

## Effect of Feeding Corn Stover Silage with FML Additive on Feed Digestibility in Female Sheep

Audiava Happy Kenthida Vanezza H.<sup>1</sup>, Ifar Subagiyo<sup>2</sup>, Hermanto<sup>3</sup>

<sup>1</sup>Magister's Program Student, Faculty of Animal Science, Universitas Brawijaya, Veteran St. Malang, 65145 East Java, Indonesia

<sup>2,3</sup>Lecturer, Faculty of Animal Science, Universitas Brawijaya, Veteran St. Malang, 65145 East Java, Indonesia

**ABSTRACT:** This study aimed to assess how female fat-tailed sheep respond to diets containing fresh corn stover and corn stover silage enhanced with Fermented Mother Liquor (FML) additives. The experiment involved 15 sheep with an average weight of 18.5 ± 1.55 kg, using a randomized group design (RAK) comprising three dietary treatments and five groups classified by body weight. The dietary treatments were: 100% fresh corn stover, a 50:50 mix of fresh corn stover and corn stover silage, and 100% corn stover silage. Data analysis was performed using ANOVA, and significant results were further examined with Duncan's Multiple Range Test (DMRT). The findings indicated that none of the treatments had a significant impact on the digestibility of Dry Matter (DMD), Organic Matter (OMD), or Crude Protein (CPD). It was concluded that the diet containing an equal mix of fresh and silage corn stover yielded the most favorable outcomes, although overall digestibility did not differ significantly across treatments. Consequently, corn stover silage with FML additives may serve as a practical alternative to fresh corn stover.

**KEYWORDS:** Corn stover, silage, Fermented Mother Liquor (FML), digestibility, female sheep

### INTRODUCTION

Silage is an alternative animal feed that is very important as a source of forage, especially during the lean season. (Sadarman et al., 2020). When fresh forage is difficult to find due to limited land or climatic conditions, silage is able to ensure the continuity of animal feed throughout the year. This preservation technology allows farmers to store feed ingredients for a long time with maintained quality, especially for ruminants (Yuliyati et al., 2018). In addition to being used as an alternative in the dry season, silage making also aims to accommodate excess forage production at harvest time or utilize forage during the best growth but not yet used. The success of silage making is influenced by the WSC content, moisture content of the forage used, the amount of *Lactic Acid Bacteria* (LAB), and oxygen levels. Corn stover consisting of stems, leaves and young fruit has great potential as a silage base material because it is available in abundance after the corn harvest period. This material is very strategic to overcome the need for crude fiber for ruminants, especially in areas with limited quality forage. This plant can be grown on fertile land such as rice fields, and is able to produce higher production compared to grasses that grow on marginal land. As an annual crop, corn stover has an advantage in the crop rotation system because after harvesting, the land can be immediately used for other commodities. In addition to its high production, corn stover also contains important nutrients, especially crude protein of 7.8% needed by ruminants (Mustika and Hartutik, 2021). The utilization of corn stover as feed not only provides a supply of crude fiber, but also supports feed continuity throughout the year. However, the availability of corn stover is seasonal because it is highly dependent on corn planting patterns. At harvest time, stover is available in large quantities, but not available when there is no harvest activity. To overcome this irregularity, farmers can preserve corn stover in the form of silage. This process allows maximum utilization of the harvest and reduces the risk of feed shortages outside the growing season.

Corn stover possesses chemical properties that are conducive to the silage-making process. Its relatively high Water Soluble Carbohydrates (WSC) content supports effective and stable fermentation. For optimal silage quality, WSC levels should ideally range between 6% and 12% (Hartutik, 2017). However, one limitation of corn stover is its low crude protein (CP) content, which necessitates strategies to enhance its nutritional profile for more balanced livestock feed. One such approach involves incorporating protein-rich components like legumes. Legumes, particularly kalopo (*Calopogonium mucunoides*), are known for their high CP levels and their role as a nitrogen source in mixed silage. Kalopo has a CP content of 19.47%, and when combined with corn stover, can raise the silage's CP content by up to 9.8% (Dele et al., 2022).

