THE EFFECTS OF INCLUSION OF SILVERLEAF DESMODIUM *(Desmodium uncinatum)* FORAGE AND MOLASSES ON NAPIER GRASS (*Pennisetum purpureum*) SILAGE QUALITY

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ABSTRACT

Tropical grasses such as Napier grass (Pennisetum purpureum) have high dry matter yield but are low in protein content. One way of overcoming the low protein of Napier is to combine the grass with herbaceous forage legumes during silage making. Conserving grass-legume forage as silage is an option that alleviates feed constraints during dry periods. The objective of the study was to investigate the fermentation quality and nutritive value of Napier grass ensiled with Silverleaf desmodium (Desmodium uncinatum) forage and molasses as an additive. Existing Napier and Silverleaf forages were harvested, chopped to 2.5 cm pieces and ensiled for eight weeks in mini silos. The legume and grass were mixed in the following ratios 0:100, 20:80 and 50:50, respectively, whilst molasses was added at levels of 3% and 5% (w/w). The pH ranged from 3.86 to 5.03, indicating good fermentation quality of the silage. The best fermentation was observed in 5% molasses and 20% Silverleaf silage which had significantly (P<0.05) the lowest pH of 3.86 whilst Napier alone silage had the highest pH of 5.03. The dry matter content of the silages differed significantly (P<0.05) ranging from 22.58% to 26.18%. The CP content of the Napier alone silage was 7.4 %, which was improved (P<0.05) to 10.85% and 11.37% by the addition of 20% and 50% Silverleaf, respectively. There were no significant (P>0.05) differences in the ash and organic matter content of the silages. The crude fibre content was significantly (P<0.05) high in silages containing higher amounts of Silverleaf. The inclusion of molasses improved the fermentation characteristics of Napier grass silage whilst the inclusion of the legume Silverleaf improved the protein content of Napier grass silage.

Key words: Grass-Legume silage, Napier grass, *Desmodium uncinatum*, nutrient content.

INTRODUCTION

Tropical grasses such as Napier grass (*Pennisetum purpureum*) have high dry matter yield potential. However, the production is very seasonal and is characterized by rapid deterioration in protein content as well as dry matter digestibility. Thus, animal production from the grasses is rather low (Mbuthia and Gachiuri, 2003). Napier grass has a low crude protein content ranging from 45 to 85 g/kg DM (Yunus *et al*., 2000; Aganga *et al*., 2005) and metabolizable energy (ME) content averaging 8.6 MJ/kg DM. Consequently, diets based only on Napier grass do not meet the nutritional requirements of a lactating dairy cow, thus requiring supplementation with sources of fermentable energy and nitrogen. However, due to the high cost of commercial concentrate feeds, most smallholder dairy farmers do not

supplement grass based diets. This leads to low exploitation of the genetic potential of the animals for milk production.

One way of overcoming these problems would be to combine the grass with herbaceous forage legumes and ensile. Conserving grass-legume forage as silage is an option to alleviate feed constraints and maintain animal productivity during dry periods. Grass-legume silages combinations usually have improved protein content, digestibility and fermentation quality (Maasdorp and Titterton, 1997). The low fermentation quality is expected since most tropical forages are low in water soluble carbohydrate content that ranges from 3 to 9% (Sarwartt *et al*., 1995) and the legumes are additionally of high buffering capacity. To increase the fermentation quality of tropical forage silage, the addition of fermentable carbohydrate source such as molasses is required (Yunus *et al*., 2000; Bilal, 2009). The objective of the study was therefore to investigate the fermentation quality and nutritive value of Napier (*Pennisetum purpureum*) grass ensiled with Silverleaf desmodium (*Desmodium uncinatum*) forage and molasses as an additive.

MATERIALS AND METHODS

Description of study site

The study was conducted at the University of Swaziland, Faculty of Agriculture, Luyengo campus. It is located at latitude 26^0 32'0'' South, and longitude 31^0 14'0' East, and altitude of 638m above sea level (Monadjem and David, 2005). The site has sandy loam soil with pH of 4.81. The annual rainfall of the area ranges from 850 mm to 1000 mm and most of it is received in October to March with a peak around December. The mean maximum and mean minimum temperature is 23^0C and 11^0C, respectively (Monadjem and David, 2005).

Forage production

Pre-existing Napier grass fields and Silverleaf plots at the University of Swaziland, Luyengo campus, Pastures Section, were cut at ground level, weeded, and irrigated. Napier (*Pennisetum purpureum*) grass was harvested at 1.5m height. The Napier and Silverleaf were harvested at 15 cm above ground using a machete at 12 weeks of regrowth.

