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Feeding Value of Jambo Grass Silage and Mott Grass Silage for Lactating *Nili* Buffaloes

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ABSTRACT : This study was conducted to evaluate the feeding value of jambo grass (*Sorghum bicolour×Sorghum sudanefe*) silage and mott grass (*Pennisetum purpureum*) silage as a replacement of conventional fodder (jambo grass) in the diet of lactating *Nili* buffaloes (*Bubalus bubalis*). Thirty early-lactating (45±4 days), multi-parous *Nili* buffaloes, ten in each group, were allotted to three experimental diets. Jambo grass and mott grass were ensiled with molasses (at 2% of fodder DM) in two trench silos for 30 days. The control diet (JG) contained 75% jambo grass while the other two diets contained 75% jambo grass silage (JGS) and 75% mott grass silage (MGS). The remaining 25% DM in each diet was supplied by concentrates. Diets were mixed daily and fed twice a day *ad libitum* for 120 days. Dry matter intake (DMI) was higher with the JG diet compared with JGS and MGS diets. However, DMI as % body weight did not differ significantly in buffaloes fed either fodder or silage based diets. Crude protein (CP), digestible CP and NDF intakes were significantly higher on JG compared with silage-based diets. Apparent total tract digestibilities of DM, CP and NDF were similar in buffaloes fed JG, JGS and MGS diets. Milk yield (4% FCM) was similar in buffaloes fed JG and silage based diets. Fat, total solids, solid not fat, CP, true protein and non-protein nitrogen content of milk were similar in buffaloes fed fodder or silage based diets. The present results indicated that jambo grass and mott grass ensiled with 2% molasses for 30 days could safely replace the conventional fresh grass fodder (75% DM) in the diet of lactating *Nili* buffaloes without affecting their milk yield. (**Key Words :** Jambo Grass, Mott Grass, Silage, Digestibility, Milk Yield, Buffalo)

INTRODUCTION

Supply of quality fodder in ample quantities is imperative for dairy production. In South Asia, the area under fodder production has reduced over the years because of ever-increasing demand for cereals from an escalating human population (Sarwar et al., 2004; Khan et al., 2006a). Extremes of summer and winter seasons further exacerbate the availability of green fodder in the region and thus render the dairy buffalo poor producers (Sarwar et al., 2005). The decline in green fodder availability is one of the major concerns impeding milk yield of buffaloes and cattle in south Asia (Khan et al., 2004, 2006b). Preservation of surplus fodder during high fodder availability periods (February to March and August to September) could regularize the fodder supply during fodder scarcity periods (May to July and November to December) in the region. However, few attempts have been made to ensile locally available fodders and scientific literature is limited on the effects of ensiled fodders on the productivity of buffaloes. Further, because of continuous use of fresh green fodders over the years through the "cut and carry system", dairy farmers in south Asia believe in a myth that feeding silage could hamper buffalo productivity (Khan et al., 2006c).

Preservation of fodder is achieved through ensiling under anaerobic conditions where microbes use the fermentable sugars in fodder to produce organic acids, mainly lactic acid (Bolsen et al., 1996). The most widely ensiled fodder is maize (Sarwar et al., 2006), however, oat, sorghum, barley, millet grasses can also be ensiled (Sarwar et al., 2005).

Mott grass (MG) and jambo grass (JG) are highly nutritious, multi-cut hybrid fodders and have recently received much attention in South Asia. These fodders maintain their quality over long re-growth periods and could be ensiled to improve fodder supply (Sarwar and Nisa, 1999). For better preservation, the fodder must have high

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Table 1. Chemical composition (mean±SD) of jambo grass (JG), mott grass (MJ), jambo grass silage (JGS) and mott grass silage (MGS) on a dry matter basis

Chemical composition (%)	JG[1]	MG[1]	JGS[2]	MGS[2]
pH	DN	DN	3.76±0.12	4.05±0.11
Lactic acid	DN	DN	3.90±0.10	3.95±0.13
Dry matter	22.0±2.3	28.0±3.6	27.5±1.2	20.0±2.0
Crude protein	10.9±0.5	11.9±0.9	9.55±1.4	11.5±1.3
True protein	7.6±0.8	8.8±0.6	6.9±0.4	7.3±0.6
Neutral detergent fiber	75.2±3.8	76.8±3.2	70.0±2.1	72.0±1.8
Acid detergent fiber	39.7±2.0	47.0±2.4	42.0±1.3	48.0±1.6
Acid detergent lignin	4.29±0.6	4.32±0.2	5.40±0.2	5.70±0.3
Cellulose	35.4±2.2	29.8±2.5	35.0±1.1	46.0±1.4
Ash	8.59±0.7	11.9±0.3	9.50±0.6	11.0±0.5

