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Effect of Urea-Molasses and Lactic Culture on Silage Fermentation of *Cenchrus ciliaris*

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Abstract To study the effect of additives, urea, molasses and lactobacillus cultures, on silage fermentation of *Cenchrus ciliaris* in arid regions, 5 treatments with different proportions of urea (1 and 2% DM) and molasses (8%) were studied in laboratory silos. Molasses addition showed a significant effect ($P < 0.01$) on lactic acid production, pH and coliform population, while crude protein levels of the silage increased to 9.29% and 12.27% (DM) on addition of 1% and 2% urea, respectively. Uniform addition of LAB culture at the rate of 6% (cell concentration 1.15 x 10^6 cells gm^{-1}) affected final silage quality only in the presence of added molasses

Key words Additives, lactic culture, ensiling, *Cenchrus ciliaris*

Ensiling is well accepted method of preserving and storing forage crops and grasses, which allows greater feed energy production per unit area than other preservation systems (O'Leary *et al.* 1981). However, development of grass silage feeding systems has been slow, mainly because of problems with preservation and low animal performance due to low intake (Dulphy *et. al.* 1981). The problem of preservation and the extent and quality of silage fermentation varies with the type of forage, ambient temperatue, degree of wilting and number of lactic acid bacteria (LAB) amongst other factors (Garcia *et al.* 1989). Most of these factors are environmentally related and therefore area specific. Two of the significant factors encountered in arid and semi-arid regions are, inadequate protein and energy contents in the ensiling material and insufficient number of epiphytic latic acid bacteria, leading to preservation problems and acceptability of feed by the animals.

An attempt has been made to ensile *C. ciliaris* with different levels of urea molasses and LAB addition to standardize proper formulation for good quality grass silage.

Materials and Methods

Cenchrus ciliaris was harvested at late flowering stage (D.M. 28.5%, C.P. 4.28%) from C.R. Farm, Central Arid Zone Research Institute, Jodhpur, chopped with minimum possible wilting to 1.0 to 1.5 cm size. Urea was added at the rate of 1% (D.M. basis) to two treatments (T-II, T-IV) and 2% (D.M. basis) to the other two treatments (T-III and T-V). While molasses @ 8% (D.M. basis) was added to one each of these sets (T-IV and T-V). In the first set, *C. ciliaris* was ensiled without urea and molasses addition but non-specific lactobacillus culture (LAB; 1.15 x 10^6 cells ml^{-1}) was added in all the treatments at the uniform rate of 6% (D.M. basis of the premix) in the form of buttermilk. Silage premix from all the treatments was filled in laboratory silo (1.5 L double lid plastic bottles) in triplicate excluding all entrapped air to maximum possible and incubated at 31±2°C (room temperature) for 7 weeks. Samples were collected at periodical intervals for biochemical and microbiological examinations. Sample extraction and water souble carbohydrates (WSC), lactic acid, total nitrogen and crude protein (C.P.), pH and dry matter observations were carried out as described earlier (Pancholy & Mali 1992). Microbiological examination was carried out with extraction under aseptic conditions by the modification described by Kamra *et al.* (1983) for total bacterial population, coliforms, yeast and moulds, and lactobacillus population. Statistical analysis was done using two way analysis of variance.

The silage produced from all the treatments was assessed for quality, as per biochemical and

Table 1 *Effect of urea-molasses addition on Lactic acid production and pH*

Teatment	Period (days)					
	15	30	45	60	75	Mean
LACTIC ACID (% DM) :						
T–I	1.69 (7.49)	2.05 (8.26)	2.26 (8.72)	2.18 (8.52)	2.15 (8.45)	2.06 (8.28)
T–II	2.54 (9.22)	2.76 (9.57)	1.87 (7.92)	1.91 (7.99)	1.71 (7.63)	2.15 (8.46)
T–III	2.69 (9.51)	2.58 (9.22)	2.74 (9.51)	2.83 (9.68)	3.06 (10.13)	2.75 (9.61)
T–IV	2.98 (10.02)	3.10 (10.19)	4.54 (12.33)	5.61 (13.73)	6.06 (14.09)	4.45 (12.07)
T–V	2.61 (9.28)	3.2 (10.35)	4.66 12.51)	5.61 (13.73)	5.80 (13.97)	4.37 (11.96)
Mean	2.50 (9.10)	2.73 (9.51)	3.21 (10.19)	3.62 (10.73)	3.75 (10.85)	
CD 1% for treatment	0.178					
CD 1% for period	0.178					
CD 1% for treatment x period	0.397					
pH:						
T–I	5.76	5.36	5.13	5.13	5.10	5.29
T–II	5.36	5.13	5.26	5.73	5.83	5.46
T–III	5.33	5.20	5.46	5.73	5.83	5.51
T–IV	5.14	4.76	4.23	4.13	4.06	4.46
T–V	5.43	5.13	4.33	4.16	4.30	4.67
Mean	5.40	5.11	4.88	4.97	5.02	
CD 1% for treatment	0.049					
CD 1% for period	0.049					
CD 1% for treatment x period	0.110					

Figures in parentheses show angular transformation (arcsin) values

microbiological standards, and those of good quality were offered to a group of lactating Tharparkar cattle, for preliminary acceptability and immediate overall effects, including health and milk production, keeping one group as control.

