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EFFECT OF UREA-MOLASSES BLOCK SUPPLEMENTATION ON NUTRIENT DIGESTIBILITY AND INTAKE OF AMMONIATED MAIZE STOVERS IN COW-CALVES

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ABSTRACT

An experiment was conducted in a 4x4 Latin square design with four cow-calves (Holstein Friesian, aged 6-8 months) to investigate the effect of supplementing molasses-urea block (MUB) to untreated or ammoniated maize stovers on feed intake and *in vivo* digestibility of nutrients. Each period consisted of 10 days adaptation, followed by five days data collection. The four diets were untreated maize stovers (Diet A), untreated maize stovers with MUB (Diet B), ammoniated maize stovers (Diet C) and ammoniated maize stovers with MUB (Diet D). Daily consumption of maize stovers and total feed by the calves were higher ($P<0.001$) on the diets containing ammoniated maize stovers than those containing untreated maize stovers. Ammoniation increased the intake of maize stovers by 61%. Supplementary feeding of MUB did not change the daily intake of both untreated and ammoniated maize stovers. Calves receiving untreated maize stovers consumed more MUB ($P<0.001$) than those given ammoniated maize stovers (496.40 vs 180.20g DM/d). Daily water consumption was affected ($P<0.001$) by diets and was lowest on Diet A. Calves receiving ammoniated maize stovers consumed more water than those given untreated maize stovers. MUB increased ($P<0.001$) the water consumption only on untreated maize stovers. Mean water consumption was 13.93, 15.91, 15.07 and 15.60 lit/d on diets A, B, C and D, respectively. *In vivo* digestibility of dry matter, organic matter and crude protein were influenced ($P<0.001$) by diet composition. Among the four diets, dry matter digestibility was minimum ($P<0.001$) on Diet A and remained the same on diets B, C and D (55.82, 58.02 and 58.14%, respectively). Organic matter and crude protein digestibility were higher in the claves receiving ammoniated maize stovers. Supplementation of MUB increased ($P<0.001$) the digestibility of all the three nutrients in untreated maize stovers but did not affect the digestibility of ammoniated maize stovers. The results demonstrated that MUB supplementation might not be required when calves are fed ammoniated maize stovers.

Key words: Molasses Urea Blocks, ammoniation, maize stovers; *in vivo* digestibility, feed intake, calves.

INTRODUCTION

Low animal productivity during dry season is commonly observed due to inadequacy of quality feed. Straw and other agro-industrial by-products have been used as a basal feed for ruminants for many years in Pakistan. Cereal straws are deficient in critical nutrients and cannot meet nutrients requirement of the animals without supplementations.

Maize stovers form a good source of bulk feed in ruminant rations, but their utilization in terms of total feed intake and digestibility is poor. Niazi (1998) estimated annual availability of 3.85 million tones of maize stovers in Pakistan and these as livestock feed, contribute 0.173 million tones crude protein (CP) and 1.694 million tones total digestible nutrients (TDN).

Many attempts have been made to improve the nutritive value of cereal straws through chemical, physical and biological treatments. Among these, ammoniation through urea-treatment has been found relevant to farming system in Pakistan. Urea treatment increases the CP contents and digestibility of the straw and as a result feed intake of the animals is generally increased. Most of the work on urea treatment in the past has been done with cereal straws and limited information on urea treatment of maize stovers is traceable.

Supplementation of poor quality roughages for deficient nutrients is recognized as appropriate approach to increase their utilization as an animal feed. Feeding of molasses-urea block (MUB) has been widely advocated as a useful supplementary strategy that provides critical nutrients for optimizing rumen

fermentation in animals fed poor quality roughages (Preston and Leng, 1984; Habib *et al*., 1991). Both on-station and on-farm research has revealed that MUB feeding significantly increased growth rate and milk production in ruminants fed low quality roughages (Habib *et al*., 1991). However, response to MUB was less marked when the animals were fed good quality forages (Saeed *et al*., 2002). Information on interactive effect of feeding ammoniated crop residues with MUB supplementation is scarce. The present study was, therefore, designed to investigate the effects of ammoniation or supplementation of MUB on feeding value of maize stovers when given alone or in combination to growing calves.

MATERIALS AND METHODS

Animals and experimental diets

This study was conducted in a 4x4 Latin square design, involving four cow calves and four diets (A, B, C and D). Each experimental period consisted of 10 days adaptation, followed by five days data collection. Four cow calves (Holstein Friesian) of 6 to 8 months age and weighing about 80 kg were used in the study. They were kept in individual pens with separate arrangements for feeding, watering and faeces collection.