During ensiling, lactic acid bacteria ferment the forage into lactic acid, which leads to the breakdown of proteins into amino acids, ammonia (N-NH<sub>3</sub>), Volatile Fatty Acids (VFA), and carbon dioxide (CO<sub>2</sub>). The inclusion of kalopo helps increase the crude

protein content while also reducing excessive protein degradation during fermentation, thereby helping to maintain or enhance the silage's nutritional value (Mahendra et al., 2022). In addition to legume supplementation, the crude protein content of corn stover silage can be further improved through the use of additives. One such additive is Fermented Mother Liquor (FML), a by-product of Monosodium Glutamate (MSG) production derived from molasses. FML is a blackish-brown liquid with a distinct odor, produced by fermenting carbohydrate-rich substrates like molasses using microorganisms such as *Corynebacterium* species. Due to its high protein content, FML can serve as a valuable additive in silage preparation (Yulanda et al., 2021). FML contains 35% crude protein, and the inclusion of 6% FML in corn stover silage has been shown to increase its CP content from 8% to 12.71% on a dry matter basis (Fikrah et al., 2024). This improvement makes the resulting silage a promising alternative feed option for female sheep, potentially matching or even exceeding the nutritional value of fresh corn stover. Therefore, the purpose of this study was to assess the impact of corn stover silage supplemented with FML on nutrient digestibility in female sheep, as a replacement for fresh corn stover.

## MATERIALS AND METHODS

The study was carried out at the Sumber Sekar Field Laboratory, Faculty of Animal Science, Universitas Brawijaya, and at the Laboratory of the Livestock and Fisheries Department in Blitar District. A total of 15 female fat-tailed sheep, each 6 months old and weighing an average of  $18.5 \pm 1.55$  kg, were used in this research. The feed provided included fresh corn stover (FC), corn stover silage (CS), and a concentrate mix composed of Corn Gluten Feed (CGF), pollard, Dried Distillers Grains with Solubles (DDGS), coconut meal, ground corn, palm kernel meal, and mineral supplements (limestone). Equipment used in the study included conventional pens, containers for feed and water, feed scales, and plastic materials.

An in vivo experimental approach was employed, involving three dietary treatments with five replications each. Observations were made on feed intake, digestibility, and nitrogen retention. The treatments applied in this study were as follows:

P1 = 100% Corn Stover (FC)

P2 = 50% Corn Stover (FC) + 50% Corn Stover Silage (CS); P3 = Corn Stover Silage (CS)

## Experimental Procedure

The procedure for making corn stover silage in this study was carried out through several stages. First, the harvested forage was wilted by aerating in the shade for about 48 hours. After wilting, the forage was chopped using a chopper machine until it was 3-5 cm in size. Next, the chopped forage is mixed evenly with FML additive as much as 6% of fresh weight, which has previously been mixed with a binder in the form of Corn Cobs Fiber (CCF) in a ratio of 1:2 (w/w). The forage and additive mixture is then put into a silo in the form of a 200 liter plastic barrel, compacted, and tightly closed to create anaerobic conditions during the ensilage process. In the last stage, the silo was stored in the feed warehouse for 21 days until the fermentation process was complete. Forage and concentrates are weighed according to the needs of the livestock that have been determined and then put into the bucket mixed evenly to make it homogeneous, mixing is done every feeding, namely in the morning and evening. The feed is ready to be given to livestock by placing it in the feeding trough in front of each livestock. Feces collection on the last 10 days.

## Data Analysis

The collected data were organized using Microsoft Excel and subsequently analyzed through Analysis of Variance

(ANOVA) based on a Randomized Group Design (RAK) to assess the impact of the treatments on the measured parameters.

When significant differences among treatments were detected by ANOVA, further comparison was conducted using Duncan's Multiple Range Test.

## RESULT AND DISCUSSION

The results of the analysis of variance (ANOVA) indicated that the dry matter (DM) content in corn stover silage was greater than that in fresh corn stover. This level falls within the optimal range for silage fermentation, which is typically between 25% and 35% (McDonald et al., 1991).



**Table 1. Nutrient contents of the feed ingredients during experimental**

Ingredients	DM (%)	OM (%)	CP (%)
		%DM	
Corn Stover	22,36	90,67	9,31
Corn Stover Silage	25,74	90,46	14,4
Concentrate	81,19	93,98	19,19

Note: FC= dry matter, OM= organic matter CP= crude protein.

Dry Matter (DM) in silage plays a crucial role in determining its shelf life. Low DM levels can lead to increased butyric acid production due to the activity of *Clostridium* bacteria, while excessively high DM can hinder the fermentation process because of insufficient moisture for fermentative microbes. In this study, the DM content of corn stover silage was found to be higher than that reported by Rokhayati (2023), who obtained 26% DM with molasses addition. However, this value remains lower than the findings of Mustika and Hartutik (2021), who reported 31.4% DM with the inclusion of pollard and 36.2% with rice bran. Similarly, Mahendra et al., (2022) recorded 26.05% DM in corn stover silage supplemented with lactic acid.

