Influence of Berseem and Lucerne Silages on Feed Intake, Nutrient Digestibility and Milk Yield in Lactating *Nili* Buffaloes

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ABSTRACT : This study was conducted to evaluate feeding value of berseem and lucerne silage as a replacement for conventional fodder (berseem fodder) in lactating *Nili* buffaloes. Fifteen early lactating multi-parous *Nili* buffaloes, five buffaloes in each group were allotted three experimental diets. Berseem and lucerne fodders were ensiled at 30% DM (wheat straw was used to adjust the DM of fodders) with molasses (at the rate of 2% of fodder DM) in two bunker silos for 30 days. The diets contained 75% DM from berseem fodder (BF), 75% DM from berseem silage (BS) and 75% DM from lucerne silage (LS). Each diet contained 25% concentrate DM. Diets were mixed daily and fed twice a day at *ad libitum* intakes. Dry matter intake (DMI) was significantly higher (13.8 kg/d) in buffaloes fed BF diet than those fed LS (12.5 kg/d) and BS (11.9 kg/day) diets. The differences in digestible DMI and DMI as percent body weight were significant between fodder and silage based diets but non-significant when BS and LS were compared. Lower DMI with silage-based diets was probably because of low silage pH. Intake of NDF (NDFI) was higher (5.68 kg/d) in buffaloes fed BF diet followed by those fed LS (5.50 kg/d) and BS (5.00 kg/d) diets. The difference was significant ($p<0.05$) across fodder and silage based diets but NDFI was non-significant across both silage-based diets. The apparent DM digestibility was significantly different ($p<0.05$) between fodder and silage-based diets but was non-significant between LS and BS diets. Four percent fat corrected milk yield was significantly different ($p<0.05$) between fodder and silage-based diets but was non-significant between LS and BS diets. Higher milk yield with fodder based diet was because of more digestible nutrient intake (Table 3) compared with silage based diets. Milk CP, TP and NPN and SNF did not show any treatment effects. The present results indicated that the berseem and lucerne fodder ensiled at 30% DM level with 2% molasses could safely replace (75% DM) the conventional leguminous fodder in the diets of lactating *Nili* buffaloes. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 4 : 475-478)***

Key Words : Silage, Berseem, Lucerne, Intake, Digestibility, Milk Yield, *Nili* Buffaloes

INTRODUCTION

In south Asian region, extremes of winter (November to January) and summer (May to July) hamper fodder availability and thus impede ruminant productivity (Nisa et al., 2004). This situation calls for preservation of forages to assure year around green fodder availability to ruminants (Sarwar et al., 2003b).

Preservation of fodder is achieved by attaining acidic pH through anaerobic fermentation where bacteria convert fermentable carbohydrates into organic acids, predominantly lactic and acetic acids. Factors that affect the rate of pH decline and final pH of silage are fermentable carbohydrates in forage, its buffering capacity (related to the amount of acid needed to change the pH), dry matter (DM) content and the type and amount of bacteria present on the forage (Bolsen et al., 1996; Higginbotham et al., 1998; Sarwar et al., 2003a).

Berseem (*Trifolium alexandrium*) and lucerne (*Medicago sativa*) are highly nutritious, high yielding and abundantly available multi-cut legumes and could be ensiled to regularize fodder availability. However, leguminous fodders have high buffering capacity (due to high protein and mineral content), and high moisture content that led to slow pH decline during ensiling and caused heavy nutrient losses (Bolsen et al., 1996; Jeon et al., 2003). These fodders could be best ensiled after lowering their moisture content and by supplementing with a fermentable carbohydrate source.

Moisture content of leguminous fodders could be reduced either by field wilting or by the addition of some absorbent (Fransen and Strubi, 1998; Khan et al., 2004). But field wilting is not desirable due to higher labor costs. Dry roughages high in DM and low in N could be added to improve the DM of berseem and lucerne before ensilation.

