Fermentation Characteristics of Corn Stover and *Gliricydia sepium* Combination Silage with Different Presentations

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ABSTRACT

The problem on agricultural waste utilization as forage source was its low quality and perishable character. As effort to improve the utility of agricultural waste, there is need both preservation process and nutrient quality improvement. Corn stover was one of common agricultural waste with huge number of biomass for forage source. The presence of corn stover in Indonesia while harvest season need to be overcome by fermentation technique, such as silage. Meanwhile, *Gliricydiasepium*known as high crude protein content, which suitable for feed protein source. Corn stover and *Gliricydiasepium* combination silage to be expected could improve feed quality and continuity. This research was aimed to compare the fermentation characteristicsof Corn Stover and *Gliricydiasepium*combination silage with different percentation (10, 30, and 50%) of *Gliricydiasepium* as the treatments. The research variables were organoleptic (odor and color), chemical (pH and Dry Matter (DM)) and silage *Fleigh Value*. The result showed that using 10 and 30% *Gliricydiasepium* on silage have higher DM (32.51±1.68 and 34.16±4.47 vs. 27.28±0.37) and lower pH (3.34±0.07 and3.36±0.04 vs. 3.47±0.09)compare with 50%,that's make *Fleigh Value* of them was higher (136.57±4.91 and 138.91±9.55 vs.120.67±3.84) and all treatments were classified as excellent. The organoleptic variable showed that all combinations have similar green to yellow fresh color with acid fermentation odor. Based on silage fermentation characteristic in this research, theimprovement of corn stover silage quality by using *Gliricydiasepium* was recommended, and this need further research about silage crude protein content.

Keywords: Silage, Corn Stover, *Gliricydia sepium,* Characteristic, Fermentation.

INTRODUCTION

The problem on agricultural waste utilization as forage source was its low quality and perishable character. As effort to improve the utility of agricultural waste, there is need both preservation process and nutrient quality improvement. Corn stover was one of common agricultural waste with huge number of biomass for forage source. The presence of corn stover in Indonesia while harvest season need to be overcome by fermentation technique, such as silage. Meanwhile, *Gliricydiasepium*known as high crude protein content, which suitable for feed protein source. Corn stover and *Gliricydiasepium* combination silage to be expected could improve feed quality and continuity.

Silage is one of feed and forage preservation techniques on certain level of water content through microbial fermentation by lactic acid bacteria called as ensilage and occur on place which named as silo (McDonald *et al.* 2002). The suitable plant species as silage

material should be have high field dry matter production, high digestibility, low buffer capacity, and higher water soluble content (Demirel 2011).

This research was aimed to compare the fermentation characteristics of Corn Stover and *Gliricydiasepium* combination silage with different percentage as the green concentrate goal which to provide high quality and continuity feed based on agricultural waste.

MATERIALS AND METHODS

Silage Production. The research was conducted in Animal Feed and Nutrition, Universitas Halu Oleo on March until May 2017. The research materials were 75 days harvested corn stover, *Gliricydia sepium* herbage, and corn yellow meal. Corn stover and *Gliricydia sepium* were chopped at ±3 cm long size, and wilted 24 hours due to decrease water content for ensilage process proper level. Ensilage process were started by packed the materials based on its proportion to the one liter plastic jars the silos and wrapped it tightly to create anaerobic condition and store it on direct sun light free location. All the silos were stored until harvest day on 21st day, when generally the lowest silage pH was reached/ fifth ensilage phase (Schroeder 2004). The proportion of material as the treatments (corn stover: *Gliricydia sepium*: corn yellow meal) were: 1) 80: 10: 10%, 2) 60: 30: 10%, and 3) 40: 50: 10%.

The research designed using Completely Randomized Design (CRD) which contains three different treatments (materials proportion) and five replications as research units. The obtained data were analyzed using Analysis of Variance and the differences were analyzed using Duncan Multiple Range Test (DMRT).

Evaluation. The organoleptic observations were conducted on silage harvest day by comparing the treatment result based on its odor and color. Silage pH was obtained by crushing 10 gram fresh silage on 100 ml distillated water, and the acidity of filtered water measured using pH meter. Couple of samples were taken to further analysis *i.e.* 1) Dry Matter (DM) Content through silage drying on 60 and 105°C; 2) Crude Protein (CP) Content were analyzed based on Kjeldahl method through on proximate procedure; and 3) Fleigh value were calculated based an Otzurk *et. al.* (2006) formula: *Fleigh* Value = 220 + [(2 × DM(%)) – 15] – (40 × pH).

RESULTS AND DISCUSSION

Organoleptic Quality . Corn Silage occasionally has two other prominent odors, propionic acid and ethanol. Propionic Acid has more of a tendency to sting the nose tissues as opposed to a distinct smell. Ethanol Smells similar to rubbing or medicinal alcohol and can also be astringent.

Table 1. Silage Organoleptic Quality

	10%	30%	50%
Odour	+++ acid	+++ acid	+++ acid
Colour	+++ green yellowish	+++ green yellowish	+++ green yellowish

The odour and colour qualities were evaluated based on subjective opinion

Silage odors can also be used to evaluate fermentation. Normal silage has minimal odor due to lactic acid. If acetic acid production is high, then silage may have a vinegar smell. High ethanol content from yeast fermentation may impart an alcohol odor to silage.

Clostridial fermentation results in a rancid butter smell. Propionic acid fermentation results in a sharp, sweet smell and taste. Heat-damaged silages will have a caramelized or tobacco smell. No silage should have a musty, mildew or rotten smell due to molding (Saun and Heinrichs, 2008).

