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Chemical composition and bio-chemical properties of sugarcane top (SCT) before and after ensiling

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Abstract
Sugarcane tops were ensiled in a different combination using different levels of urea (0, 0.25, 0.50%) and molasses (0, 2.5, 5.0%) for 45 days. Chemical composition of different sugarcane top silage showed that the DM contents were increased with the increasing level of molasses. However, the values of OM were almost similar in all the treatments. Crude protein contents were reduced after 45 days of ensiling in all the treatments (with or without urea addition) compared to initial value (first day of ensiling) but increased with the increasing level of urea. Thus increasing molasses levels decreased the crude protein. Hemi-cellulose content was decreased during ensiling of sugarcane tops but NDF, ADF, cellulose and lignin contents were increased in most of the treatments during ensiling period. DM loss was reduced with the increasing level of molasses. Addition of urea increased ($P<0.05$) the pH, but addition of 5% molasses reduced ($P<0.05$) the pH. TVFA values were comparatively lower in molasses supplemented groups. However, the value for lactic acid was increased ($P<0.05$) with the increasing levels of molasses. The *in-vitro* dry matter digestibility (IVDMD) of sugarcane top silage was found to increase with the increasing level of urea and molasses. It was concluded that best quality silage in terms to biochemical properties and digestibility of sugarcane tops can be prepared by adding molasses @ 5% and urea @ 0.5%.

Keywords: Sugarcane top silage, chemical composition and bio-chemical properties

Introduction

Shortage of conventional feed resources is a major constraint for decreased productivity of livestock and poultry in developing countries like India. Hence, a search for unconventional feed resources has become necessary. One such feed resource is sugar cane tops (SCT), a by-product obtained after the harvesting of the sugar cane plant. The tops are left on the ground in abundant quantities and the farmers use them directly for their animals without any processing. Sugarcane top is one, which may form a very good staple source of green fodder for large as well as small ruminants (Chumpawadee *et al*., 2006) [9]. Sugarcane tops is available in huge quantities in India and many other developing countries. It is left in the field after harvest and widely used for feeding of the animals owned by the farmers or workers on the sugar estates. India stands second in sugarcane (*Saccharum officinarum* Linn) production in the world with annual yield of about 355 million tons (Indian sugar, 2008) [11]. Since the tops form about 15-20 % of the total sugarcane (Garg, 2000) [10] about 50-60 million tons of sugarcane tops are available every year in our country.

However, sugarcane tops are highly palatable with good intake characteristics but at present sugarcane, tops are not being utilised fully as animal feed.

A large quantity of sugarcane top goes unutilised. If the surplus sugarcane tops, available at the time of harvest can be preserved, they can serve the need of the farmers in the time of shortage of green fodders. Therefore, there was a need to develop a suitable method for preservation such as ensiling of the sugarcane top and its value addition using molasses and other additives. Leaves from the sugarcane plant can also be included in the silage.

Materials and Methods

Green sugarcane tops (having about 30% dry matter) was collected from the nearby village and chopped to small pieces (2-3 cm) and ensiled using different levels of urea (0, 0.25and 0.50%) and molasses (0, 2.5and 5.0%). Nine different kinds of silages were prepared using different combinations of urea and molasses at laboratory level in the polythene bags 1kg of material was filled in each bag and stored at room temperature for 45 days.

Representative samples of different types of sugarcane top's silages before (at first day) and after 45 days of ensiling collected and kept for DM estimation in a hot air oven at 60 ± 1^0C for at least 48 hours. Dried samples were used for the estimation of OM, CP as per (AOAC, 1995) [3] and cell wall constituent's *i. e.* NDF, ADF, HC, cellulose and lignin were determined as per Van Soest *et al*. (1991) [20]. For determining pH, total volatile fatty acids, lactic acid and total nitrogen extracts of silages were prepared by soaking about 30g sample in 60 ml distilled water at 5 ^{0}C for 24hours. The pH of the silage extract was immediately recorded by a pre-calibrated digital pH meter (Decibel, Model DP-510). The TVFA in the silage extract were determined following the procedure of (Barnett and Reid, 1956) [5] using Markham's distillation apparatus. Lactic acid was determined as per the method of (Barker and Summerson, 1941) [4]. In-vitro DM digestibility of all treatment's samples were analyzed by modified two stage *in-vitro* method of (Tilley and Terry, 1963) [21]. All the data generated in the above experiments were statistically analyzed using (SPSS, 2007) [18] computer package. Comparison of treatment groups was done by ANOVA procedures (Snedecor and Cochran, 1989) [17].

