



## Exogenous enzyme increased feed intake but not growth and feed efficiency of sheep fed edamame wastes

A Marzuki<sup>1</sup>, T M Syahniar<sup>1</sup>, M Andriani<sup>1</sup>, S Nusantoro<sup>1</sup> and E Kustiawan<sup>1\*</sup>

<sup>1</sup>Department of Animal Sciences, Politeknik Negeri Jember, Jember 68122, Indonesia

\*email: erfana\_kustiawan@polije.ac.id

**Abstract.** Feed management strategies, for example using cheap agricultural by product to reduce feed cost, are commonly used in improvement of livestock farming. This research aimed to access efficacy of commercial exogenous enzyme (consisting of mixture *lignolytic* and *cellulolytic*) formulated with edamame waste on feed intake, growth, and feed efficiency of sheep. Nine local sheep were assigned using completely randomized design, treated with 3 levels of exogenous enzyme i.e. 0, 1.4, and 2.8 g/kg of total mixed ration formulated using edamame waste. The sheep were reared in individual cage and given treatment in 3 replications. Feeding and drinking were ad libitum and after two weeks feed intake (FI), average daily gain (ADG) and feed conversion ratio (FCR) were calculated. FI was significantly affected by the treatment and FI significantly increased in line with the treatment levels. However exogenous enzyme did not affect ADG and FCR

### 1. Introduction

National demands of meat have increased in line with population growth and its consumption level. Unfortunately, domestic meat supply does not meet the market requirement, leading to boost livestock production. Sheep is a livestock commodity that has been promoted to fulfill meat demand in Indonesia and there are several programs from the government that are provided for farmer, i.e. extension in farm management, and nowadays its farming system is conducted towards intensification.

Since feed cost has been the main component that contribute to the production cost, feed management strategies are commonly used to improve livestock farming, for example using cheap agricultural by product to reduce feed cost. To that end, edamame soybean wastes can be used as an alternative feed. Edamame soybean, also known as vegetable soybean, production in Jember account for 10,000 - 15,000 tons a day, exported in the form of fresh frozen and whole seeds. The process of edamame resulted wastes in the form of soybean pod.

Edamame is categorized as soybean varieties, harvested at premature state, in which its pod contains 11.3% crude protein, crude fiber and 32.5% [1] equivalent to elephant grass (9.7% protein; 36.1% fiber;). Soybean pod also contain ADF 36.8% and NDF 52.9% [1] and lignin at 9.88% [2], which became constraints for ruminants to digest [3]. From the aspect of nutritional physiology, the ability of small ruminants (like sheep) to utilize nutrients in ration is lower than that of large ruminants. Research showed that the ability of cattle and sheep to digest good, medium and low-quality forages. Based on digestibility data and volatile fatty acids, it was revealed that the digestive system of small ruminants was inadequate and had a lower ability compared to cows to digest low-quality forages [4].



The application of exogenous enzymes i.e. enzymes treatment through the ration to improve digestibility, feed nutrition and livestock performance have been shown a positive result. Several studies have shown that exogenous enzymes (fibrolytic, cellulolytic or its combination) were successfully applied to improve the nutritional value of several feedstuffs (such as straw, alfalfa, and Bermuda grass), non-activating anti-nutrients that lead to improved performance and carcass of ruminants[5–9]. Application of exogenous enzyme in edamame is not well explored. Thus, this research aimed at access efficacy of commercial exogenous enzyme (consist of mixture fibrolytic and cellulolytic) formulated with edamame waste on feed intake, growth, and feed efficiency of sheep.

## 2. Methodology

### 2.1. Design of experiment

This experiment was conducted at Department of Animal Sciences, Politeknik Negeri Jember. Nine local sheep (*domba ekor tipis*), having average body weight 17.24 kg, were assigned using Completely Randomized Design, reared in individual housing of 1.2 m x 1 m of dimension. The sheep have been keeping for two months but the data published here for two weeks only due to the experiment is ongoing. Feeding and drinking were ad libitum.

We used fresh edamame that contained approximately 90% pod and 10% seed. The waste the dried up to 12% moisture and then ground using 5 cm grinding screen. Feed was formulated as Total Mixed Ration (TMR), in which edamame was the main constituent (Table 1). There were 3 treatments (P0, P1, and P2) i.e. the level of commercial exogenous enzyme (Bioproton, PTY LTD, Australia) were 0; 1,4; and 2.8 g/kg of TMR respectively.

Table 1. Feed Formulation of TMR used in this experiment

No	Ingredients	%
1	Edamame waste	35
2	Maize bran	25
3	Rice bran	8
4	Palm kernel meal	15
5	Copra meal	12
6	Molasses	2
7	CaCO <sub>3</sub>	2
8	Premix	1
Total		100
Calculated nutrient content		
	Total digestible nutrient	71,39
	Crude protein	12,61
	Crude fiber	19,14



2.2. Parameters of experiment

We used three parameters, namely feed intake (FI), average daily gain (ADG), and feed conversion ratio (FCR) using the following equations;

FI=Feed given-Feed refusal (1)

ADG = (Final body weight - Initial body weight) / Duration of rearing (2)

FCR= FI / (Final body weight - Initial body weight) (3)

2.3. Statistical analysis

Data analysis were conducted using SPSS 23. FI and FCR were normalized using 1/x transformation To meet the assumption of normality and homogeneity in Anova. Afterward, data were analyzed using analysis of variance (Anova) and then Duncan post hoc for data with significant result.