[1] JG and MG were harvested at 50 days of age for ensiling.
[2] JGS and MGS were ensiled with molasses (at the rate of 2% of fodder DM) in two trench silos for 30 days.
DN = did not determine.

concentrations of fermentable carbohydrates, low buffering capacity, relatively low DM content (20-30%) and adequate lactic acid bacteria. However, JG and MG fodders contain low concentrations of fermentable carbohydrates (Nisa et al., 2005) and thus various additives like molasses (Bolsen et al., 1996; Khan et al., 2006a) and crushed grains (Sarwar et al., 2005) can be used as a source of fermentable sugars to achieve better fermentation and preservation.

Our previous *in vitro* and *in situ* studies (Nisa et al., 2005) have indicated that ensilation of MG and JG with 2% molasses for 30 days best preserves these fodders. However, scientific information regarding dietary effects of MG and JG silages on feed consumption, digestibility and milk yield in buffaloes is limited. Therefore, the present study was conducted to examine the influence of MJ and JG silages on nutrient intake, digestibility and milk yield in *Nili* buffaloes (*Bubalus bubalis*).

MATERIALS AND METHODS

Fodders and silages

Mott grass cuttings and JG seeds (Imperial Chemicals Industry, Pakistan Limited) were sown in the fields of the Animal Nutrition Research Center, University of Agriculture, Faisalabad, Pakistan. Both grasses were analysed for their chemical composition at various stages of growth (data not shown). Between 50 to 60 days of age both grasses were selected for ensiling based on their CP and DM contents. Samples of each fodder at 50 days of age were dried at 55°C and ground to a particle size of 2 mm through a Wiley mill for chemical analysis. The DM of MG and JG samples was determined by drying at 105°C for 4 h followed by equilibration in a desiccator (AOAC, 1999), and organic matter (OM) was calculated as weight loss upon ignition at 600°C. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents in both fodders were determined with the ANKOM fiber analyzer using reagents described by Van Soest et al. (1991). The N contents of both fodders were determined by a Kjeldahl method (AOAC 1999). Chemical analysis of MG and JG harvested at 50 days for ensiling is presented in Table 1. Jambo grass harvested after 50 days was used in the control diet as a forage source in the subsequent feeding trial.

Jambo grass and MG fodders were ensiled separately with molasses at 2% of DM for 30 days. Each fodder was chopped (3 cm) using a locally manufactured chopper. Chopped fodder was filled into cemented trench silos (8×4×2 m) and it was pressed properly to remove air and thereby attain anaerobiasis. Each silo was covered with a 10 cm thick layer of rice straw, followed by a polyethylene film. The polyethylene film was then plastered with a blend of wheat straw and mud (5 cm thick) to avoid any cracking while drying. It was presumed that the plastic sheet and mud plastering provided anaerobic conditions for proper silage making.

After opening these silos, silage pH was recorded using a pH-mV meter (HM-21P, TOA Corporation, Japan). Lactic acid in MG and JG samples was determined in aqueous extracts by means of a GLC with a semi-capillary FFAP (nitroterephthalic acid-modified polyethylene glycol) column (Hewlet-Packard, Germany), over a temperature range of 45 to 230°C. True protein (TP) was estimated by multiplying TCA insoluble-N×6.25. The mott grass silage (MGS) and jambo grass silage (JGS) samples were analyzed for DM, N, NDF, ADF, cellulose, ADL, and total ash using methods described above. When silage was used, the polyethylene sheet was removed, and silage was withdrawn starting with the upper layer and working downwards to the lower layers. After an amount of fermented fodder was taken out from each pit, just sufficient for one day's feeding, the polyethylene film was put back to keep the pit sealed. Chemical composition of MGS and JGS is presented in Table 1.