These variations are likely attributable to differences in treatments, especially the type of additives used, which can enhance fermentation effectiveness and accelerate moisture reduction. Additives such as Fermented Mother Liquor (FML) and molasses—both in liquid form—may increase the silage’s moisture content, thereby lowering the DM percentage (Yulanda et al., 2021). The DM value is a useful indicator of silage quality and fermentation success. Even though the DM in this study isn’t the highest, it still falls within the ideal range to support microbial fermentation and maintain silage stability.

The Organic Matter (OM) content observed in this study also indicates excellent silage quality. Organic matter reflects the total digestible organic components available as energy for livestock. The OM level here exceeds those reported in some previous studies—87% OM with molasses addition and 86.7% without additives. Differences in OM may be influenced by factors such as the initial feed composition, moisture level, additive usage, and fermentation performance. Fikrah et al., (2024) found OM levels of 86.9% under similar treatment, with a base material OM of 85%. In contrast, the raw material in this study had an OM of 90.67%, which contributed to the higher final OM. These findings suggest that the silage contains a high proportion of digestible organic material, making it a valuable energy source for ruminants. Typically, OM content in sheep feed ranges from 80–90% of total DM, so the results are within optimal nutritional standards.

The crude protein (CP) content of corn stover silage enhanced with FML additives in this research was higher than that reported by Fikrah et al., (2024), who found that corn stover silage without additives had a CP level around 8%, while silage with FML reached 12.2%.

**Table 2. Average digestibility value**

Treatments	Nutrients digestibility (%)		
	DM	OM	CP
P1	84,30±4,51 <sup>a</sup>	85,23±4,24 <sup>a</sup>	86,68±3,15 <sup>a</sup>
P2	87,16±1,83 <sup>a</sup>	87,90±1,73 <sup>a</sup>	88,99±1,09 <sup>a</sup>
P3	86,63±1,19 <sup>a</sup>	87,42±1,16 <sup>a</sup>	88,84±0,92 <sup>a</sup>

Note: The same superscript in the same column indicates the effect is not significant (P>0,05)

Digestibility represents the proportion of nutrients in feed that livestock can absorb and utilize. The degree of digestibility indicates how much of the feed’s nutrients are available in a form that can be broken down within the digestive system (Ismail, 2011). In this study, feeding sheep with either fresh corn stover or corn stover silage did not significantly affect the digestibility of



dry matter (DM), organic matter (OM), or crude protein (CP) ( $P > 0.05$ ). An increase in feed intake does not necessarily lead to improved digestibility, as digestibility reflects the percentage of nutrients absorbed rather than the total quantity of feed consumed. Although sheep consumed more DM, OM, and CP when fed either fresh or ensiled corn stover, it is likely that their digestive capacity for these nutrients had reached its maximum. Greater feed intake may increase the passage rate of digesta through the digestive tract, reducing retention time and thus limiting nutrient absorption efficiency. As a result, even with different intake levels, the proportion of nutrients digested remains relatively constant, leading to no significant variation in digestibility among treatments.

The digestibility values for DM, OM, and CP in Treatment P1 were lower compared to Treatments P2 and P3. This could be attributed to the use of corn stover silage enhanced with Fermented Mother Liquor (FML) in P2 and P3, which likely improved palatability and nutrient utilization. The inclusion of microbial inoculants or fermentation additives can enhance protein breakdown and promote better rumen fermentation, thereby improving OM digestibility, particularly in fibrous feeds like silage (Fadli et al., 2022). In contrast, fresh forage tends to have more intact cell walls and higher lignin content, which can hinder microbial degradation in the rumen (Pendong et al., 2022). The improved digestibility of DM and OM in silage treated with FML additives aligns with the observed increase in its CP content. FML, as a silage additive, contributes to higher DM content, which in turn increases the amount of CP that is broken down in the rumen, enhancing ammonia availability.

The combination of 50% fresh corn stover with 50% silage resulted in lower digestibility values for DM, OM, and CP compared to feeding fresh corn stover alone, with digestibility values reported by Hartutik and Soebarinoto (2010) at 83.10% for DM, 84.53% for OM, and 85.16% for CP. However, these values are still below those achieved in the P2 and P3 treatments, suggesting that incorporating a higher proportion of silage in the feed can improve the overall efficiency of nutrient digestion.

## CONCLUSION

The results of research on the provision of corn forage silage (*Zea mays*) with the addition of Fermented Mother Liquor (FML) additives, using a mixture of 50% fresh corn stover and 50% corn stover silage, showed the best performance in female fat-tailed sheep by increasing feed digestibility. The treatment of 50% fresh corn stover and 50% corn stover silage and 100% corn stover silage gave the same feed digestibility response as feed that was 100% fresh corn stover, so corn stover silage with the addition of FML additives can be used as an alternative to fresh stover stover in the lean season.

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