The following diets were fed to the experimental calves:

Diet A.	Untreated maize stovers (control)
Diet B.	Untreated maize stovers + MUB
Diet C.	Ammoniated maize stovers
Diet D.	Ammoniated maize stovers + MUB

Chopped maize stovers of about 1.5 cm particles were used in all the four diets fed *ad libitum*. The MUB were prepared by mixing molasses (40%), urea (10%), calcium hydroxide (8%), clay (10%), sodium chloride (4%), minerals (5%) and wheat bran (23%). Ingredients were thoroughly mixed in warm molasses and molded to rectangular blocks of an average weight of 3 kg. The blocks were left for 24 h to solidify before feeding.

Ammoniation of maize stovers

Thirty-three kg of urea was dissolved in 200 liters of water and was sprinkled on 650 kg of chopped stovers. After thorough mixing, the stovers were stacked and covered with a plastic sheet to make it airtight. After four weeks, the stack was opened from one side, the required quantity of treated stovers were removed from the stack about 30 minutes before feeding, and spread in open air for about 10-15 minutes to get rid of pungent smell.

Feeding

The calves were stall fed individually once a day throughout the experimental period. They were gradually adapted to their respective diets during first 10 days of each experimental period. The refusals of maize stovers fed *ad libitum* (i.e., 10% in excess of the previous day consumption) was recorded daily during the last five days to estimate feed intake. Representative samples of feed offered and refused were analyzed for dry matter contents. Pre-weighed MUB were placed in feeding troughs and were available to the calves for free licking round the clock. Weight of MUB was recorded daily to estimate daily intake of the blocks. Similarly, known volume of water was offered four times a day and the left over was measured to calculate daily consumption. Nutrients composition (AOAC,1990) of untreated and ammoniated maize stovers and MUB is given in Table 1.

Table 1: Dry matter, ash and crude protein contents of feeds

Feed	Dry matter (DM,%)	Ash (% in DM)	Organic matter (% in DM)	Crude protein (% in DM)
Untreated maize stovers	89.93	8.13	91.87	4.91
Ammoniated maize stovers	69.87	7.84	92.16	9.49
Molasses urea block	87.20	39.61	60.39	33.97

In Vivo digestibility of nutrients

During the last five days of each experimental period, digestibilities of dry matter (DMD), organic matter (OMD) and crude protein (CPD) were measured through daily collection of faeces, as described by Saeed *et al*. (2002). Samples of feed and faeces were analyzed for dry matter, ash and crude protein with the procedures of AOAC (1990).

Statistical analysis

The date were statistically analyzed with the standard procedure of analysis of variance according to the Latin Square Design, as described by Steel and

Torrie (1981). The main factors were diets, periods and animals. The means were compared for significance of difference with the LSD procedure (Steel and Torrie, 1981). A statistical package (SAS, 1999) was used to perform the statistical analysis.

RESULTS AND DISCUSSION

Feed intake

Results on daily feed intake by the calves are summarized in Table 2. The daily dry matter intake (DMI) of maize stovers and total feed were significantly higher (P<0.001) in the calves receiving ammoniated maize stovers (diets C and D) than those given untreated maize stovers (diets A and B). Ammoniation increased (P<0.001) the intake of maize stovers from 1715.79 g/d on Diet A to 2778.65 g/d on Diet C. Zorrilla-Rios *et al.* (1985), Schiere *et al.* (1989) and Liamas-Lamas and Combs (1990) reported similar increases in DMI of cereal straw due to ammoniation in cattle and sheep and such effect was attributed to chemical changes in treated plant material and alteration of rumen turn over rate in the animal (Horton, 1978; Horton and Steacy, 1979). Reid *et al.* (1979) reported that increased fragility in ammoniated straw made the particles more susceptible to mechanical fracture during chewing and rumination. Nevertheless, the present results suggested that higher DMI of stovers was associated with improved DM digestibility in the calves.