Table 2. Ingredients and chemical composition of experimental diets on a dry matter basis

Ingredients (%)	Diets[1]		
	JG	JGS	MGS
Fodder[2]	75.0	-	-
Silage[3]	-	75.0	75.0
Rice polishing	3.60	3.25	3.75
Wheat bran	5.00	5.00	5.00
Maize gluten meal 30%	6.40	6.35	6.25
Maize oil cake	2.50	2.50	2.50
Canola meal	2.50	2.50	2.50
Cane molasses	4.00	4.00	4.00
Mineral Mixture	1.00	1.00	1.00
Urea	-	0.40	-
Chemical composition (%)			
Dry matter	44.3	40.1	42.6
Crude protein	12.7	12.7	12.5
Neutral detergent fiber	62.8	58.8	66.4
Acid detergent fiber	32.4	34.0	41.6
Hemicellulose	30.4	24.7	24.8
Cellulose	27.5	27.2	37.1
Acid detergent lignin	3.43	4.26	4.49
Ash	8.88	9.50	10.2
NE_L[4] (Mcal/kg)	1.33	1.32	1.33

[1] JG (control). JGS and MGS diets contained 75% dry matter from jambo grass (JG) fodder, jambo grass silage (JGS) and mott grass silage (MGS), respectively.

[2] Jambo grass was harvested after 50 days of age for feeding.

[3] JGS and MGS were ensiled with molasses (at the rate of 2% of fodder DM) in two trench silos for 30 days.

[4] NE_L, Net energy for lactation was calculated using equation given in NRC (2001).

Animals and diets

Thirty early-lactating (45±14 days), multi-parous *Nili* buffaloes with similar body weight (481±30 kg) and milk yield (8.80±0.52 kg/day) were used. Three iso-nitrogenous and iso-caloric experimental diets were formulated using NRC (2001) standards for energy and protein. Jambo grass (control), JGS and MGS diets contained 75% DM from jambo grass (JG) fodder, jambo grass silage and mott grass silage respectively. The remaining 25% DM in each diet was supplied by the concentrates (Table 2). The three diets were allotted to 30 buffaloes at random (10 buffaloes/diet). Animals were housed on a concrete floor in separate pens. Fresh and clean water was made available round the clock in each pen throughout the experimental period. Diets were mixed daily and fed twice (06:00 and 18:00) a day *ad libitum* (10% feed refusal). The trial lasted for 120 days with the first 20 days for dietary adaptation and 100 days for sample collection. Daily feed intake and milk production were recorded and averaged over 100 days.

Buffaloes were milked twice daily, and individual milk yields were recorded. Milk samples were collected at two consecutive milkings (pm and am) fortnightly with a 12 h interval, preserved in 2-bromo-2-nitro-propane-1-3-diol and kept refrigerated (6°C) until analysis (Johnson et al., 1999). Total-N in milk was estimated by a Kjeldhal method (AOAC, 1990). Milk CP content was calculated as %N multiplied by 6.38. Milk TS were determined by heating a milk sample on a steam bath (10-15 minutes), followed by heating at 98-100°C for 3 h in a hot air oven (AOAC, 1990). Milk fat was determined using fat extraction tubes following the method of Roese Gottlieb (AOAC, 1990). Solids-not-fat was calculated as the difference of TS and milk fat. Fat corrected milk (FCM; 4% fat) was calculated as described by Tyrrell and Reid (1965) using the equation: 4% FCM = milk (kg/d)×(44.01×milk fat%+163.56)/339.60. Total milk ash was determined by incineration at 550°C (AOAC, 1990). Milk samples were de-proteinized with sulfosalicylic acid and MUN was determined by a diacetyl monoxime assay on a Skalar SAN Plus segmented flow analyzer (Skalar, Inc., USA). In this method, urea was measured by an enzymatic reaction (modified Berthelot reaction) that splits urea to ammonia that is quantified colormetrically (De Jong et al., 1992).

During the last week of the study, a digestibility trial was conducted as described by Khan et al. (2004). Fecal grab samples were taken twice daily such that a sample was obtained for every 3 h interval of a 24 h period (8 samples) between morning and evening feedings (Sarwar et al., 1991). The acid insoluble ash was used as a digestibility marker (Van Keulen and Young, 1977). Feed offered and orts were sampled daily and composited by animal for analysis. Feed, orts, and fecal samples were also analyzed for DM, N, ash contents NDF, ADF and ADL by methods described above.

