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Characteristics of Silage Prepared from Hybrid Napier, Maize and Lucerne

[1]Markos Fisaha Delena and [2]Y. G. Fulpagare

[1] *MSc. Scholar; Department of Animal Husbandry and Dairy Science MPKV. Rahuri, Maharashtra, India*

[2]*Major Advisor and Head of Department, MPKV. Rahuri, Maharashtra, India*

Abstract: *To estimate the fermentation quality in various treatment combinations after ensiling and to assess feasibility of preparation of silage from hybrid napier. Hybrid Napier (Jaywant), Maize (African Tall) and Lucerne (RL-88) were grown in forage production farm of Research Cum Development Project, MPKV, Rahuri. Hybrid napier grass and lucerne were harvested as first cut at 60 and 40 days after sowing, respectively while maize was harvested at 50% flowering stage. All fodders were chaffed and then mixed as per treatment combinations viz; T_1 - 100% Hybrid napier (HN), T_2 - 100% maize (M), T_3 - 50%HN with 50%M, T_4 - 50%HN with 50% lucerne (L), T_5 - 50%HN with 25%M & 25%L, T_6 - 75%HN with 25%M and T_7 - 75%HN with 25%L. Then filled into polythene silo bags after mixing the cane molasses (at the rate of 3%). Silo bags were opened after 60 days and samples were collected immediately for pH, volatile fatty acids and dry matter estimation. The pH significantly lowered in all treatments (3.5 - 4.2). Significantly ($P<0.05$) highest lactic acid was observed in T_4 and T_5 while the lowest in T_1. The highest acetic acid observed in T_1 and the lowest in T_5, T_6 and T_7. The total nitrogen content of silages was significantly ($P<0.05$) increased in the highest lucerne inclusion level. On the basis of the results of experiment it can be concluded that from Hybrid napier a good quality silage can be prepared either as sole or in combination with maize and lucerne.*

Key words: Fermentation quality, Hybrid napier, Mixing level, Silage

I. Introduction

Napier grass (pennisetum purpureum scheme) is one of the popular grass in the tropics and sub tropics and is usually harvested at short intervals to feed at an early growth stage. However, it has a low crude protein content ranging from 45 to 85 g/kg DM [1, 2, 3].

The quality of Napier grass fodder can be improved through the incorporation of legumes to supply extra protein [2]. It is well known that alfalfa (Medicago sativa) is a forage crop with high nutritive value and is often a major component of diets for high-producing dairy cows [4, 5]. Maize can also be easily ensiled. However, its major shortcoming is its low CP content, which ranges from 70 g/kg DM to 80 g/kg DM [6, 7, 8]. The protein content of the maize silage can be increased by adding a protein rich legume [9].

Tropical grasses, including Napier are also low in water soluble carbohydrates (≤50 g/kg compared to forage maize (>100 g/kg) and do not ferment well when ensiled without additives [10, 11]. However, since alfalfa (Medicago sativa) have higher protein content and low fermentable carbohydrates cane molasses may be used as an additive to improve fermentable sugars and to promote the growth of lactic acid bacteria for their better preservation. The scanty studies have been reported on ensiling of Hybrid napier grass or it's supplementation through multipurpose trees and forage legumes for basal rations of ruminants [1, 12, 2]. However, scientific information on fermentation characteristics and nutritive value of Hybrid Napier ensiled with maize and lucerne is also limited.

The objective of this work, therefore, to know the fermentation quality of Hybrid napier grass with maize and lucerne.

II. Material And Methods

2.1 Forage production and ensiling

Hybrid Napier (Jaywant), Maize (African Tall) and Lucerne (RL-88) were grown in forage production farm of Research Cum Development Project on cattle, MPKV, Rahuri. Hybrid napier grass and lucerne were harvested as first cut at 60 and subsequently at 40 days, respectively after plantation. While the fodder maize was harvested at 50% flowering stage after sowing. The hybrid napier, maize and lucerne were chopped in to smaller pieces before ensiling to make it easy to compact silage and to remove inside air from the bags. Before ensiling plant materials were mixed according to treatment combinations. To improve fermentation quality of ensiling materials 3% sugar cane molasses was sprinkled uniformly to all treatments over the chopped fodders and thoroughly mixed. For the ease of application, the sugar cane molasses was diluted with water 3:1 ratio before use. The chopped fodders were filled in to polythene silo bags layer by layer. After filling, the bags were

compressed by hand pressing, squeezed gently to expel air as much as possible and compact silage and tightly tied with string to avoid air entrance. Finally the bags were stored in laboratory carefully for 60 days as ensiling period at room temperature.

