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Silage characteristics of sugarcane (*Sacchrum officinarum*) tops in Sri Lanka

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Introduction

Sugarcane tops (SCTs) is generally known to be a major byproduct of sugarcane industry which is currently not utilized in a profitable manner and it is widely available at low cost particularly during the dry period in Sri Lanka when the forage are scarce for feeding of ruminants. Usually, the residue after sugarcane harvesting contains dry leaves, fresh leaves and growing point of the stalk. It increases drying of leaves in the field within 2 to 3 days after harvesting due to dry weather conditions prevailing in the harvesting period and much of the tops are burned and wasted in the field. Therefore, it is difficult to use tops as feed unless they are preserved. Silage making is a good preservation technique which can be used under this condition. Therefore, the objective of this study was to compare the ensiling characteristics and nutritive value of SCTs or Guinea (*Panicum maximum*) 'A' grass with different additives.

Materials and Methods

Sample collection: Sugarcane tops from twelve months aged, rain fed, CO-775 sugarcane variety in Udawalawe, Sri Lanka were collected at harvesting. Guinea grass (GG) at 50% early bud stage was also collected from the same area. Rice (*Oryza sativa*) bran (RB) was purchased from a mill at Udawalawe and molasses was obtained from Sugar Research Institute, Sri Lanka.

Experimental design: The experimental design was a 2×4 factorial, Complete Randomized Design with 8 treatments and 3 replicates per treatment. Two varieties (SCTs and Guinea grass) were the 2 factors of the experiment.

Preparation of bacteria inoculant: (FJLB – Fermented Juice of Epiphytic Lactic Acid Bacteria): Freshly cut (50g) sugarcane or GG leaves were chopped and ground using a blender by adding 300ml of water. The juice was separated and mixed with 1 teaspoon of sugar and the liquid was bottled and sealed carefully to give airtight conditions. It was prepared about one and half days prior to silage preparation.

Silage preparation: Sugarcane tops and GG were separately cut into small pieces using a multi chopper machine and ensiled alone or with 3 additives namely 1% urea, 1% urea with 2.5% Rice Bran (RB) or 2% molasses for a period of 35 days in 1 kg laboratory silos. Bacteria inoculant prepared from Sugarcane were added to all sugarcane treatments (15ml/kg of silage) whereas bacteria inoculant prepared from GG were added to all GG treatments (15ml/kg of silage) at the time of ensiling. Urea and rice bran were added to increase the nitrogen content of silage because nitrogen content of sugarcane and GG were very low at the time of harvesting.

Laboratory analysis: Proximate analysis (AOAC, 1995) was carried out for the SCTs, GG and RB samples. After 35 days, silos were opened and visual observation was done. pH values of the silage samples were measured using a pH meter where dry matter contents were determined by drying in an oven at 60^{o}C to a constant weight. Crude protein contents of the silage were estimated (AOAC. 1995). Water soluble carbohydrate (WSC) content was determined using Anthrone test (AFIA, 2011) while lactic acid (Barnett, 1951) and ammonia nitrogen (Parsons *et al*., 1984) were analyzed using spectrophotometer.

Statistical analysis: Data were statistically analyzed using analysis of variance (ANOVA) with SAS program (Version 9.1). Means were compared using Duncan's Multiple Range Test.

Results and Discussion

Physical characteristics of silage: Silage without additives and ensiled with molasses had an olive green color, fruity aroma, and moist texture whereas silage samples ensiled with urea were brown in color. Guinea grass ensiled with urea had a slightly bad smell, but was not spoilt. Overall acceptability of all the silage samples of SCTs was better than that of Guinea grass silage.

