 2023; Baihaqi et al., 2020; Lisnanti et al., 2023).

The provision of different types of fiber sources in the ration significantly influences IOFC (P<0.01). Treatment P2, with the addition of corn husk, has the highest IOFC value because in treatment P2, the weight gain of sheep is highest, and the feed conversion ratio is low, resulting in more efficient cost expenditure. Koch (2023) stated that factors influencing the calculation of IOFC include weight gain during fattening and prices.

Based on Table 4, the lowest average IOFC is found in treatment P1, and the highest average IOFC is in treatment P2. The selling price of local female sheep during the study was Rp. 52,000/Kg. The feed prices used in this study, based on dry prices converted to fresh prices (Ice feed), for each treatment were feed P1 at IDR 1,689/Kg, feed P2 at IDR1,430/Kg, and feed P3 at IDR 1,487/Kg. Different IOFC values for each treatment are due to the difference between the selling price of local female sheep per Kg and the feed cost incurred for production. Retnani et al. (2023) stated that the value of IOFC for each treatment differs, influenced by factors such as weight gain, feed consumption, and feed prices during maintenance.

CONCLUSION

The administration of different fiber source types in the ration had a significant effect (P<0.05) on weight gain and feed conversion, and a highly significant effect (P<0.01) on feed efficiency and income over feed cost (IOFC). However, for dry matter consumption, there was no significant difference (P>0.05). The provision of corn stover resulted in the highest weight gain, feed efficiency and IOFC, meanwhile, its feed conversion was the lowest in local female feedlot sheep compared to the other treatments.

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CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

NOVELTY STATEMENT

An investigation into alternative fiber sources based on agricultural waste in Indonesia, confirming intake parameters, production, and economic analysis provides accurate information as a breakthrough in conditions where ruminant feed materials are currently very expensive.

AUTHORS' CONTRIBUTIONS

ER, IRF, BDD, NH, W and ZAB: Designed the study and collected samples and performed examinations. All authors have drafted and revised the manuscript. All authors have read, reviewed, and approved the final manuscript.

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