Our previous study (unpublished) indicated that berseem and lucerne fodders ensiled with wheat straw to increase their DM contents up to 30% and addition of molasses (at the rate of 2% of fodder DM) could better preserve these fodders. However, the information regarding the nutritive value of berseem or lucerne plus wheat straw silage and their impact on milk production in *Nili* buffaloes is limited. Therefore, the present study was planned to evaluate nutritive value of berseem and lucerne silage as a replacement of conventional fodder (berseem fodder) on the performance of lactating *Nili* buffaloes.

MATERIALS AND METHODS

Preparation of silage

Berseem and lucerne fodders were ensiled at 30% DM

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Table 1. Chemical composition of berseem fodder, lucerne and berseem silages (DM basis)

Ingredients	Berseem fodder	Berseem silage	Lucerne silage
Lactic acid	-	3.94	3.48
pH	-	4.30	4.35
Dry matter	23.0	30.3	30.2
Crude protein	17.0	15.1	17.1
Neutral detergent fiber	48.0	49.8	52.1
Acid detergent fiber	32.0	35.8	33.2
Acid detergent lignin	8.00	8.50	8.80
Cellulose	12.6	16.4	14.3
Hemicellulose	16.0	14.0	18.9
Ash	11.4	11.2	10.4
NE_L (Mcal/kg)[1]	1.44	1.34	1.29

[1] Net energy for lactation was calculated as described in NRC (2001).

(wheat straw was used to reduce the DM of fodders) with molasses (at the rate of 2% of fodder DM) in two bunker silos for 30 days. The fodders were chopped using locally manufactured chopper and silos were filled with this chopped fodder and pressed properly to remove air to have good anaerobiasis. Each pit was covered with 4 inches thick layer of rice straw, followed by covering with a plastic sheet. The plastic sheet was then plastered with a blend of wheat straw and mud to avoid any cracking while drying. It was presumed that plastic sheet and mud plastering provided anaerobic conditions for proper silage making. Plastic sheet was removed to collect the silage for each feeding time; withdrawal of silage was started through the upper layer and working downwards to the lower layers. After being taken silage from the pit the plastic sheet was put back to keep the pit sealed.

Animals and diets

Fifteen early lactating multi-parous *Nili* buffaloes, five animals in each group with similar body weight and milk production, were selected. The groups and diets were allotted to animals at random. Animals were housed on a concrete floor in separate pens. Fresh and clean water was made available round the clock in the sheds for whole experimental period. Three iso-nitrogenous and iso-caloric diets were formulated using NRC (2001) standards for energy and protein. The BF diet contained 75% of berseem fodder while BS and LS diets contained 75% berseem silage and lucerne silage, respectively and 25% concentrate. Diets were mixed daily and fed twice a day at *ad libitum* intakes. The trial lasted for 75 days with first 15 days for dietary adaptation and 60 days for sample collection. Daily feed intake and milk production were recorded and averaged over 60 days. Milk samples (a.m. and p.m.) were collected weekly during the last 60 days of feeding trial and were analyzed for CP, true protein (TP), non-protein nitrogen (NPN), fat, solid not fat (SNF) and total solids (TS) by methods described by AOAC (1990). During last week of the study, a digestibility trial was conducted. Fecal grab samples were taken twice daily such that a sample was obtained for every 3-hour interval of 24 h period (Sarwar et al., 1991; Sarwar et al., 2004). The acid insoluble ash was used as digestibility marker (Van Keulen and Young, 1977).

Sample collection and chemical analyses

The samples of berseem fodder, berseem silage, lucerne silage and all experimental diets taken during study period were dried at 55°C in a forced air oven. These samples were ground to 2 mm particle size through a Wiley mill and analyzed for DM, N content and ash by the methods of AOAC (1990), NDF, ADF and ADL by methods described by Van Soest et al. (1991). Silages were also analyzed for pH and lactic acid content (Baker and Summerson, 1961). Feed offered and orts were sampled daily and composited by animal for analysis. Orts and fecal samples were also analyzed for DM, CP and ash contents (AOAC, 1990), NDF, ADF, ADL (Van Soest et al., 1991) and NE_L was estimated according to NRC (2001).