Ensiling procedure

The forages were manually chopped separately to small pieces of about 5cm using the machete and wilted overnight. The chopped Napier grass was mixed with the chopped Silverleaf. The Napier and Silverleaf were mixed in the ratios of 100:0, 80:20 and 50:50. Molasses was added at 3% and 5% (Moran, 2005) weight of the Napier-legume mixtures. For ease of application, the molasses was diluted with water at a ratio of 3:1 and mixed with the Napier only and the Napier-legume mixture prior to ensiling (Mbuthia and Gachuiri, 2003). The ensiling treatments were replicated three times. The silage was preserved in 10 litre plastic buckets making sure that the forages in each bucket were

compacted by pressing them down manually. The buckets were sealed using a masking tape such that they were air-tight to undergo fermentation for 8 weeks.

Laboratory analysis

For chemical analysis, dry silage samples were ground to pass through a 1mm sieve using a laboratory Wiley mill (Model 4, Thomas Wiley, USA). The chemical analysis of the fresh Napier, Silverleaf and the silage was done according to the AOAC (1990) procedures. The dry matter (DM) was determined by drying samples at 105^0 C in an oven for 48 hours, crude protein (CP) using the Kjeldahl method; ash by combustion of a sample at 550^0C overnight, organic matter (OM) was obtained by difference of DM and ash content, ether extract (EE) by extracting with anhydrous ether using a Soxhlet apparatus and crude fibre (CF) using a Dosi Fibretec, P Selecta Model hot extractor. A pH meter (pH510, Eutech Instruments, Malaysia) was used to measure the pH of the silages. Samples of 40g from each silo were soaked in 200 ml of cool distilled water for 2 hours. The mixture was then filtered and the supernatant used for determination of the pH (Mtengeti *et al*., 2006).

Statistical analysis

The data collected was analysed using the general analysis of variance (ANOVA) technique using Statistix (2006) version 2.0 with the following model:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

Y_{ij} is the dependent variable (e.g. pH, DM, EE, CP etc), μ is the overall mean, T_i is treatment effect, and e_{ij} is the residual error. The means were then separated by the Least Significant Differences at 95% confidence level.

RESULTS AND DISCUSSION

Chemical composition of fresh forages

The chemical composition of the fresh forages before ensiling is shown in Table 1. The DM content of Silverleaf was significantly ($P>0.05$) higher than that of Napier grass. Similarly, the CP content of Silverleaf was greater ($P<0.05$) than that of Napier. There were no significant ($P>0.05$) differences in the ash, organic matter and crude fibre (CF) content of the two forages. The CP content of Napier was slightly lower than that reported by Mbuthia and Gachuiri (2003) that ranged from 95-107 g kg^{-1} DM at 8 weeks. This difference may be due to the fact that the CP content of Napier is highly dependent on soil fertility (Kariuki *et al*., 1998) since in both studies no fertiliser where used. However, the CP content of Napier in this study was similar to the findings of Aganga *et al*. (2005) who reported a value of 6.67% for Napier harvested at a height of 1.25m. The DM, ash and OM content of the Napier was similar to values reported in literature (Kariuki *et al*., 1998; Aganga *et al.*, 2005)

The nutrient contents of Silverleaf are within the range of those reported in literature (Getachew *et al*., 2000). However, the CP at 16.8% is higher than 13.5% reported by Jingura *et al*. (2001). The variation in CP content my be due to differences in age and amount of leaf

material in the forage (Mupangwa *et al*., 2006). The CF level of Silverleaf (30.2%) was comparable with 29.8% reported by Amodu *et al*. (2005). The ash and OM content of Silverleaf was similar to values of 10.9% and 89% reported by Jingura *et al*. (2000).

Table 1: The chemical composition (%) of the fresh Napier and Silverleaf forages.

Forage	DM	CP	Ash	OM	CF
Napier	15.62[a]	6.71[a]	12.50	87.50	32.25
Silverleaf	26.48[b]	16.80[b]	12.00	88.00	30.20

[ab]Means within a column with different superscript are significantly different at P<0.05.