Results and Discussion

The effect of additives on fermentation and the final silage quality was assessed on the basis of physical and biochemical characteristics. Physical appearance of the silage, in all the five treatments differed in smell, texture, and appearance. Silage from treatments IV and V (1% and 2% urea with 8% molasses, respectively) were golden brown, almost similar in appearance and improved in texture to the original *C. ciliaris* grass. All other silages were dark brown in colour with a distinct unpleasant smell and sticky texture.

Effect of urea and molasses addition on fermentation, has been presented in Tables 1 and 2. Addition of molasses, at the rate of 8% (D.M. basis), had a significant ($P < 0.01$) effect on lactic acid production and pH. Lactate values in silages, with 1% and 2% urea and 8% molasses (Treatment IV and V), were significantly higher than all other treatments, and pH lower than 4.2 could not be achieved, without addition of molasses. Lactate production in silage with 1% urea level was significantly higher ($P < 0.01$) than with 2% urea level only at the initial stage, thereafter the differences were insignificant. However, after 60 days of ensiling, pH increased in the treatment V (2% urea) not conforming to standard values of a good quality silage (pH less than 4.2 and lactic acid between 3 to 12% of D.M.). It is

Table 2 *Effect of urea-molasses addition on water soluble carbohydrates (% DM)*

Teatment	Period (days)					
	15	30	45	60	75	Mean
T–I	1.75 (7.63)	1.30 (6.63)	0.67 (4.68)	0.34 (3.46)	0.55 (4.31)	0.92 (5.43)
T–II	1.06 (5.92)	1.05 (5.92)	0.93 (5.64)	0.75 (5.02)	0.69 (4.80)	0.89 (5.46)
T–III	1.18 (6.20)	1.10 (6.11)	0.90 (5.54)	0.68 (4.80)	0.50 (4.18)	0.86 (5.36)
T–IV	2.18 (8.52)	1.53 (6.84)	1.16 (6.29)	0.95 (5.64)	0.90 (5.54)	1.34 (6.56)
T–V	2.38 (8.91)	2.48 (9.10)	1.26 (6.55)	1.15 (6.20)	0.95 (5.64)	1.64 (7.28)
Mean	1.70 (7.43)	1.49 (6.92)	0.98 (5.74)	0.77 (5.02)	0.71 (4.89	
CD 1% for treatment	0.228					
CD 1% for period	0.228					
CD 1% for treatment x period	0.510					

Figures in parentheses show angular transformation (arcsin) values

possible, that at a later stage of fermentation, acid production may not be sufficient to counteract buffering action, produced by increased N_2/ammonia levels as a result of 2% urea addition and therefore, a significant increase in pH is observed.

During initial stage, i.e., first 15 days of ensiling, lactic acid production was independent of molasses and urea treatment, but after 30 days of ensiling, addition of molasses showed a positive effect on lactic acid production. It has been observed that if the metabolic activity during the initial period is intensive, sugars accounting for more than 10% of the D.M. are fermented (Patterson *et al.* 1990). It is possible, therefore, that sugars present in the forage, are utilised at the initial level, producing sufficient lactic acid and reducing the pH rapidly. However, after 15 days of ensiling, the residual sugars may not be sufficient to produce enough acids to bind ammonia-N evolved during fermentation. The addition of molasses, a source of easily degradable carbohydrate therefore improves the quality of wastelage.

As expected, the addition of urea had a direct effect on total N and crude protein content of the silage, and addition of urea at 1% and 2% levels increased the C.P. content to 9.29% and 12.27%, respectively (Table 3).

Table 3 *Biochemical and microbiologial characteristics of Cenchrus ciliaris silage*

Characteristics	Treatments				
	T–I	T–II	T–III	T–IV	T–V
pH	5.10	5.83	5.73	4.06	4.30
Lactic acid (% DM)	2.15	1.71	3.06	6.06	5.80
WSC (% DM)	0.92	0.89	0.86	1.34	1.64
Total nitrogen (% DM)	0.73	1.41	1.79	1.49	1.96
Crude protein (% DM)	4.55	8.84	11.2	9.29	12.27
Lactic acid bacteria (log no. of cells gm^{-1})	7.18	7.28	7.32	8.12	8.24
Coliforms (log no. of cells gm^{-1})	1.8	2.4	2.56	Absent	Absent

Addition of molasses had a marked effect on the number of coliform bacteria, which were drastically reduced after 45 days of fermentation in treatments with 8% molasses, and were absent in the final product (Table 3). This may be due to relatively lower pH attained by molasses addition. Lactobacillus counts were not affected by treatments, but were directly proportional to the period of ensiling.

Green grasses, at the usual hay stages, generally have less than 25 per cent of dry matter. Such forage is too watery to make good quality silage, unless the D.M. increased (Morrison 1957). Wilting prior to ensiling does reduce protein degradation and moisture, but there is controversy over the importance of wilting as a strategy to improve nutritive value of silage (McDonald 1981). Direct cut grass silages are readily ingested by animals, if they are prepared with an efficient additive (Waldo 1977), and if they are finely chopped (Castle *et al.* 1979). In the present experiment, *C. ciliaris* harvested at the flowering stage, and ensiled with 1% urea, 8% molasses and 6% LAB culture in buttermilk, at cell concentration of 1.15×10^6 cells ml^{-1}, produced a good quality silage after 45 to 60 days of ensiling. The silage was readily accepted by the Tharparkar cattle and a relative increase in milk production was observed which, however, could be confirmed only after long term feeding.

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