Fermentation Quality of Sweet Potato Vine Silage at Different Molasses Levels

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Abstract

High sweet potato vine quantity during season of production and the absence of the technology for conservation form the main constraint to optimum utilization of the forage. Conservation could remove the constraint of feed wastage and availability of crude protein reach roughage for livestock during times of feed scarcity. A laboratory experiment on ensiling sweet potato vines was carried out to determine the quality of fermentation at different levels of molasses. A completely randomized design was used at molasses levels of 0, 5, 10, 15 and 20% on unwilted vines. Chopped sweet potato vines weighing 60 kg was used for each molasses treatment level. The silage samples were taken 30 days after ensiling to determine its chemical composition. The dry matter (DM) and crude protein (CP) contents decreased with increasing levels of molasses from 22.5 for fresh Fresh sweet potato vine to 13.38 for silage without molasses and l3.57 and 11.10 percent CP for silage with molasses. Neutral detergent fibre (NDF) decreased with increase in molasses rates too. The NDF of silage without molasses decreased slightly to 38.22 compared to 39.72 in the fresh material. There was significant (P<0.05) pH value decrease after addition of molasses which were not different among the treatments with various molasses rates. Silage without molasses had a higher pH of 4.5 but ranged from 3.9 to 4.0 for silage with molasses. DM content of sweet potato vines increased significantly (P<0.05) with the addition of molasses. There was no significant (P>0.05) change in DM for the silage with different molasses rates which ranged from 179.9 - 188.9g/Kg with golden brown colour and good fruity smell.

Key Words: Fermentation, Dry matter, Neutral Detergent Fibre, Crude Proteins, pH

INTRODUCTION

Low crude protein and energy content in grass form the main causes of reduced livestock production (FAO, 1981; Gitau *et al*., 1998) in the tropics. There is need to supplement the grass based diets with feeds containing high crude protein and energy contents to enhance production on small holder farms.

Sweet potato vines (*Ipomea batatas* (L.) Lam is a suitable alternative owing to their high crude protein content that is highly digestible (Irungu *et al*., 2004) and can cause high dry matter intake among cattle. Cattle have been shown to increase production when fed with sweet potato vines in the smallholder farms (Ouda *et al*., 2002) with lactating cows producing more milk, weaned calves gaining weight faster and

increased dry matter intake when sweet potato vines were included in their diets (Kiragu *et al*., 2000).

Huge amounts of sweet potato vines are rapidly produced during harvesting due to their seasonality of growth. If the vines are not preserved, they decay rapidly. The main constraints for using sweet potato vines as feed are labour and lack of storage technology. Use of vine silage overcomes both of these constraints and has been reported (Bang, 2010) to improve the digestibility of feed, maintain good growth of pigs and potentially improve carcass quality and economic returns. The farmers are able to process the vines during the off-season when labor is more abundant, and store the silage for use when feed is scarce. Bang (2010) states that sweet potato silage could be stored for up to seven months with very simple equipment and relatively-low material costs.

Sweet potato vines can be ensiled together with their roots to produce well-preserved silage (Hoang Huong *et al*., 2004). Previous studies have used molasses to improve the energy content of silage, ensure low pH and prevent proteolysis (Shahid *et al*., 1999). Sweet potato vine cultivar *Wagabolige* was ensiled with molasses in a study whose objective was to determine the quality of vine silage fermented at different levels of molasses.

MATERIALS AND METHODS

A laboratory study to determine the quality of sweet potato vine silage fermentation at different levels of molasses was carried out using a completely randomized design. Molasses were added at the rate of 0, 5, 10, 15 and 20% of the wet sweet potato vine material prior to ensiling. Molasses were diluted with water to achieve a homogenous solution. Black polyethylene tubes measuring 150cm by l00cm were used for ensiling the material. One end of the tube was tied tightly with a sisal rope to form a silo. Sweet potato vines cultivar *wagabolige* were harvested at 120 days after planting and chopped to a length of 2.5cm. Sixty kilograms of the chopped unwilted vines were ensiled in each of the five polythene tubes. The vines were thoroughly mixed layer by layer with molasses, in polyethylene tubes.

Thorough compaction was done to exclude all the air in the silo and each polyethylene tube tightly tied. The material was stored in a warehouse and allowed to ferment for 30 days. The silos were then opened and samples taken for analyses. The parameters of interest were the PH of the silage as a requirement for long storage and nutrient contents of the silage.