Statistical analysis

The data collected on different parameters (feed intake, milk production, milk composition and digestibility) were analyzed according to Completely Randomized Design. The statistical model used for all parameters was;

$$Y_{ij} = \mu+\tau_j+\varepsilon_{ij}$$

Where, μ was overall mean,

τ_j was the effect of treatment (3 treatments) and

ε_{ij} was difference within treatments (error term).

In case of significant ($p<0.05$) difference among treatment means, the Duncan's Multiple Range test was applied (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Chemical composition of berseem fodder, lucerne and berseem silages is presented in Table 1.

Feed intake

Dry matter intake (DMI) was significantly higher (13.8 kg/d) in buffaloes fed BF diet than those fed LS (12.5 kg/d) and BS (11.9 kg/day) diets (Table 3). The differences in digestible DMI and DMI as percent body weight were significant ($p<0.01$) between fodder and silage based diets but non-significant when BS and LS were compared (Table 3). Lower DMI with silage-based diets was probably because of low silage pH. Ruiz et al. (1992) reported lower intake of silage due to the presence of fermentation products and described that DMI was negatively correlated

Table 2. Ingredients and chemical composition of experimental diets (DM basis)

Ingredients (%)	Diets[1]		
	BF	BS	LS
Fodder	75.0	-	-
Silage	-	75.0	75.0
Rice polishing	5.50	7.00	7.00
Wheat bran	5.50	3.45	4.00
Maize gluten meal 30%	3.00	3.00	3.00
Cane molasses	9.00	9.00	9.00
Mineral mixture	2.00	2.00	2.00
Urea	-	0.55	-
Chemical composition (%)			
DM	37.2	42.2	42.6
CP	15.4	15.4	15.4
NDF	41.1	42.0	43.9
ADF	26.1	28.9	27.1
Hemicellulose	15.0	13.0	16.8
Cellulose	10.7	13.4	20.3
ADL	6.20	6.51	6.75
Ash	10.8	10.7	10.1
NE_L (Mcal/kg)	1.48	1.41	1.40

[1] BF, BS and LS diets contained 75% Berseem fodder, Berseem and lucerne silages, respectively.

Table 3. Nutrient intake and digestibility in *Nili* buffaloes fed experimental diets

Items	Diets[1]			SE
	BF	BS	LS	
Dry matter intake (kg/day)	13.8[a]	11.9[c]	12.5[b]	0.06
DMI (% BW)	3.24[a]	2.63[b]	2.89[ab]	0.15
Apparent DM digestibility (%)	64.8[a]	62.0[b]	63.4[ab]	0.69
CP intake, kg/day	2.13[a]	1.84[c]	1.93[b]	0.01
Apparent CP digestibility (%)	72.0	71.5	71.6	0.75
NDF intake (kg/day)	5.68[a]	5.00[b]	5.50[b]	0.03
NDFI (% BW)	1.40[a]	1.10[b]	1.27[ab]	0.07
NDF digestibility (%)	52.5	52.4	52.4	2.35
Digestible nutrient intake (kg/day)				
Dry matter	8.95[a]	7.39[c]	7.94[b]	0.11
Crude protein	1.53[a]	1.31[c]	1.38[b]	0.02
Neutral detergent fiber	2.98[a]	2.62[b]	2.90[a]	0.13

[1] BF, BS and LS diets contained 75% Berseem fodder, Berseem and lucerne silages, respectively.
[a-c] Means in a same row with different superscripts are significantly different (p<0.05).