Statistical analysis

The data collected on different parameters (feed intake, digestibility, milk yield, and milk composition) were analyzed according to a Completely Randomized Design using SAS (1988). 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).

When there was a significant ($p<0.05$) difference between treatment means, the Duncan's Multiple Range test was applied (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Chemical composition of JG, MG, JGS and MGS is given in Table 1. The pH and lactic acid contents of both silages indicated good preservation of JG and MG crops. The DM, CP and fiber fractions were not reduced when MG

Table 3. Nutrient intakes and total tract apparent digestibilities in buffaloes fed jambo grass (JG), jambo grass silage (JGS) and mott grass silage (MGS) based diets

Parameters	Diets[1]			SE	p values
	JG[2]	JGS[3]	MGS[3]		
DM intake (kg/day)	13.3[a]	12.5[b]	12.03[b]	0.11	0.020
DM intake (%body weight)	2.86	2.69	2.57	0.28	0.112
Apparent DM digestibility (%)	56.7	55.1	54.6	0.89	0.231
CP intake (kg/day)	1.74[a]	1.63[b]	1.57[c]	0.02	0.012
Apparent CP digestibility (%)	71.3	71.13	71.42	0.72	0.091
NDF intake (kg/day)	8.35[a]	7.32[c]	7.99[b]	0.07	0.017
NDF digestibility (%)	48.5	47.8	47.4	2.31	0.094
Digestible nutrients intake (kg/day)					
Dry matter	7.54[a]	6.86[b]	6.57[b]	0.11	0.014
Crude protein	1.24[a]	1.16[b]	1.13[b]	0.02	0.021
Neutral detergent fiber	4.05[a]	3.50[c]	3.79[b]	0.19	0.013

[1] JG (control), JGS and MGS diets contained 75% dry matter from jambo grass (JG) fodder, jambo grass silage (JGS) and mott grass silage (MGS), respectively.
[2] Jambo grass was harvested after 50 days of age for feeding.
[3] JGS and MGS were ensiled with molasses (at the rate of 2% of fodder DM) in two trench silos for 30 days.
Means in the same row bearing different superscripts are significantly (p>0.5) different.
SE = Standard error among means.

and JG were ensiled for 30 days with 2% molasses. Addition of corn starch or molasses to MG at ensiling time possibly improved the availability of fermentable sugars for anaerobic fermentation (Nisa et al., 2005). Higher lactic acid content and corresponding lower pH of oat grass ensiled with cane molasses were attributed to the availability of easily fermentable sugars for better growth of lactic acid producing bacteria (Sarwar et al., 2005; Bureenok et al., 2005). This drop in pH could prevent nutrient losses because of stability of the fermented medium. Khan et al. (2006a) reported that higher DM, protein and fiber fractions in OG ensiled with molasses were probably a result of the reduced activity of plant microbial enzymes attributable to an early drop in pH and stability of the medium compared with OG ensiled without molasses.

Feed intake

Dry matter intake (DMI) and digestible DMI were higher (p>0.05) in buffaloes fed the JG diet compared with those fed JGS and MGS diets (Table 3). However, DMI as a percent of body weight was similar in buffaloes fed either fodder or silage based diets. The DMI in buffaloes was similar with both silage-based diets. Low DMI with silage-based diets possibly occurred because of the presence of fermentation products (Thomas and Thomas, 1985). The DMI of silage is negatively correlated with silage pH, concentration of acids (Rook and Thomas, 1982) and moisture content (NRC, 2001; Sarwar and Hasan, 2001). Crude protein and digestible CP intake were also higher (p>0.05) in buffaloes fed the JG diet compared with the silage-based diets (Table 3). Excessive degradation of CP to NPN during ensiling might be a reason for low CP intake when silage based diets are fed to lactating buffaloes (Ruiz et al., 1992). In the present study the concentration of CP in all diets and CP digestibility were similar, thus the significant reduction in CP intake was possibly because of the significant variation in DMI and NPN content of the silages. The NDF intake was significantly (p>0.05) different in lactating buffaloes fed the experimental diets (Table 3). The NDF intake (NDFI) was higher in buffaloes fed JG diets than in those fed silage-based diets. A similar trend was noticed for digestible NDFI in buffaloes fed either fodder or silage based diets. The differences in NDFI may be attributed to the variations in DMI and NDF contents in the experimental diets and fermentation of fodder (Bolsen et al., 1996). Previous studies (Torotich, 1992; Rooke, 1995) reported depressed DM and NDF intake in cattle fed silage-based diets because of low ruminal pH and reduced digestibility. However, in the present study the digestibility was similar across experimental diets and thus the silage moisture content might have depressed the intake when silage based diets were fed to lactating buffaloes (Dado and Allen, 1995).