Results and Discussion

Chemical composition and cell wall constituents of these different types of sugarcane tops silages before (at first day) and after 45 days of ensiling were estimated (Table 1). It showed that the DM contents were increased with the increasing level of molasses. However, the values of OM were almost similar in all the treatments. Crude protein contents were reduced after 45 days of ensiling in all the treatments (with or without urea addition) compared to first day of ensiling and increased with the level of addition of urea. After 45 days of ensiling the highest crude protein value was found in the T_6 (8.06%) followed by T_3 (7.81%) and T_9 (7.38%) where 0.5% urea was added but increasing molasses levels decreased the crude protein. Hemi-cellulose content was decreased during ensiling of sugarcane tops but NDF, ADF, cellulose and lignin contents were increased in most of the treatments during ensiling period. (Chauhan and Kakkar (1981) [7] also made similar observation when they prepared silage of SCT -. Similar results were also reported earlier in Napier grass silage (Yunus *et al*., 2000) [22]. It was further observed that the ensiling had no adverse effect on the organic matter content of the green fodder (SCT) as it remained almost same before and after ensiling. However, ensiling was found to reduce significantly ($P<0.05$) the CP content in all the treatments, but the addition of urea significantly increased the CP content, but contrary to observation made in this study, most of the earlier workers found either no change (Man and Wiktorsson, 2002) [13] or slightly increased (Kutty and Prasad, 1980) [12] CP value in the SCT after ensiling. However, addition of urea was reported to increase the CP content by most of the workers (Chinh *et al*., 2001) [8]. Noroozy and Alemzadeh (2006) [15] reported that the treating sugarcane tops silage with urea and molasses increased the crude protein from 1.25 to 6.75 percent, but there were no significant differences in TDN content. In respect of different fiber contents, it was observed that hemi-cellulose content decreased and NDF, ADF, cellulose and lignin contents increased during ensiling of SCT. (Chauhan and Kakkar (1981) [7] reported increased NDF, ADF, cellulose and lignin contents during ensiling of SCT, but they reported an increase in hemi-cellulose content also, whereas we found that hemi-cellulose content was reduced during ensiling.

Table 1: Chemical composition of SCT before and after ensiling

Treatment and sample		DM	OM	CP	NDF	ADF	HC	Cellulose	Lignin
T_1	1st day	31.17	92.78	7.83	76.97	41.29	35.68	35.43	5.86
	After 45 days	30.60	92.26	3.64	80.68	45.73	34.95	42.64	6.80
T_2	1st day	31.67	92.24	9.31	75.34	42.02	33.32	35.10	6.92
	After 45 days	27.63	91.40	5.89	74.30	45.44	28.86	41.85	7.10
T_3	1st day	31.99	92.51	13.03	76.12	41.87	34.25	33.88	7.99
	After 45 days	28.53	91.79	7.81	79.79	50.33	29.46	41.59	8.74
T_4	1st day	33.41	92.53	6.26	75.62	42.43	33.19	35.57	6.86
	After 45 days	31.02	92.07	4.28	77.87	46.61	31.26	40.03	6.58
T_5	1st day	31.48	92.75	7.50	75.43	36.29	39.14	28.26	7.53
	After 45 days	30.89	91.85	5.12	76.58	46.41	30.17	39.12	7.29
T_6	1st day	31.47	92.11	11.73	71.40	38.87	32.53	33.63	5.24
	After 45 days	29.76	91.90	8.06	77.25	47.51	29.74	38.73	8.78
T_7	1st day	32.41	92.17	7.96	69.65	37.66	31.99	32.50	5.16
	After 45 days	31.93	91.34	3.73	72.55	44.32	28.23	37.72	6.60
T_8	1st day	32.20	92.47	10.28	73.28	38.96	34.32	34.19	4.77
	After 45 days	31.16	91.21	5.73	74.39	43.16	31.23	35.58	7.58
T_9	1st day	32.20	90.73	13.39	67.76	38.75	29.01	33.42	5.33
	After 45 days	31.29	91.33	7.38	72.86	43.94	28.96	36.80	7.14
Mean	1st day	32.00	92.25	9.70	73.51	39.79	33.72	33.61	6.18
	After 45 days	30.31	91.68	5.74	76.25	45.94	30.31	38.54	7.40

Alvarez and Preston (1976) [2] showed that when ensile ng of sugarcane was performed without any additives, a high proportion of soluble sugars were converted to alcohol, and nutritive value was seriously depressed. These studies indicated that incorporation of urea and molasses to preferment chopped sugarcane was advantageous as it gave better quality silage in terms of its chemical composition. Ali *et al*. (2015) [1] reported that treatment of sugar cane tops with urea increased CP, Ash and NDF contents. The crude protein content of sugar cane tops was increased from 2.76 % in UTC to 11.83 % in the TCT.