with silage pH. Moisture content of the silage had affected intake negatively (Sarwar and Hasan, 2001, Sarwar et al., 2003a; Yahaya et al., 2004). In present study, the DM contents of silage-based diets were higher than BF because the fodders were ensiled with wheat straw to increase the DM contents thus moisture might have not reduced the intake. However, the depressed DMI with silage-based diets may be explained by the physical limitation imposed by the wheat straw. Therefore, the depression in DMI of silage-based diets compared with BF diet was because of the presence of fermentation products mainly lactic acid and the gut fill effect due to the presence of wheat straw in silage based diets. The CP and digestible CP intake also followed a similar trend as was observed in DMI and digestible DMI across all treatments (Table 3). Intake of NDF (NDFI) was higher (5.68 kg/d) in buffaloes fed BF diet followed by those fed LS (5.50 kg/d) and BS (5.00 kg/d) diets. The difference was significant ($p<0.05$) across fodder and silage based diets but NDFI was non-significant across both silage-based diets (Table 3). Similar results were noted for NDF intake as percent body weight and digestible NDF intake across all diets. Reduced NDFI with silage-based diets might be due to depression in ruminal pH because of lactic acid contents and thus in ruminal fiber degradability (Ruiz et al., 1992; Sarwar et al., 2004). Moreover, the wheat straw in silage-based diets might have limited the NDFI because of its gut filling effect.

Digestibility

The apparent DM digestibility (DMD) was significantly different ($p<0.05$) between fodder and silage-based diets but was non-significant between LS and BS diets (Table 3). Khorasani et al. (1993) reported higher DMD of fodder due to higher concentration of soluble carbohydrates and lower lignin content in the fodder than that of its silage. In the present study, lower DMD with silage-based diets might be because of low silage pH due to lactic acid contents that might have depressed the ruminal pH at least initially and thus cellulolytic activity. Furthermore, the presence of poorly digestible wheat straw in silage-based diets might have contributed to lower DMD. Apparent CP and NDF digestibilities remained unaltered across all treatments (Table 3). Khorasani et al. (1993) reported similar CP digestibility of various silages. Furthermore, Ruiz et al. (1992) reported that ensilation of fodders rather improved digestibility of fiber fractions due to fermentative decomposition of cell wall. Torotich (1992) reported that depression in hemicellulose and cellulose digestibility of silage may be due to lower ruminal pH, which depressed the growth of cellulolytic bacteria in the rumen.

Milk yield and composition

Four percent fat corrected milk (4% FCM) yield was significantly different ($p<0.05$) between fodder and silage-based diets but was non-significant between LS and BS diets (Table 4). Higher milk yield with fodder based diet was because of more digestible nutrient intake (Table 3) compared with silage based diets. Total solids of milk were significantly ($p<0.05$) higher in animals fed silage-based diets as compared to those fed fodder based diets. The increased TS were due to increased milk fat content. Chamberlain and Roberston (1992) reported that acetate is a major end product of lactate fermentation therefore; the conversion of lactic acid content of silage-based diets to acetate might have improved the milk fat contents in the present experiment. Milk CP, TP and NPN and SNF did not

Table 4. Milk yield and composition in *Nili* buffaloes fed experimental diets

Items	Diets[1]			SE
	BF	BS	LS	
Milk yield (kg/day)	8.74[a]	7.82[b]	7.79[b]	0.58
Milk fat (%)	5.60[b]	6.52[a]	6.72[a]	0.13
Solids not fat (%)	9.38	9.34	9.40	0.07
Total solids (%)	15.0[b]	15.7[a]	16.1[a]	0.18
Crude protein (%)	4.08	3.99	3.99	0.15
True protein (%)	3.18	3.16	3.19	0.11
Non protein nitrogen (%)	0.90	0.82	0.80	0.19

[1] BF, BS and LS diets contained 75% Berseem fodder, Berseem and Lucerne silages, respectively; [2]Milk yield was calculated as 4% fat corrected fat corrected milk.

[a-c] Means in a same row with different superscripts are significantly different (p<0.05).

show any treatment effect (Table 3). Similarly milk CP may be attributed to the similar CP contents of all experimental diets. These findings were consistent with Sutton (1989) and Khorasani et al. (1993) who reported no change in milk protein percentage when cows were fed diets containing similar CP content.

CONCLUSION

The berseem and lucerne fodder ensiled at 30% DM with 2% molasses could safely replace the conventional leguminous fodder (75% DM) in the diets of lactating *Nili* buffaloes.

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