3. Results and discussion

FI of sheep fed TMR is in the range of 492.32 until 613.25. FI is statistically affected by the experimental treatment (p<0.05; Table 2). It is also found that FI linearly increased along with increasing the level of exogenous enzyme. Sheep fed P3 showed the highest FI and being increased about 24% compared with other treatments. ADG is ranging from 231.25 up to 462.50, and FCR in the range of 1.61 until 2.17. Even though both ADG and FCR were not affected by level of exogenous enzyme (p>0.05), there is a trend of increasing of ADG of sheep and improvement of feed efficiently.

Table 2. Performance of sheep fed TMR formulated with various exogenous enzyme levels

Table with 7 columns: Parameter, Treatment (P1, P2, P3), Anova, Contrast (Linier, Quadratic). Rows include Feed Intake (g/d), ADG (g/d), and FCR.

All values are Mean of respective treatment (N=3) a,b,c Means in the same row with different letters differ significantly (P < 0.05).

The results of FI in this experiment is consistent with previous publication[10], in which growing lambs aged 5 months and 14.6 average of body weight, fed olive cake meal treated with fibrolytic exogenous enzyme showed improvement of performance. ADG and FCR of sheep in this experiment also in line with[10].

This research did not any data that support the explanation of FI elevation. Other parameters such as ruminal volatile fatty acid digestibility are needed. According to published research[10], it was speculated that FI increased due to the hydrolysis of polysaccharides resulting sugars which may improve feed palatability. Furthermore, the fibrolytic enzymes can elevate the level of fiber degradation by the ruminal microorganisms and this will reduce content of rumen and hence increase FI.

Contrary to the others publications[10,11], in the present experiment growth and feed efficiency in sheep did not affected by treatment. However, the data showed that the use of exogenous enzyme



improved both parameters. According to published paper[11] improvement in the average live weight gain might be address to the high activity of ruminal fermentation and digestion of nutrient of the diet, which is attributable to improved feed efficiency increased availability of nutrients to the animals. Several factors affecting the difference in experimental results include the age of animals, the quality of diet, as well as activity and delivery of exogenous enzyme. This experiment used young local lambs that might have different capacity to digest diets.

As a conclusion, FI of sheep was significantly affected by exogenous enzyme treatment and it was also found that FI increased in line with the treatment levels. However, ADG and FCR were not statistically affected by exogenous enzyme. Further investigations that elaborate ruminal parameters need to be conducted.

#### 4. Acknowledgement

Authors acknowledge P3M Politeknik Negeri Jember for PNPB Research Grant 2020, contract number 407 /PL17.4/PG/2020.

#### References

- [1] K. M. Chee, K. S. Chun, B. D. Huh, J. H. Choi, M. K. Chung, H. S. Lee, I. S. Shin and K. Y. Whang, *Comparative feeding values of soybean hulls and wheat bran for growing and finishing swine*, Asian-Australas J Anim Sci **18** (2015), no. 6, 861-867.
- [2] K. Brijwani, H. S. Oberoi and P. V. Vadlani, *Production of a cellulolytic enzyme system in mixed-culture solid-state fermentation of soybean hulls supplemented with wheat bran*, Process Biochemistry **45** (2016), no. 1, 120-128.
- [3] B. Baurhoo, C. A. Ruiz-Feria and X. Zhao, *Purified lignin: Nutritional and health impacts on farm animals—a review*, Animal Feed Science and Technology **144** (2012), no. 3, 175-184.
- [4] S. A. Soto-Navarro, R. Lopez, C. Sankey, B. M. Capitan, B. P. Holland, L. A. Balstad and C. R. Krehbiel, *Comparative digestibility by cattle versus sheep: Effect of forage quality*1,2, Journal of Animal Science **92** (2014), no. 4, 1621-1629.
- [5] L. B. Kondratovich, J. O. Sarturi, C. A. Hoffmann, M. A. Ballou, S. J. Trojan and P. R. B. Campanili, *Effects of dietary exogenous fibrolytic enzymes on ruminal fermentation characteristics of beef steers fed high- and low-quality growing diets*1, Journal of Animal Science **97** (2019), no. 7, 3089-3102.
- [6] Z. X. He, G. O. Ribeiro, K. A. Beauchemin, T. A. McAllister and W. Z. Yang, *Inoculum source and transfer of rumen contents from bison to cattle improved in vitro gas production and feed digestibility, but not the responses to exogenous enzymes supplementation*, Animal Feed Science and Technology **248** (2019), 37-46.
- [7] M. A. P. Meschiatti, V. N. Gouvêa, L. A. Pellarin, C. D. A. Batalha, M. V. Biehl, T. S. Acedo, J. R. R. Dórea, L. F. M. Tamassia, F. N. Owens and F. A. P. Santos, *Feeding the combination of essential oils and exogenous  $\alpha$ -amylase increases performance and carcass production of finishing beef cattle*1, Journal of Animal Science **97** (2018), no. 1, 456-471.
- [8] S. Sujani and R. T. Seresinhe, *Exogenous enzymes in ruminant nutrition: A review*, Asian Journal of Animal Sciences **9** (2015), no. 3, 85-99.
- [9] I. A. Aboagye, J. P. Lynch, J. S. Church, J. Baah and K. A. Beauchemin, *Digestibility and growth performance of sheep fed alfalfa hay treated with fibrolytic enzymes and a ferulic acid esterase producing bacterial additive*, Animal Feed Science and Technology **203** (2015), 53-66.
- [10] Abid K *et al.*, Mar. 2020 Effect of treating olive cake with fibrolytic enzymes on feed intake, digestibility and performance in growing lambs *Anim. Feed Sci. Technol.* **261** p. 114405.
- [11] Gado H M Salem A Z M Odongo N E and Borhami B E, Apr. 2011 Influence of exogenous enzymes ensiled with orange pulp on digestion and growth performance in lambs *Anim. Feed Sci. Technol.* **165**, 1–2 p. 131–136.