Effect of addition of molasses and urea on the bio-chemical characteristics and *in-vitro* dry matter digestibility (IVDMD) of sugarcane tops silage was studied (Table 2). It was observed that DM loss was reduced with the increasing level of molasses and it was lower where 5% molasses was added with sugarcane top. Addition of urea significantly ($P<0.05$) increased the pH but addition of 5% molasses significantly ($P<0.05$) reduced the pH. Similar to pH, significantly ($P<0.05$) higher TVFA value was found at 0.5% urea with no molasses. TVFA values were low in T_1 and T_7. The value for lactic acid was significantly ($P<0.05$) increased with the increasing levels of molasses as well as urea. An increase in the pH and total nitrogen (TN) with the addition of urea and decreased pH with the addition of molasses was expected, because urea is an alkaline compound and molasses is expected to produce acidic condition on fermentation. This was in agreement with the results of Chinh *et al*. (2001) [8] who also found decreased pH with the increasing level of molasses in sugarcane leaf silage. Similarly, Mthiyane *et al*. (2001) [14] reported increased pH with the increasing level of broiler litter in sugarcane top silage. Man and Wiktorsson (2002) [13] studied the influence of various levels of molasses in ensiling of common crop residues and reported that the increased molasses level reduced pH and the water soluble carbohydrates concentration. Yunus *et al*. (2000) [22] prepared a silage from napier grass at different stages of growth using various levels of urea and molasses as additives and reported at all urea levels, pH decreased significantly with increasing molasses levels and at all level of molasses, urea addition increased total nitrogen significantly. Catchpoole and Henzell (1971) [6] reported quality silage had a pH value of 4.2 or below, same pH value was found in T_7, T_8 and T_9 in this study. A low pH of silages implies a proper fermentation and good preservation. The value for lactic acid was higher ($P<0.05$) in T_7 (21.18), where 5% molasses was added with no urea and significantly ($P<0.05$) lower in T_2 and T_3, where 0.25 and 0.5% urea were added with no molasses, indicating that the level of lactic acid increased ($P<0.05$) as the molasses level increased, but when urea level increased this parameter tend to decrease. Similar trend was observed earlier (Chinh *et al*., 2001; Yunus *et al*., 2000) [8, 22] who reported that the concentration of lactic acid increased significantly as the molasses level increased but decreased when urea level was increased. Mthiyane *et al*. (2001) [14] reported higher lactic acid values in the SCT silage than observed in the present study. The *in-vitro* dry matter digestibility (IVDMD) of sugarcane top silage was increased with the increasing level of urea and molasses with highest value in 5% molasses and 0.5% urea added sugarcane top silage at it was 50.61% compared to 24.35%, where no urea and molasses were added.

Vidal and Lopez (1971) [21] also made similar observation, as they observed increased DMD of SCT silage with additives compare to fresh SCT silage. Addition of urea + molasses + sulfuric acid numerically decreased potential of GP, probably this effect was due to high amount of sulfur in medium. By contemporary using of molasses and sulfuric acid, high sulfur resulted in reduction of rumen bacteria growth, especially cellulolytic ones and NDF digestibility (Sharifi *et al*., 2016) [16]

Table 2: Effect of addition of molasses and urea on the bio-chemical characteristics and in-vitro dry matter digestibility of sugarcane tops silage

Tr.	Molasses (%)	Urea (%)	DM loss (%)	pH	TN (g/l)	TVFA (mEq/l)	Lactic acid (g/ml)	IVDMD (%)
T_1	0	0.00	$13.15^a±0.19$	$4.23^d±0.01$	$0.58^f±0.01$	$1.48^e±0.08$	$11.20^h±0.81$	$24.35±0.57^g$
T_2	0	0.25	$14.28^a±1.82$	$4.92^b±0.07$	$0.94^c±0.02$	$4.58^b±0.13$	$17.18^g±1.20$	$26.49±0.44^f$
T_3	0	0.50	$12.56^a±1.87$	$5.22^a±0.04$	$1.25^a±0.02$	$7.73^a±0.55$	$20.09^f±0.96$	$28.69±0.40^e$
T_4	2.5	0.00	$8.56^b±1.34$	$3.97^e±0.01$	$0.69^e±0.01$	$2.23^d±0.15$	$27.92^e±0.53$	$33.94±0.74^d$
T_5	2.5	0.25	$3.33^c±1.29$	$4.20^d±0.06$	$0.82^d±0.02$	$2.53^d±0.15$	$34.82^d±1.06$	$34.87±0.85^d$
T_6	2.5	0.50	$6.86^b±0.93$	$4.49^c±0.04$	$1.29^a±0.01$	$3.67^c±0.22$	$39.42^c±1.22$	$38.19±1.02^c$
T_7	5.0	0.00	$3.16^c±0.20$	$3.94^e±0.07$	$0.60^f±0.01$	$1.87^e±0.03$	$43.56^b±0.53$	$41.01±0.23^b$
T_8	5.0	0.25	$4.81^c±0.95$	$3.94^e±0.01$	$0.92^c±0.02$	$2.47^d±0.03$	$45.86^b±0.71$	$42.05±0.06^b$
T_9	5.0	0.50	$4.14^c±1.08$	$3.98^e±0.04$	$1.18^b±0.04$	$2.53^d±0.15$	$49.40^a±0.67$	$50.61±1.56^a$

a, b, c, d, e, f, g, h figures bearing different superscripts in a column differ significantly ($P<0.05$).