Chemical composition of the napier silages

The chemical composition of the different silages is shown in Table 2. The pH values of the silages were significantly different (P<0.05). The Napier alone silage had the highest pH value of 5.03 which indicates a poorly fermented silage due to low fermentable carbohydrates present in Napier (Mbuthia and Gichuiri, 2003; Bilal, 2009). A decrease in pH due to inclusion of molasses was observed in the other silages. The inclusion of molasses at 5% resulted in lower silage pH values compared to the control. Yunus *et al.* (2000) reported that molasses additive has a clear effect on reducing silage pH values, being the main factor that contributes to the successful ensiling of foliage. The best fermentation was observed in 5M 20S silage which had the lowest pH of 3.86. The decline in pH promotes increased populations of efficient homo-fermentative lactic-acid bacteria. These bacteria reduce silage pH faster and more efficiently by producing predominantly lactic acid (Niekerk *et al*., 2007, Van Hiep *et al*., 2008). According to Bilal (2009), the optimum pH for high quality silage is between 3.8 and 4.5 where the activity of proteolytic enzymes stops. The pH values for the Napier-Silverleaf silages were similar to those reported by Mbuthia and Gichuiri (2003) of Lablab and Mucuna ensiled with Napier and by Amodu *et al*. (2005) of Lablab-Millet silage.

Table 2: The chemical composition (%) of different Napier and Silverleaf silages.

Treatment*	pH	DM	CP	Ash	OM	CF
0M 0S	5.03[a]	22.58[e]	7.40[c]	12.50	87.50	24.82[c]
3M 0S	4.30[bc]	25.20[cd]	6.88[cd]	12.00	88.00	26.45[bc]
5M 0S	3.89[bc]	26.18[ab]	6.66[d]	12.17	87.83	28.13[b]
3M 20S	4.30[bc]	25.53[bcd]	9.38[b]	10.83	89.82	28.03[b]
5M 20S	3.86[c]	26.87[a]	9.04[b]	10.67	89.33	32.52[a]
3M 50S	4.31[b]	24.67[d]	11.37[a]	11.50	88.50	33.98[a]
5M 50S	3.96[bc]	25.65[bc]	10.85[a]	11.00	89.00	34.63[a]

[abcde]Means within a column with different superscript are significantly different at P<0.05.

*Where: 0M 0S = 0% Molasses and 0% Silverleaf, 3M 0S = 3% Molasses and 0% Silverleaf, 5M 0S = 5% Molasses and 0% Silverleaf, 3M 20S = 3% Molasses and 20% Silverleaf, 5M 20S

= 5% Molasses and 20% Silverleaf, 3M 50S = 3% Molasses and 50% Silverleaf, 5M 50S = 5% Molasses and 50% Silverleaf.

The DM content of the silages differed significantly ($P<0.05$) but the range was below that reported by Mbuthia and Gichuiri (2003) of 28.4 to 30.2%. The difference could be attributed to the stage of growth of the forages since the DM content in forages increases with maturity (Mupangwa *et al*., 2006). Ensiling forage material with less than 30% DM may create an environment which is totally anaerobic that is suited to spoilage Clostridial bacteria rather than one that is microaerophilic and suited to lactic acid bacteria (Sarwatt, 1995). In addition, it may result in the loss of valuable nutrients as water and soluble nutrients accumulate at the bottom of the silo as silage effluent.

Inclusion of the legume in the silage significantly increased the CP content of the silage. The silages with 50% inclusion level of Silverleaf had the highest ($P<0.05$) CP, followed by the 20% inclusion level, which was intermediate, and least the other silages (Table 2). Similar findings have been reported (Sibanda, 1997; Mbuthia and Gichuiri, 2003; Amodu *et al*., 2005). In this study, the CP content of the silages increased from 7.4% to 11.37% with the inclusion of the legume. This finding is in agreement with Maasdorp and Titterton (1997) who reported an increase in the CP level from 7.7% to 12.8% when Silverleaf was ensiled with Napier. The CF content of the silages was significantly ($P<0.05$) different and reflected that of their constituents. The CF values of the silages ranged from 24.82 to 34.63% and are comparable to values reported by Amodu *et al*. (2005). There were no significant ($P>0.05$) differences in the ash and OM content among the silages. The ash content was lower when compared to values (12.63 to 14.63%) reported by Aganga *et al*. (2005) and higher than the ash content found in millet and lab-lab silage by Adomu *et al*. (2005) which ranged from 1.7 to 2.8%. The OM values are similar to values reported by Olorunnisomo and Fayoni (2012) for Napier-Gliricidia silage which ranged from 88% to 89%. Mbutia and Gichuiri (2005) reported lower OM content of 78.5% to 79.9% for Napier-Lablab and Napier-Mucuna silages, respectively.

CONCLUSION

In is concluded that the inclusion of molasses improves the fermentation characteristics of Napier grass silage whilst the inclusion of the legume Silverleaf improved the protein content of Napier grass silage. The inclusion of high protein legumes such as *Desmodium uncinatum* in Napier silage improves the nutritional quality of the silage for ruminant animals.

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