Productivity of Local Goat Fed Corn Stover Treated with Fungi *Trichoderma sp*. and Supplemented Gliricidia

Rohmiyatul Islamiyati (Corresponding author)
Animal Nutrition Department, Faculty of Animal Husbandry, Hasanuddin University, Makassar, South Sulawesi, 90245 Indonesia
Tel: + 62-081244244401 Fax: +62-411587217 Email : *rohmiyatul_islamiyati@ymail.com*

Asmuddin Natsir
Animal Nutrition Department, Faculty of Animal Husbandry, Hasanuddin University, Makassar, South Sulawesi, 90245 Indonesia
Tel: + 62-081242058810 Fax: +62-411587217 Email : *asmuddin_natsir@yahoo.co.id*

Sjamsuddin Rasjid
Animal Nutrition Department, Faculty of Animal Husbandry, Hasanuddin University, Makassar, South Sulawesi, 90245 Indonesia
Tel: + 62-411587217 Fax: +62-411587217 Email : *sjamsuddinrasjid@hotmail.co.id*

Ismartoyo
Animal Nutrition Department, Faculty of Animal Husbandry, Hasanuddin University, Makassar, South Sulawesi, 90245 Indonesia
Tel: + 62-411587217 Fax: +62-411587217 Email : *ismartoyo@gmail.com*

Abstract: The aim of this research was to examine the use of corn stover which was previously treated with fungi *Trichoderma sp*. (treated corn stover) and enriched with gliricidia leaves as feed for local goat. A completely randomized block design (CRBD) with four treatments and three blocks as replicates were applied. A total of 12 one year old local goats (Marica x Kacang) at a body weight 12.46. ± 1.64 kg, derived from Jeneponto districts were divided into three sampling groups. Each goat was placed in a metabolic cage 65 x 100 cm. One of four treatments was randomly given to each goat within every block. The treatments were A: 80% corn stover + 20% gliricidia leaves, B: 60% corn stover + 40% gliricidia leaves, C: 80% treated corn stover + 20% gliricidia leaves, D: 60% treated corn stover + 40% gliricidia leaves. The amount of feed offered to each goat was 3.5% of their body weight on dry matter basis. Results of experiment indicated that performance of the goats fed on treated corn stover was significantly better than those received untreated corn stover. The performance of the goats given 40% gliridia leaves was much better than those given with 20% gliricidia leaves regardless of their basal diets whether treated or untreated corn stover. In conclusion, treating corn stover with fungi *Trichoderma sp*. could improve nutritive value of corn stover for goats and its productivity could be further improved by 40% with gliricidia leaves supplements feed.

Keywords: *Trichoderma sp.*; goat; corn stover; gliricidia

1. Introduction

Productivity of ruminants is mainly determined by the availability of feed in terms of quantity and quality. One strategy to overcome this problem is by optimizing utilization of alternative feed resources such as feed from agricultural by product. Corn stover is an agricultural by product that has a high potency as ruminant feed. In South Sulawesi, production of corn stover is quiet high because one of the government program in agricultural sector is a program to achieve corn production of 1.5 million tons of corn. Dry matter production of corn by product

ranges from 5 to 6 tons per ha (Direktorat Budidaya Ternak Ruminansia, 2006).

However, one factor that is limited the corn crop wastes as ruminant feed is its low nutritional value. Therefore an effort to increase it is required. Treatment can be performed phsycally, chemically or biologically. Each method has its own advantages and disadvantages. One method that commonly used biologically to improve the quality of corn stover is by utilizing microorganism. One distinct advantage of this method is that it is more environmentally friendly. A decomposer fungus in nature is an organic material and plays an important role in life. *Trichoderma* fungi is the most widespread one and can be found on farms or plantations. Trichoderma mycelium can produce an enzyme such as glucanase and chitinase (Junaid, 2006), hemicelulase and lignolityc enzyms (Mahrous *et al*., 2010).