The organoleptic variable (Table. 1) showed that all combinations have similar green to yellow fresh color with acid fermentation odor. Silages with excessive acetic acid will have a yellowish hue; while those with high butyrate will have a slimy greenish color. Brown to black silage usually indicates heating from fermentation and moisture damage. These silages have the highest potential for molding and are unacceptable feeds. White coloration of silage is usually indicative of secondary mold growth (Saun and Heinrichs, 2008).

pH. pH was one of several criteria to evaluated ensilage fermentation. Generally, lower pH reflected better and stable silage preservation (Seglar 2003) and lactic acid content (Amer *et al*. 2012). The obtained silage pH in this research (Table 2.) were showed significance different ($p<0.05$) due *to Gliricydia sepium* on silage. Data were showed that *Gliricydia sepium* utilization on silage until 50% level still produce below 4.00 silage pH (3.34 to 3.47). This was proving that ensilage process was occurring in good condition. pH silage on 50% usage *Gliricydia sepium* on silage (3.47±0.09) were significant lower compared with 10 and 30% (3.34±0.07 dan 3.36±0.04). The increasingly *Gliricydia sepium* utilization on silage, would increase silage buffering capacity. The pH of an ensiled sample is a measure of its acidity, but is also affected by the buffering capacity of the crop (Kung and Shaver, 2001).

Table 2. Silage Quality

Parameters	*Gliricydia sepium* Combination		
	10%	30%	50%
pH	3.34±0.07[a]	3.36±0.04[a]	3.47±0.09[b]
Dry Matter Content (%)	32.51±1.68[a]	34.16±4.47[a]	27.28±0.37[b]
*Fleigh*Value	136.57±4.91[a]	138.91±9.55[a]	120.67±3.84[b]
Crude Protein Content (%)	11.26±2.18 [b]	11.29±1.28 [b]	15.22±2.20 [a]

Number which followed by different letter on same parameters show significant different ($p<0.05$).

Buffering capacity measures to what degree a forage sample will resist a change in pH. All forages have different buffering capacities. Fresh forage with a high buffering capacity will require more acid to reduce its pH than forage with a low buffering capacity. In general, fresh legumes have a higher buffering capacity than do fresh grasses or corn (Kung, 2010).

The lower acidity level or pH shall inhibit the growth of harmful bacteria and stop the plant enzyme activities which degrade protein. In acid condition, lactic and acetic acid capable to inhibit the growth of fungi microorganism forming (Muck 2011). Lactic acid bacteria (LAB) was fermented the plant water soluble carbohydrate (WSC) to be lactic acid, and little part was to be acetic acid. Due to that acid forming, the ensiled material pH decrease and the growth of degradable microorganism was inhibited.

Dry Matter (DM) Content. The suitable forage for silage material should be have high in field DM production and lso high digestibility, low buffering capacity, and higher WSC (Demirel 2011). WSC dramatically decreased and DM losses increased when corn forage was not immediately packed into silos after chopping (Kung, 2010).

The obtained DM on this research (Table 2.) was showed significant differences ($p<0.05$) as the effect of *Gliricydia sepium* using percentage on silage. The data showed that 50% *Gliricydia sepium* utilization on silage was still high (27.28±0.37), although it's still on lower percentage if compared with 10 and 20% *Gliricydia sepium* utilization (32.51±1.68 and

34.16±4.47). This was proving that ensilage process was occurring in good condition. This result was inline around Jatkauskas dan Vrotniakiene (2005) result, which was reported as 33.7%. The DM percentage difference in this research maybe was affected by the difference of silage material percentage, which has effect on silage pH. On 50% *Gliricydia sepium* ulitization have lower pH, which allegedly there are occur DM degradation due to microbial and plant enzyme activities.

***Fleigh* Value**. *Fleigh* value based on Otzurk et al. (2006) was one of silage quality evaluation method based on silage DM content, and pH. The result silage on *Fleigh* value was categorized as very good quality; over than 100. The 10 and 30% *Gliricydia sepium* utilization (136.57±4.91 and 138.91±9.55) have higher different significant ($p<0.0\%5$) compared with the 50% one (120.67±3.84). This could be caused by the lower of silage pH and DM of the 50% *Gliricydia sepium* utilization on silage.

Fleigh value could be high due to DM increasingly and decreasing of silage acidity (pH). The high of DM percentage reflected ensilage process and that's will keep/ preserve the silage material, while low pH can describe the ensilage process was occur in good condition. The minimum material lost, low of pH, silage structure and its odor were some indication of good ensilage process, and that's all should indicated the high of silage recovery ability (Yosef*et al*. 2009).

Crude Protein (CP) Content. The important occurrence on aerobic phase is proteolysis or forage protein breakage which reached 50% forage protein content become amino acids, ammoniac, and amine. The enzyme activities which work on this proteolysis process would stop with the increasing of acidity condition. This phase should be passed as quick as possible (Schroeder 2004).

The result of this research showed that silage crude protein (CP) content was 11.26 to 15.22%. The CP content of 10 and 30% % (11.26±2.18 and 11.29±1.28) *Gliricydia sepium* utilization were have significance lower ($p<0.05$) compare with the 50% (15.22±2.20). This result was higher (13.8%) than Jatkauskas dan Vrotniakiene (2005) which make grass and legumes silage. The high of CP content on this research could be used as the recommendation to making high CP silage. High CP content on ruminant feed silage based, especially forage, would useful to provide high quality and continuity feed.

CONCLUSIONS

Based on silage fermentation characteristic in this research, the improvement of corn stover silage quality by using *Gliricydia sepium* was recommended until 50% utilization, due to high CP content. Meanwhile the 10 to 30% *Gliricydia sepium* utilization were producing more stable fermentation.

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