Chemical Analysis

The silage dry matter (DM), CP and Ash was determined according to the standard methods of Association of official Analytical Chemists (AOAC, 1990). NDF was analyzed using the methods of Van, Soest *et al*. (1968).

pH Determination

Samples of silage weighing l00gms were taken into a beaker and 100ml of hot distilled water added. The material was left standing for 30 minutes with frequent stirring. The supernatant solution of silage extract was used to determine pH using a pH meter according to the method of Wilson and Wilkins (1972).

Statistical Analysis

The data obtained on pH and DM was subjected to analyses of variance Using Genstat and the means separated using least significant difference (lsd).

RESULTS AND DISCUSSION

Table 1. Chemical composition (%) of silage with varying levels of molasses

		Molasses rate (%)				
Parameters	Fresh forage (%)	0	5	10	15	20
CP	22.5	13.38	12.01	13.57	12.48	11.10
NDF	39.72	38.62	29.10	17.92	25.78	24.20
ASH	11.01	16.22	15.10	16.01	17.00	15.78
OM	45	83.78	84.90	83.99	83.00	84.22

There were changes in the chemical composition of sweet potato vine after it was ensiled. The CP decreased from 22.5 for the unwilted fresh material to 13.38 for treatment 1 and ranged between 11.10 to 13.57 for silage with various molasses rate. There was an insignificant ($P>0.05$) decrease in CP content which might have been caused by its utilization for microbial growth during fermentation or proteolysis. The differences in CP between treatments might have been due to different molasses rates. There were no significant changes in NDF and Ash among the treatments. This was in agreement with other findings (Nguyen *et al*., 2001; Dai *et al*., 2002) that CP, CF and ash of sweet potato vines and sweet potato roots ensiled with different additives does not show any significant difference in values.

Ensiling is a preservation method based on the fermentation of carbohydrates by microorganisms under anaerobic conditions to produce organic acids (Hoang Huong *et al*., 2004). Normally a minimum of 6 to 12% water-soluble carbohydrates are required for proper silage fermentation that can produce silage of pH 3.7- 4.2 (McDonald *et al*., 1995). The silage without molasses had higher pH of 4.5 and reduced significantly ($P<0.05$) upon the addition of molasses.

Table 2. Effect of levels of molasses on pH and DM in the silage

	Molasses rates, % (Treatments)						
Parameter	0	5	10	15	20	SE	LSD
PH	4.5a	3.9b	3.9b	3.9b	4.0 b	0.0725	0.1538
DM g/Kg	146.4b	184.0a	179.9a	188.9a	183.2a	13.8	29.2

Rows with different superscripts are significantly different P (<0.05)

The rapid fall in pH upon addition of molasses can be explained by the fact that water-soluble carbohydrates in molasses were higher than in sweet potato vines which therefore improved the amount of readily fermentable carbohydrates in the vines. The significantly ($P<0.05$) low pH values obtained in the treatments containing molasses suggest that sweet potato vines can be ensiled better with addition of molasses. This agreed with the findings of Qamar (2009) who observed a decrease in pH and increase in lactic acid with addition of Molasses to sweet potato vines.

The dry matter of ensiled sweet potato vines increased with addition of molasses, which agrees with McDonald *et al*. (1995) who reported losses of DM of less than 5% during ensiling as acceptable. The DM of sweet potato vines differed significantly ($P<0.05$) with the control. The sweet potato vine silage without molasses had significantly ($P>0.05$) low DM. Dry matter in treatment 3 (15% molasses) was the highest but not significant ($P>0.05$) as compared to other molasses rates. The silage dry matter did not widely vary with additional molasses, which is in agreement with Nguyen *et al*. (2001) and Qamar (2009) who reported that dry matter of sweet potato vine silage with different additives does not vary much. Qamar (2009) found silage without additives showing the highest pH and was in agreement with the current work as an indicator of poor quality silage. The sweet potato vines silage containing molasses had golden brown colour and a good fruity smell, which has been reported as an indicator of lactic acid (Qamar, 2009) and is indicative of proper fermentation.

CONCLUSION AND RECOMMENDATIONS

The study found that sweet potato vines can be ensiled with molasses to produce high quality silage at an optimum pH range of 3.9 to 4.0 which is conducive for anaerobic lactobacillus that are responsible for the fermentative reactions in silage. Lactate silage is characterized by a pH of 3.7 to 4.2 with high amounts of lactic acid (McDonald *et al*., 1995). Dry matter in the treatments that had molasses improved significantly as compared to the control, but, the crude proteins and Neutral detergent fibre were insignificantly lower. Ash in the treatments with Molasses was higher than in the control treatment.

Further work needs to be carried out on the effect of sweet potato silage on the growth of young dairy calves and possibly milk production in smallholder dairy farms.

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BIO-DATA

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