Corn by product biologically treated with fungi *Trichoderma sp.* can improve its potential as energy source for livestock especially for ruminants. However fungi treated corn stover is usually still low in protein content therefore supplementing with cheap protein sources such as gliricidia leaves is required. This is necessary because if the ruminants are only given corn stover but the protein requirements are not met. Winugroho and Widiawati (2009) stated that leucaena and gliricidia consumed as sole ration by sheep is highly degradable in the rumen but mostly wasted in the urine, only 24-30% are used by livestock. It is recommended that granting legume should be mixed with feed energy source with the right level so that the use of protein by the livestock can be optimised. The purpose of this experiment was to examine the use of corn stover which was previously treated by fungi *Trichoderma sp*. (treated corn stover) and enriched with gliricidia leaves as feeds for local goat.

2. Materials and Methods

2.1 Experimental Design and Treatment

The research was conducted according to a completely block design (CRBD) with four treatments and three blocks as replicates The blocks were based on the body weight of goat. The treatments were:

A: 80% untreated corn stover + 20% gliricidia leaves

B: 60% untreated corn stover + 40% gliricidia leaves

C: 80% of treated corn stover + 20% gliricidia leaves

D: 60% of treated corn stover + 40% gliricidia leaves

2.2 Preparation of Treated Corn Stover

Fungi *Trichoderma sp*. isolated from the roots of corn plants was carried out in the Plant Diseases Laboratory, Faculty of Agriculture, Hasanuddin University Makassar, South Sulawesi Indonesia. Preparation of fungi isolates was conducted according to the procedures of Belewu *et al*. (2007). This inoculum then was used for inoculation of corn stover.

Corn stover (leaves) of the DMI-2 variety corn hybrids derived from Jeneponto district was chopped into 2-5 cm length. Approximately, 5 kg of chopped corn stover was then sprayed with water to achieve 55-60% moisture content. Fungi *Trichoderma sp.* inoculum was added at the level of 5% or equivalent to $8.6x10^6$ cfu/ml to the chopped corn stover then mixed evenly. The mixture

was put into plastic bags that are punched with little holes and then covered with newspaper before incubated for two weeks. Inoculation completed after two weeks. The bags were then opened and the treated corn stover was dried before used as feeds for the goats.

2.3 Animal feeding and management

Twelve of one year old local goats (crossbred Marica x Kacang goat) from Jeneponto district, average initial live weight 12.46±1.64 kg, were randomly placed in an individual metabolic cage with sized 65 x 100 cm. The cage height was 70 cm above the floor. At the beginning of the study, each goat was drenched with Verm-O as de-worming agent and injected intramuscularly with vitamin A, D, E (ADE Injection) to meet the needs for vitamin. Each goat was fed of four experimental diets. The amount of diet offered for each goat was 3.5% of body weight on dry matter basis (NRC, 2005).

To improve palatability of the diets, molasses and commercial mineral for ruminants were added to the feed which was given twice daily at 08:00 and 16:00. The goats had a free access to water throughout the experiment. The experiment lasted for a total of eight weeks (two months) where four weeks was considered as the preliminary period and the last four weeks as the observation period.

2.4 Sample Collection and Chemical Analysis

The faeces of each goat were collected every day on the last five day of the experimental period. The daily faeces collection was put in plastic bag and weighed. The bags, with faeces, were labelled and store at 5^{o}C. At the end collection period, faeces collected daily were bulked, mixed thoroughly and a sub-sample oven dried (65^{o}C) for 48 hours to determine the dry matter and another sub-sample (10%) was taken and kept frozen for subsequent laboratory analysis.

Feed samples of untreated corn stover, treated corn stover, and gliricidia leaves were also collected during this period. Feed samples were dried in the oven at 65 ^{o}C for 48 hours for subsequent labarotary analysis.