Digestibility

Total tract apparent digestibilities of DM, CP and NDF were similar in buffaloes fed JG, MGS or JGS diets (Table 3). Contrary to the results of the present study Waldo and Jorgensen (1981) reported higher digestibility of forage-based diets. Nisa et al. (2005) also reported higher ruminal degradability of MGS and attributed this to fermentation of MG during ensiling. However, Torotich (1992) reported that the depression in digestibility of silage-based diets was due to lower ruminal pH, which might have depressed the growth of cellulolytic bacteria in the rumen. In the present study the higher intake of the JG diet compared to MGS and

Table 4. Milk yield and milk composition of buffaloes fed jambo grass (JG), jambo grass silage (JGS) and mott grass silage (MGS) based diets

Parameters (%)	Diets[1]			SE	p values
	JG[2]	JGS[3]	MGS[3]		
Milk yield, 4% FCM[4] (kg/day)	10.3	9.55	9.48	1.05	0.151
Milk fat	5.81	5.90	5.70	0.09	0.062
Solids not fat	9.17	9.10	9.19	0.11	0.187
Total solids	15.0	15.0	14.9	0.16	0.364
Crude protein	3.55	3.56	3.57	0.13	0.392
True protein	3.33	3.19	3.19	0.13	0.071
Non-protein nitrogen	0.22	0.37	0.38	0.15	0.074

[1] JG (control), JGS and MGS diets contained 75% dry matter from jambo grass (JG) fodder, jambo grass silage (JGS) and mott grass silage (MGS), respectively.

[2] Jambo grass was harvested after 50 days of age for feeding.

[3] JGS and MGS were ensiled with molasses (at the rate of 2% of fodder DM) in two trench silos for 30 days.

[4] Fat corrected milk was calculated as described by Tyrrell and Reid (1965) using equation; 4% FCM = milk (kg/d)×(44.01×milk fat% −163.56)/339.60.

SE = Standard error among means.

JGS might have mitigated (evened out) such effects on total tract apparent nutrient digestibility. Higher intake increases the rate of passage of digesta and thus reduces the digestibility of feed (Khan et al., 2006c). Similar total tract apparent digestibilities were reported previously by Sarwar et al. (2005) when they fed oat grass and its silage to lactating buffaloes.

Milk yield and its Composition

Milk yield (4% FCM) was similar in buffaloes fed JG and silage based diets (Table 4). These results were consistent with the findings of Ruiz et al. (1992) and Khorasani et al. (1993) who reported that milk yield (4% FCM) was not affected by diet type having similar digestibilities. Milk fat, TS, SNF, milk CP, TP and NPN values were also similar in buffaloes fed grass or silage-based diets (Table 4). Similar milk yield by buffaloes fed either oat grass or its silage was attributed to the similar diet digestibilities that probably provided the same amount of nutrients for the synthesis of milk (Khan et al., 2006b). Depressed milk fat (Man and Wiktorsson, 2001; Sarwar et al., 2005) and higher milk NPN content (Sarwar et al., 2005) were reported previously with silage-based diets in buffaloes. Sarwar et al. (2005) explained that depressed ruminal pH could reduce ruminal acetate production and that probably depressed milk fat in buffaloes fed silage-based diets. However, such effects were not observed in the present study when buffaloes were fed the JGS based diet. JGS contained urea that was added to make experimental diets iso-nitrogenous and this probably mitigated the negative effects of low pH related to silage feeding on ruminal acetate concentration and milk fat content in buffaloes.

CONCLUSIONS

The jambo grass and mott grass ensiled with 2% molasses for 30 days in cemented trench silos could safely replace the conventional grass fodder (75% DM) in the diets of lactating *Nili* buffaloes without any ill effects on nutrient digestibility and milk yield.

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