Conclusion

Best quality silage in terms to biochemical properties and digestibility of sugarcane tops can be prepared by adding molasses @ 5% and urea @ 0.5%. It is also concluded that making of silage from sugarcacane tops improves the biochemical properties and digestibility of sugarcane tops in compare to fresh tops.

References

1. Ali HAM, Abubakr OI, Sulieman YR. Evaluation and improvement of the nutritive value of sugar cane tops fed as sole diet to goats or supplemented with groundnut cake or sorghum grain. Journal of natural. Resoucesr. & environmental. Studies. 2015; 3(2) 29-35. (6) ISSN 1683-6456 (Print): ISSN 2332-0109 (Online)
2. Alvarez FJ, Preston TR. Ammonia/molasses and urea/molasses as additives for ensiled sugarcane. Tropical Animal Production. 1976; 1:980-1004.
3. AOAC. Animal feeds: In official methods of analysis of AOAC international, Vol. I, (16th edn). Edited by Patricia Cunniff. Virginia, 1995, 22201-3301. USA.
4. Barker SB, Summerson WH. The colorimetric determination of lactic acid in biological material. Journal Bio. Chemistry, 1941; 138:535-554.
5. Barnett JCA, Reid RL. Studies on the production of volatile fatty acids from grass by rumen liquor in artificial rumen. 1. Volatile fatty acid production from fresh grass. journal. Agricultural. Sciences, 1956; 48:315-321.

6. Catchpoole VR, Henzell EF. Silage and silage making from tropical herbage species. *Harbage Abstracts*. 1971; 41:213-219.
7. Chauhan TR, Kakkar VK. Note on the feeding value of sugarcane top silage. Indian Journal Animal Sciences, 1981; 51(2):221-222.
8. Chinh BV, Ly LV, Tao NH, Hai NV, Ngoc TB. Effect of drying, eisiling or urea treatment on the use of sugarcane leaves as ruminant feed. Proc: Workshop on improved utilization of by-products for animal feeding in Vietnam, 2001. Internet source (spec_5_4_2001_6htm).
9. Chumpawadee S, Sommart K, Vongpralub T, Pattarajinda V. Chiang Mai Journal Sciences. 2006; 33:371-380
10. Garg AK. *Annual Report NATP*. Animal Nutrition Division, IVRI, Izatnagar, 2000.
11. Indian Sugar. Sugar statistics, 2008; 7(11):57-70.
12. Kutty KPA. Prasad DA. Studies on improving nutritive value of sugarcane tops with urea or dried poultry waste by ensiling technique. Indian Journal Animal Sciences, 1980; 50(2):189-193.
13. Man NV, Wiktorsson H. Effect of molasses on nutritional quality of cassava and oliricidia top silage. Asian-Australasian Journal of Animal Sciences. 2002; 15(9):1294-1299.
14. Mthiyane DMN, Nsahlai IV, Bonsi. The nutritional composition, fermentation characteristics, in sacco degradation and fungal pathogen dynamics of sugarcane tops ensiled with broiler litter with or without water. Animal Feed Science and Technology. 2001; 94:171-185.
15. Noroozy S, Alemzadeh B. Effect of different amounts of treated sugar cane tops silage on performance of milch buffaloes. *Buffalo Bulletin.* 2006; 25(1):7-9
16. Sharifi Afrooz, Chaji Morteza, Mohammadabadi Tahereh. The comparison of digestibility of treated sugarcane tops silage by bacteria or whole microorganisms of Holstein cow and buffalo rumen. Vet Research Forum. 2016; 7(3):203-211.
17. Snedecor GW, Cochran WG. *Stastical Methods*, 8th ed. Iowa State University, Ames, Iowa, USA, 1989.
18. SPSS. Statistical Packages for Social Sciences, Version 17.0, SPSS Inc., Illinosis, USA, 2007.
19. Tilley TMA, Terry RA. Journal. British Grassland Society. 1963; 18:104-111.
20. Van Soest PJ, Robertson JB, Lewis BA. Journal Dairy Sciences. 1991; 74:3583-3597.
21. Vidal A, Lopez R. A note on the in-vitro utilization of sugarcane tops compared with other fodder for cattle. Indian Journal of Animal Sciences, 1971; 42:671.
22. Yunus M, Ohba N, Simojo M, Furuse M. Masuda Y. Effect of adding urea and molasses on napier grass silage quality. Asian-Australian Journal Animal Sciences. 2000; 13(11):1542-1547.