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Original Research

The utilization of water hyacinth (*Eichhornia crassipes*) as a substitute in complete feed on society sheep farming

Authors:
Liliek Rahardjo, Muhammad Farid Wadjdi, Uus Riwiweti and Hasan Marsyudi

Institution:
Faculty of Animal Husbandry, Islamic University of Malang, Malang, Indonesia.

Corresponding author:
Liliek Rahardjo

ABSTRACT:

Introduction

The aim of this study is to describe the effect of Water Hyacinth (WH) as a substitution for Complete Feed (CF) in the society sheep farming, especially on the production performance.

Material and Methods

The methodology used was randomized block design with four treatments and four blocks. The treatment consisted of WH 0 (0% WH + 100% CF), WH 15 (15% WH + 85% CF), WH 30 (30%WH + 70% CF), and WH 45 (45% WH + 55% CF).

Result and Discussion

All the data were analyzed using analysis of variance and least significant difference. The result showed that the most less economical was 45% water hyacinth utilization and 55% complete feed by feed intake (DM = 84.73 g/$W^{0.75}$/h/d, CP = 11.80 g/$W^{0.75}$/h/d, and TDN = 44.07 g/$W^{0.75}$/h/d); digestible (DM = 51.45%, and OM = 50.91%); daily gain of 109.17 g/h/d; feed conversion 6.75; and feed cost per gain is Rp 7.060.05 /g.

Keywords:

Complete feed, production performance, sheep, water hyacinth

Email Id:
rahardjo_unisma@yahoo.co.id

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INDRODUCTION

East Java is one of the farming centers in Indonesia, including sheep farming. The population of sheep is around 1.09 million, and have developed well and have spread almost all regions (Priyanti *et al*., 2012). Generally, sheep farming belongs to society farming with the ownership scale range from 3-5 individual/ family. The constraints faced by farmers is the difficulty to get economical feed which suits the needs of the sheep for daily life. Sheep are herbivores, which are only fed by forage. But the reality in the society farming of East Java is that there are three different systems of feeding; cattle fed only forage, cattle fed forage added concentrate, and cattle fed in the form of complete feed.

A complete feed is a form of feed made with a variety of raw materials, the content of nutrient which suit the needs of the sheep for daily life and can be administered to cattle at any time. The raw materials for making complete feed can be the waste or residual of agricultural products (rice straw, soybean straw, peanut straw, cassava peel, skin peanuts, etc.), plantations (sugar cane shoots, bark brown, leather coffee, pineapple skin, etc.) and agro-industry (rice bran, cassava, oil cake coconut, palm oil cake, pollard, tofu, etc.) (Wahyono and Hardianto, 2004). To be economical, complete feed can be done by diversifying the raw materials, such as by utilizing water hyacinths.

Water hyacinth (*Eicchornia crassipes*) is an aquatic weed that is harmful to humans; able to grow and develop well in lakes, reservoirs, dams, marshes, and springs. In general, they are abundant in tropical and subtropical regions (Aboud *et al*., 2005).

East Java has a wide of ± 47,000 km^2, with an area of lakes, reservoirs, dams, and marshes ± 88.75 km^2 as well as ponds and pools ± 705.82 km^2 (Priyanti *et al*., 2012). Those are the important water sources for the society, such as for irrigated fields or farms, freshwater fish breeding and a water source for the family needs as well as the Hydroelectric Power Plant (HEPP). There is no definitive data about the extensive spoilage of water which is due to overgrowth of water hyacinths, but those water weeds have spread and very well found in various waters. The growth of water hyacinth in Selorejo dam, Malang, East Java, has reached 1 km^2 of 6.5 km^2 area (Widianto, 2014). A very high growth rate and easy to spread nature has caused water weed to become potentially harm to the environment. But the nutrient content is as the same as the nutrient content in forage of grasses and thus, certainly, it has potential as a raw material for cattle feed (Mangisah *et al*., 2009; Mako, 2013; Riwiweti, 2013).

The objective of this study is to analyze the effect of water hyacinth (*Eicchornia crassipes*) as the substitution of complete feed in the society sheep farming, especially for the product performance (feed intake, digestibility of feed, daily gain and feed cost per gain).

MATERIALS AND METHODS

This study was conducted at the society sheep farming in Malang regency, East Java. About 16 local male sheep within 6 - 18 months age, 16.97 ± 4.56 Kg in weight, and Coefficient of Variance (CV) of 26.88% was used (Figure 1). The experimental design was Randomized Block Design (RBD) with four treatments and four blocks (based on Eq. 1) with Yij (observation value from 'i'-treatment and 'j'-repetition); μ (mean value); 'Ti' (the effect of i-treatment); 'Bj' (the effect of j-

Figure 1. Sheeps used in this study

Figure 2. Water hyacintch in Selorejo dam, Malang regency which cover the water surface

Figure 3. Mixing of all materials

block); 'Eij' (the effect of error from 'i'-treatment and 'j'-block); 'i' (1, 2, ... , 4); and 'j' (1, 2, ... , 4).