The treatments for silage making were as under:

T_1 = 100% Hybrid napier (HN) + 3% sugar cane molasses, T_2 = 100% Maize (M) + 3% sugar cane molasses, T_3 = 50% HN +50% M + 3% sugar cane molasses, T_4 = 50%HN +50% Lucerne (L) + 3% sugar cane molasses, T_5 = 50%HN + 25%M + 25% L + 3% sugar cane molasses, T_6 = 75% HN +25% M+ 3% sugar cane molasses and T_7 = 75% HN + 25% L + 3% sugar cane molasses.

2.2 Chemical analysis

The chopped fodder samples were dried before ensiling for 48 hours in hot air oven and ground to 2 mm particle size through a Willey grinding mill and stored for subsequent proximate analysis by following the standard procedure [13]. Nitrogen estimation was done by using the Kel plus (PELICAN make digestion and distillation unit). The pH of silage was determined by electronic pH meter (ELICO LI 610) according to [14] on the aqueous extract of silage. The dry matter of silage was determined by drying in the hot air oven at 100^0C over night and the oven dry matter converted into toluene dry matter by equation suggested by [15]. Lactic acid, acetic acid and butyric acid were determined according to the procedure given by [16].

The data generated during the experimental period were subjected to statistical analysis of variance (ANOVA) by completely randomized design as described in [17] with three replication. The significance of differences among treatment mean was separated by SPSS16 pack computer soft ware.

III. Results

The quality of Hybrid napier, maize and Lucerne silage shown in Table 1. DM content was decreased in HN silage and in 25%M inclusion level, there was increase in all other parameters. The change after ensiling was significantly different ($P<0.05$). Significant variation ($P<0.01$) was observed among pH of silages. The highest (4.2) pH value observed in HN (T_1) and this followed by T_5 (4.1) and T_3 (4.0) while lowest in T_7 (3.5). The highest TN was observed in T_4 (2.12%) and T_5 (2.05%) respectively and the lowest in T_2 (1.33%). The mean difference was significantly different ($P<0.05$) but T_1 and T_6, T_2 and T_3, and T_4 and T_5 were at par each other.

HN silage had lower lactic acid (L.A) than maize and all mixture silage but maize silage (control) had higher L.A value than all maize mixture and 25%L inclusion. The highest L.A was observed in T_4 and followed by T_5. However there was significant difference ($P<0.05$) among treatments. In other side the highest acetic acid (A.A) were observed in HN silage and lowest in mixture silages. Lactic acid was dominated fermentation in all silages except in HN. Acetic acid was dominant for Hybrid napier (control) silage. Butyric acid production was 0% in HN, maize and mixture silages.

The physico-chemical characteristics of different silages shown in table 2. The colour of silage in T_1, T_2 and T_3 were light green to brownish, while in other mixture silages brown colour with pleasant alcoholic smell were prominent. All silages were firm in texture, neither spoilage, nor molds and fungus development observed.

Table 1. Characteristics of Hybrid napier, maize and lucerne silage

S.N	Code	Compositions (%)					
		DM	pH	TN	L.A	A.A	B.A
1	T_1	23.5^b	4.2^g	1.77^b	6.8^a	7.2^d	0
2	T_2	18.7^a	3.8^c	1.33^a	12.2^c	4.8^c	0
3	T_3	23.0^b	4.0^e	1.45^a	9.4^b	4.0^b	0
4	T_4	24.1^b	3.9^d	2.12^c	17.2^e	4.8^c	0
5	T_5	23.2^b	4.1^f	2.05^c	15.2^d	2.4^a	0
6	T_6	23.1^b	3.6^b	1.77^b	11.2^c	2.4^a	0
7	T_7	25.7^c	3.5^a	1.98^c	9.1^b	2.4^a	0
	SE ±	0.597	0.058	0.08	0.57	0.21	
	CD(5%)	1.28	0.0642	0.17	1.74	0.62	