The feed samples (treated corn stover, untreated corn stover, and gliricidia leaves) and faeces were analyzed for dry matter (DM), ash, crude protein, crude fiber and eter extract. Prior to laboratory analysis, all samples were grounded to pass 1-mm screen. DM content was determined by drying at 105^{o}C in the oven for 24 h. The percentage of ash was determined by igniting the samples for 6 h at 550^{o}C. Organic matter (OM) was calculated as 100 - % ash (DM). Total N content of feeds were determined by the Kjeldahl procedure (AOAC, 2000).

2.5 Parameters Measured

Parameters measured in this experiment were dry matter and organic matter digestibilityies of the diets, body weight gain, feed consumption, and feed efficiency of the goats. Dry matter and organic matter digestibility were determined using the following formula:

$$\text{Dry matter digestibility} = \frac{\text{Dry matter intake} - \text{faeces dry matter}}{\text{Dry matter intake}} \times 100\%$$

$$\text{Organic digestibility} = \frac{\text{Organic matter intake} - \text{faeces organic matter}}{\text{Organic matter intake}} \times 100\%$$

Feed consumption of each goat was determined by measuring the amount of feed given every day and subtracted by the amount of orts (if any). Live weight gain was calculated as the difference from final weight and initial weight divided by the period of observation. Feed efficiency was the ratio between average daily gain and dry matter intake.

2.6 Data Analysis

The data were analysed using analysis of variance according to completely randomiced block design (CRBD). The different among treatments were further separated by Duncan's test (Gaspersz, 1991). The data were processed with *SPSS for Windows version 17*.

3. Results and Discussion

Chemical composition of feedstuff used in this experiment is presented in Table 1. Crude protein of treated corn stover increased 26.34% compared with untreated corn stover while crude fibre decreased 11.85%. Similar results reported by Azim *et al*. (2011) who stated that crude protein content of corn stover inoculated with *Trichoderma viride* 15% and incubated for 21 days increased from 6.52% to 10.28%.

Table 1. Chemical composition of feedstuff

Feed Ingredients	CP	EE	CF	NFE	Ash
			%		
Corn stover untreated	6.91	6.67	25.07	49.71	11.64
Corn stover treated with *Trichoderma sp.*	8.73	5.96	22.10	51.52	11.69
Gliricidia leaves	19.56	8.96	20.29	42.57	8.62

CP = crude protein, EE = Ether extract, CF = crude fibre, NFE = Nitrogen free extract

Elkholy *et al*. (2009) who stated corn crop residues treated with yeast increased crude protein and decresed fraction of fiber. Increasing of the protein content on treated corn stover was related to bioconversion of organic complex of fungi. Secretion of secondary metabolites by fungi such as extracellular enzymes also contributes and plays a role to increasing the protein content of treated corn stover.

Goats fed basal diet either untreated corn stover or corn stover inoculated with fungi *Trichoderma sp*. enriched with gliricidia leaves was in good conditions throughout the study. Performance data of the goats and digestibility of the diets are presented in Table 2. Analysis of variance showed that the treaments affected ($P < 0.05$) live weight gain of the experimental goats but had no significant effects ($P > 0.05$) on dry matter intake, organic matter intake, dry matter digestibility, organic matter digestibility and feed efficiency. The average daily gain of goats for treatment was 78.92 g/d. Increase on live weight gain was related to dry matter digestibility and organic matter digestibility. Fungi *Trichoderma sp*. inoculated treatment on corn stover may disrupt the bonds of

Table 2. Average daily gain, consumption, and digestibility of local goat

Item	Experimental Rations			
	A	B	C	D
ADG (g/d)	63.67[a]±18.34	90.33[b]±13.80	70.67[a]±10.07	91.00[b]±15.52
Feed efficiency	0.17±4.19	0. 21±3.25	0.18±1.36	0.23±1.68
Dry matter intake (g/d)	376.78±101.8	416.93±18.40	382.72±60.37	387.52±50.51
Organic matter intake (g/d)	335.22±90.57	373.44±16.48	340.35±53.68	346.99±45.22
Dry matter digestibility (%)	56.41±3.26	57.22±1.51	56.63±3.29	58.43±4.13
OM digestibility (%)	58.09±0.91	61.50 ±1.17	59.65±1.64	61.76±1.52