The group of sheep based on the early body weight including: block 1 (sheep with body weight of 11.17 ± 0.1 Kg); block 2 (sheep with body weight of 14.00 ± 1.29 Kg); block 3 (sheep with body weight of 18.33 ± 1.41 Kg); and block 4 (sheep with body weight of 22.33 ± 1.19 Kg). The given treatment in the form of subtitution of Water Hyacintch (WH) to the Complete Feed (CF) by comparison as follows: WH 0 (0% WH +100% CF); WH 15 (15% WH + 85% CF); WH 30 (30% WH + 70% CF); and WH 45 (45% WH + 55% CF).

The used raw materials for making complete feed are commonly used by a breeder. It was easy available in the Malang regency, East Java. The determination of nutrient content was based on the needed nutrients for fattening sheep normally (Siregar, 1994). The raw materials contain oil cake of coconut (*Cocos nucifera*), rice bran (*Oryza sativa*), cassava (*Manihot* sp), milled corn (*Zea mays*), leather coffee (*Coffea robusta*), wheat pollard (*Triticum aestivum*), molasses (*Saccharum officinarum*), salt, urea and lime; each of them 15.01%, 18.76%, 27.54%, 7.50%, 22.52%, 5.22%, 2.25%, 0.15%, 0.75% and 0.22% respectively.

The used water hyacinths which were from Selorejo dam, Malang regency, East Java (Figure 2) was less palatable feed ingredient. Thus, in this study, the feed ingredients were fermented. Water hyacinths are cut around ± 3 cm, then fermented in anaerobic condition for four days. The used materials for fermentation contain 1.00% molasses, 0.08% salt (NaCl), 2.00% water (H_2O) and 0.01% cellulolytic microbes (Wadjdi, 2013). Each of these ingredients was mixed manually (Figure 3) and then the fermented water hyacinths (Figure 4) were substituted with complete feeds according to the nutritional content of each treatment (Table 1).

The parameters which were observed in this study included: feed consumption (DM = Dry Matter, CP = Crude Protein, and TDN = Total Digestible Nutrient); digestibility of feed (DM = Dry Matter and OM = Organic Matter); daily gain; feed conversion; Feed Cost

Table 1. Composition and nutrient content of feed treatment

Descriptions	Treatments			
	WH 0	WH 15	WH 30	WH 45
Feed treatment composition:				
Water hyacinth (%)	0.00	15.00	30.00	45.00
Complete feed (%)	100.00	85.00	70.00	55.00
Nutrients content:				
DM (%)	79.08	70.22	56.25	52.50
CP (%)	14.43	14.27	14.10	13.93
TDN (%)	53.17	52.79	52.40	52.01

Figure 4. Fermented water hyacinth

per Gain (FC/G).

The proximate analysis of the feed nutrients was done (AOAC, 1995). The obtained data were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference (LSD) using SPSS 13.0 software (Steel and Torrie, 1991).

RESULTS

The fermented water hyacinth

Water hyacinth as an aquatic weed, has a potential to harm aquatic environment. If the plants are used as feed resources, it will be continuously available, abundant and economical. The utilization as feed material can be in the form of fresh, dried or given a specific treatment (silage, fermentation or according to the needs of animal feed). The applicative feed technology is simple, economical and can be carried out by the society breeder as fermentation technology. The advantages of fermentated feed products is that they are more palatable (Table 2).

There is a process of fermentation in the water hyacinth which causes the CP and TDN contents become slightly lower but the texture and flavour are better; therefore, it becomes more palatable (Table 2). It can be used as feed material, particularly as a feed substitute in the complete feed for sheep.

The effect of treatment on the production performance

The effect of feed treatments WH 0, WH 15, WH 30 and WH 45 are not significantly different ($P>0.05$) to the feed intake (DM, CP, and TDN); digestibility (DM and MO); daily gain; and feed conversion, but significantly different ($P <0.05$) to feed cost per gain (Table 3). The lowest feed cost per gain is for WH 45 treatment, but it is not different with WH 15 and WH 30 (Table 3 and Figure 5).

Based on Table 3, DM intake in the WH 45 (84.73 g/ $KgW^{0.75}$/h/d) treatment is same as 4.30% of weight body and higher than 3.49%. The sheep given complete feed from various agricultural and industrial wastes had a daily gain of 122.12 g/h/d - 128.90 g/h/d, feed conversion 7.56 to 8.08, and feed cost per gain is Rp 8,755.67/g - Rp 14,310.43/g (Figure 5).