1. Each value is the average of three observations 2. SE : Standard error
2. Different superscript are significant ($P<0.05$ and $P<0.01$)

Table 2. Physio-chemichal characteristics of hybrid napier, maize and lucerne silage

Parameter	Treatments						
	1	2	3	4	5	6	7
Colour	LG- B	LG- B	LG- B	B	B	B	B
Aroma	PA	PA	PA	PA	PA	PA	PA
Texture	Firm	Firm	Firm	Firm	Firm	Firm	Firm
pH	4.2	3.8	4.0	3.9	4.1	3.6	3.5

1, 2, 3….7 = treatment number, B = brown colour, LG-B = light green to brown colour, PA= pleasant alcoholic smell.

IV. Discussion

The observed results were consistent with the findings of 3.75 pH [18] in 4% molasses treated napier grass silage; 3.36- 4.33 for maize silage[19] and 4.2 and 3.6 for napier grass silage with addition of 2% and 5% molasses, respectively [20]. According to [21] higher fermentable sugars of un-wilted forages with the addition of molasses did not always reduce the final silage pH at very low (<20%) DM. But in present investigation pH value lowered with molasses treatment at 18.7% DM for maize silage. Treatment of fodders before ensiling with molasses lowered silage pH due to increased lactic acid production [20]. In this experiment the addition of molasses effectively reduced pH values in all silages. According to standard given by [21] and [22] in viewpoint of pH these silages considered as higher quality.

The quality silage has a butyric acid concentration of less than 0.2%, lactic acid 3 to 13% of DM and VBN/TN less than 11% [23]. The results presented in Table 1 were in agreement with their findings in terms of lactic acid production in T_1, T_2, T_3, T_6 and T_7. However, extremely higher values were observed in T_4 and T_5. This may be because of addition of cane molasses which was significantly increased lactic acid bacteria by improving sugar content of ensiled crops. Butyric acid production was also in agreement. Hybrid napier mixed with lucerne significantly ($P<0.05$) increased TN. This may be because of the lucerne is from leguminacea family of whose members contain the higher percentage of nitrogen that tend to increase with level of lucerne inclusion from 25% to 50% in hybrid napier silage which increases the TN content. TN values for hybrid napier silage with 25% and 50% phasey bean inclusion were 2.03 and 2.19 per cent, respectively and 1.70% for control silage (HN) had been reported by [24]. This result was in agreement with findings of present study.

Lactic acid was the main preservative organic acid in the silage and acetic acid was the next one [18]. Napier grass silage mainly produces lactic acid rather than acetic acid [25]. In this study also lactic acid was observed as dominant preservative at various level of mixture of maize or lucerne with hybrid napier silage. However the higher acetic acid (7.2%) value observed in HN silage than lactic acid (6.8%) and so that fermentation dominated by acetate for control silage (HN). This may be because of compaction level in polythene silo bags. Several researchers [23, 26] suggested that acetic acid is main preservative in tropical forage silages. The main preservative organic acid for silage may also depend on the extent of compression of forages in silo [18]. The quality silage usually preserves the original colour of the forage [27, 28]. The light green to brownish colour obtained in this investigation was in agreement. It was close to the original colour of the grass which was an indication of good quality silage that was well preserved. The pleasant smell is also accepted for good silage [29].

V. Conclusion

In present study addition of cane molasses significantly lowered pH in all silages. Lactic acid was dominant organic acid in HN mixture silage with maize and lucerne. However, acetic acid was dominant in silage prepared from HN alone. The fermentation quality of silage prepared from HN and its combinations with maize and lucerne was significantly good to that of maize. Hence on the basis of the results of experiment it can be concluded that from Hybrid napier a good quality silage can be prepared either as sole or in combination with maize and lucerne.

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