Table 1. Chemical composition (%) of initial forage samples and rice bran used in the study

	Sugarcane tops	Guinea grass	Rice bran
Dry matter	98.04±0.04	98.39±0.18	97.16±0.07
Crude protein	5.67±0	8.07±0.06	13.59±0.35
Crude fiber	37.47±0.34	37.53±0.05	8.06±0.04
Ash	8.02±0.51	10.48±0.03	8.69±0.11

Nutritional value and ensiling characteristics of silages: Guinea grass ensiled with molasses had the highest ($P<0.05$) DM content (35.84%) compared to the SCTs ensiled with 1% urea which had the lowest (Table 2). Addition of molasses supplied more WSCs for lactic acid bacteria (LAB) fermentation and prevented breakdown of sugars and organic acids in the grass and may have reduced the DM losses. A slight reduction of DM content could be seen in urea added silage samples compared to controls of both the varieties. Addition of urea at the time of ensiling increased ($P<0.05$) the protein content of the silage, but the variety had no significant ($P>0.05$) effect (Table 2). Urea is a non-protein nitrogenous compound; therefore, it must have increased the CP as well as the ammonia nitrogen content of silage prepared in this study. The CP content of the control SCTs silage (4.4%) was lower than that of corresponding fresh SCTs (5.67%) (Table 1). This may be related with the loss of CP during the fermentation process. However, the CP content of the forage ensiled with molasses was similar to that of the initial forages. Also, molasses reduced the breakdown of protein and nitrogenous compounds of forage samples and this resulted preservation of nutrients and reduced the nutrient losses during ensiling (Carpintero *et al*., 1969).

Table 2. Composition and fermentation qualities of sugarcane tops and Guinea grass silage[*].

Component	Sugarcane tops				Guinea grass			
	Control	1% urea	1% urea with rice bran	2% molasses	Control	1% urea	1% urea with rice bran	2% molasses
Dry matter (%)	34.82±0.26^{ab}	33.88±0.40^{b}	34.06±0.45^{b}	34.52±0.62^{b}	34.26±0.54^{b}	34.21±0.22^{b}	35.13±0.18^{ab}	35.84±0.29^{a}
Crude protein (%)	4.40±0.22^{e}	12.72±0.43^{b}	16.02±0.19^{a}	5.38±0.64^{d}	8.03±0.23^{c}	13.29±0.07^{b}	15.59±0.12^{a}	8.82±0.17^{c}
pH	4.66±0.01^{d}	6.20±0.33^{b}	6.16±0.15^{b}	4.59±0.01^{d}	5.73±0.01^{bc}	8.64±0.15^{a}	9.01±0.26^{a}	5.24±0.04^{c}
Lactic acid (%)	14.77±0.13^{cd}	14.76±0.04^{cd}	15.35±0.1^{ab}	15.22±0.01^{abc}	14.99±0.19^{bcd}	14.71±0.04^{d}	14.76±0.16^{cd}	15.58±0.27^{a}
Ammonia nitrogen (%)	1.35±0.08^{e}	9.97±0.02^{b}	10.14±0.05^{ab}	1.67±0.1^{e}	4.98±0.1^{c}	10.43±0.15^{a}	9.82±0.12^{b}	3.11±0.21^{d}
Soluble carbohydrate (%)	7.34±0.2^{c}	5.6±0.18^{d}	4.69±0.12^{e}	11.59±0.38^{a}	6.31±0.4^{d}	7.86±0.29^{c}	7.27±0.28^{c}	8.9±0.26^{b}

[*] Mean ± S.E; Average of 3 silos; [**] $^{a, b}$ Means within a row with different superscripts are significantly different ($P<0.05$)

The pH value of silage prepared from SCTs was significantly lower ($P<0.05$) compared to Guinea grass silage (Table 2). Addition of molasses at the time of ensiling resulted lower ($P<0.05$) pH values in silage of both varieties however, no significant ($P>0.05$) differences were observed with controls. Lactic acid produced during LAB fermentation may have decreased the pH value of the silage. Addition of urea or urea with RB at the time of ensiling significantly ($P<0.05$) increased the pH of the ensiled forages compared to other. Lactic acid concentration of SCTs and GG silage in the present study was ranged from 14.71 to 15.58%.

Conclusion

According to the results, fermentation characteristics of silage depended on the type of crop as well as the type of additives used at the time of ensiling. Inclusion of molasses at the time of ensiling had a positive effect whereas inclusion of urea had a negative effect on the fermentation characteristics of silage. According to this study, sugarcane tops silage had better fermentation characteristics compared to that of guinea grass silage. Addition of molasses had enhanced the fermentation characteristics of silage. Therefore, sugarcane tops can be recommended as a quality feed material for making of quality silage under Sri Lankan conditions.

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