DISCUSSION

The fermented water hyacinth and sheep production performances

Sheep are herbivores eating forage as the main food. Recently, the production of forage in East Java was

Table 2. The different nutrient contents in the fermented and non-fermented water hyacinth

Description	Water hyacinth	
	Non-fermented	Fermented
DM (%)	06.32	11.35
CP (%)	15.64	13.33
TDN (%)	52.21	50.61
Colour	Green	Brownish green
Scent	Unpleasent	Slightly fragrant
Texture	Fibrous, slightly hard	More lenient
Palatability	No palatability	Palatability

DM = dry matter, CP = crude protein and TDN = total digestible nutrient

Table 3. The effect of treatment feed to the production performance

Parameters	Treatments					
	WH 0	WH 15	WH 30	WH 45	SEM	Prob.
Feed intake						
DM (g/kgW$^{0.75}$/h/d)	86.15	87.87	85.27	84.73	2.26	0.96
CP (g/kgW$^{0.75}$/h/d)	12.43	12.54	12.02	11.80	0.32	0.87
TDN (g/kgW$^{0.75}$/h/d)	45.81	46.39	44.68	44.07	1.20	0.92
Digestible						
DM (%)	52.11	48.16	49.75	51.45	5.05	0.88
OM (%)	52.55	50.68	50.42	50.91	5.09	0.98
Daily gain (g/h/d)	110.92	112.50	111.67	109.17	1.20	0.67
Feed conversion	6.18	6.46	6.37	6.75	0.30	0.80
FC/G (Rp/g) ##	11,149.33^{b}	8,916.79^{ab}	7,815.32^{a}	7,060.05^{a}	554.05	0.02

^{ab} Means in the same row without common letter are different at P<0.05; FC/G = feed cost per gain 2013; and 1 $ = Rp 12,500.00.

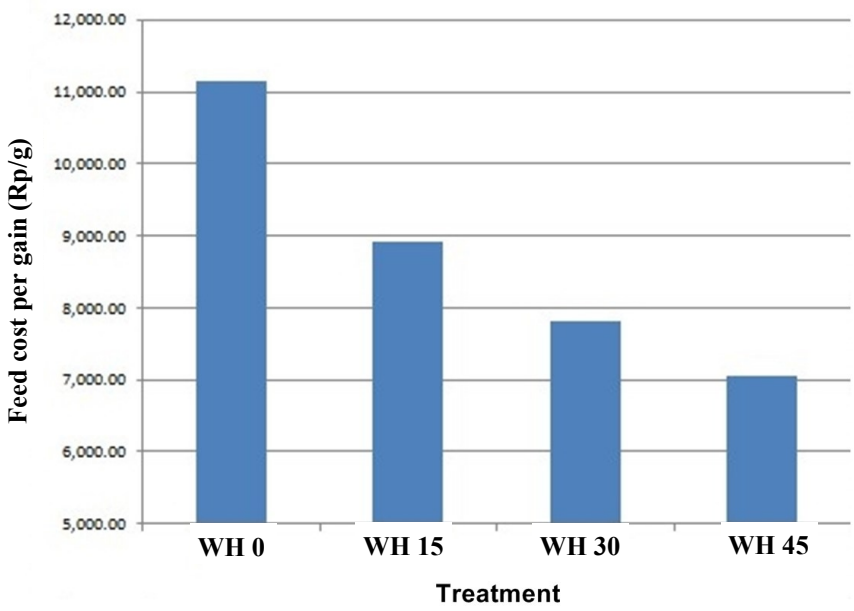

Figure 5. Feed cost per gain on WH 0, WH 15, WH 30 and WH 45

strongly influenced by the season; during the rainy season the availability was high and during the dry season the availability was limited. One of the alternatives was to utilize water hyacinth as feed material (Zahmi *et al.,* 2012). Recently, water hyacinth has received much attention due to its potential benefit as animal fodder (Sophal, 2010).

Fermentation of most tropical plant can increase the quality. Fermented WH could be ensiled for ruminant feeding. Water hyacinths were successfully ensiled with either 4% of sugarcane molasses, 15% of rice bran or with combination of two additives. Molasses is more preferable because it is less expansive (Ho *et al.,* 2013).

The previous study using the utilization of water hyacinth (40%), cowpea pods (30%) and groundnut stubbles (30%) for goat were successful (Dada, 2002). Furthermore, compared to the other study, WH 45 treatment had less daily gain (109.17 g/h/d), but better in feed conversion (6.75) and had a cheaper feed cost per gain (Rp 7.060.05/g) (Purbowati *et al.,* 2010).

CONCLUSION

The most economical treatment is the utilization of 45% water hyacinth and 55% complete feed which had a better feed intake (DM = 84.73 g/$W^{0.75/}$h/d, CP = 11.80 g/$W^{0.75/}$h/d, and TDN = 44.07 g/$W^{0.75/}$h/d), digestibleity (DM = 51.45%, and OM = 50.91%), daily gain (109.17 g/h/d); feed conversion 6.75; and feed cost per gain (Rp 7.060.05/g).

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