Description: Mean along the same row with different superscripts is significant (P <0.05)

lignocellulose and lignohemiselulose resulting in the energy from cellulose and hemicellulose was more available for the goats. Live weight gain obtained in this study was higher than that of Masetyo (2006) who reported a mean daily gain of 57.14 g/d of local female goat fed corn stover supplemented with lamtoro leaves.

Ngitung (2013) stated that the live weight gain of goats fed grass field with gliricidia leaves 48.10 g/d. Positive effects of inoculation treatment of *Trichoderma harzanium* on different materials was reported by Belewu *et al*. (2007) who stated an increase in milk production of goats fed treated cassava peel.

The average dry matter and organic matter intake of goats accross the treatment were 390.99 g/d and 349.00 g/d. There was an increasing trend of dry matter or organic matter intake for goats supplemented with 40% gliricidia leaves rather than 20% regardless of whether the basal diet of corn straw was treated or untreated. Gliricidia was preferred by goats to meet the need of proteins. Similar results was reported by Azim *et al*. (2011) who stated that there was an increase in dry matter intake, protein intake, live weight gain of crossbreeding (RhamanixOssimi) sheep fed corn stover inoculated with 15% *Trichoderma viride* compared to those fed untreated with corn stover, i.e. 96.20 vs. 95.20 g/kgBW$^{0.75}$, 14.60 vs 11.80 g/ kgBW$^{0.75,}$ and 156 vs. 126 g/d, respectively.

The average feed efficiency for all treatments was 0.20. There was a tendency that the feed efficiency increased for the goats' accross the basal diet (treated and untreated corn stover) when supplemented with either 20% gliricidia or 40% gliricidia leaves. Omer *et al*. (2012) stated that Rahmani live weight gain of sheep given ration containing 30% corn stover inoculated by *Trichoderma reesi,* was 243 g/d compared to that fed control (untreated) which was 190 g/day. Dry matter digestibility increased from 69.91% to 72.86%, organic matter digestibility improved from 73.46% to 78.15%, and better feed conversion (5.39 vs 6.26).

The average dry matter digestibility of goats accross the treatment was 57.17% in with the highest dry matter digestibility being observed for treatment D and lowest in treatment A. Similar trend was observed for

organic matter digestibility of goats in which the highest organic matter digestibility was observed for treatment D and the lowest in treatment A with a 60.25% average.

Belewu *et al*. (2010) who stated that goat fed feather meal and rice husk treated Trichoderma increased dry matter digestibility, organic matter digestibility, crude protein digestibility and ether extract digestibility. Aye and Adegun (2010) who stated that gliricidia based multinutrient block supplements could be fed with Panicum cassava peels to improve feed intake, nutrient digestibility and nitrogen utilization leading to a better performance of sheep.

The average nitrogen intake of goats for treatment A was 6.57 g/d, but 55.85% of that amount was excreted in the faeces. This implies that most of nitrogen in the rumen derived from gliricidia leaves can not be optimally utilised by the animal fed untreated corn stover as basal diet.

Winugroho and Widiawati (2009) stated that nitrogen loss through faeces of sheep fed gliricidia as sole diet reached 26.7%. In efficient use of nitrogen from gliricidia on untreated corn stover might be related to unsinchrony of availability of C from corn stover and N from gliricidia (Natsir, 2008; 2012).

4. Conclusion

In conclusion, feeding the goats with *Trichoderma sp*. treated corn stover and gliricidia leaves could improve 40% performance level of the goats. This study implies that local goat's production can be easily improved with the proper enriched nutritional feed. Further research should be conducted on the correct proportion of the feed with other fungal species and local leaves.

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