Molasses-urea block feeding did not change the daily consumption of maize stovers on both ammoniated and untreated maize stovers (Table 2). Total DMI was increased (P<0.05) when MUB was offered with untreated maize stovers but did not change in response to MUB feeding with ammoniated stovers. Failure of MUB to increase the daily intake of untreated maize stovers does not agree with Sudana and Leng (1986), Sansoucy *et al.* (1987), Habib *et al.* (1991) and Shahab-ud-din (1992), who reported higher intake of basal diets in steers, calves, and sheep with MUB supplementation. In the present study, calves unexpectedly consumed large quantities of MUB (496.40 g DM/d on Diet B), which may have caused substitution effect on voluntary intake of maize stovers. In fact the daily intake of maize stovers tended to be 8% higher on Diet B than Diet A but the difference did not qualify statistical significance. The consumption of MUB by animals fed Diet D, containing ammoniated maize stovers was low (180.20 g DM/d) and did not improve the DMD and OMD of the diet. These observations agree with Schiere *et al.* (1989), who did not find any effect of MUB on the intake of ammoniated rice straw in male calves.

Intake of Urea Molasses Block

As shown in Table 2, the daily intake of MUB was higher (P<0.001) in the calves receiving untreated maize stovers than those given ammoniated maize stovers (496.40 verses 180.20 g DM/d). Daily consumption of MUB in calves varying from 150 to 300 g/d has been reported by Tiwari *et al.* (1989), Habib *et al.* (1991) and Garcia and Restrepo, (1995). Such variation in MUB intake in animals has been related to composition and texture of the blocks and to the eating behavior of the animals (Sansoucy *et al.*, 1987; Habib *et. al.*, 1991). In the present study, the MUB were hard, yet the calves consumed large quantities of the block. Moreover, the calves quickly adapted to MUB licking over 5-7 days. The present findings clearly showed that quality, especially nitrogen contents of basal diet, was a major factor affecting daily consumption of MUB in the claves.

Water consumption

Daily water consumption by the calves was minimum (P<0.05) on Diet A containing untreated maize stovers with no MUB. Among the four diets, water intake significantly varied (P<0.01) from 13.93 to

Table 2: Daily feed and water consumption of calves fed untreated or ammoniated maize stovers supplemented with or without molasses-urea block (MUB)

Diets	Maize stovers (g DM/d)	MUB (g DM/d)	Total feed (g DM/d)	Water (lit/d)
Untreated maize stovers (Diet A)	1715.5^{b}	-	1715.79^{c}	13.93^{b}
Untreated maize stovers + MUM (Diet B)	1815.93^{b}	496.40^{a}	2348.33^{b}	15.91^{a}
Ammoniated maize stovers (Diet C)	2778.65^{a}	-	2778.65^{a}	15.07^{a}
Ammoniated maize stovers + MUB (Diet D)	2674.66^{a}	180.20^{b}	2854.86^{a}	15.60^{a}

Means with different superscripts in the same column are different (P<0.05).

Table 3: *In vivo* digestibility (%) of dry matter, organic matter and crude protein in calves fed untreated or ammoniated maize stovers supplemented with or without molasses urea block (MUB)

Parameters	Untreated maize stovers (Diet A)	Untreated maize stovers + MUB (Diet B)	Ammoniated maize stovers (Diet C)	Ammoniated maize stovers + MUB (Diet D)	CV (%)
Dry matter	43.67[b]	55.82[a]	58.02[a]	58.14[a]	13.57
Organic matter	55.06[c]	62.58[a]	65.70[a]	65.73[a]	9.04
Crude protein	28.84[c]	58.95[b]	64.28[a]	62.61[a]	27.99

Means with different letters in the same row are significantly different (P<0.05).

15.91 lit/d (Table 2). Calves receiving ammoniated maize stovers consumed more water (P<0.05) than those given untreated maize stovers. As compared to Diet A, MUB feeding increased (P<0.05) water intake to the same extent when fed with untreated maize stove (Diet B) or ammoniated maize stovers (Diet D). There was a positive correlation (r = 0.62, P<0.001) between dietary nitrogen intake and water consumption similar to that reported earlier by Saeed *et al.* (2002). Church and Pond (1984) suggested that greater consumption of nitrogen might lead to increased water requirements due to high urinary nitrogen excretion through kidneys.

***In Vivo* digestibility of nutrients**

The experimental diets significantly affected the digestibility of dry matter (P<0.001), organic matter (P<0.001) and crude protein (P<0.05). Among the four diets, DMD remained lowest (P<0.05) on Diet A and was the same on diets B, C and D (Table 3). Both OMD and CPD were higher (P<0.05) on diets containing ammoniated maize stovers. Supplementation of MUB consistently increased (P<0.05) DMD, OMD and CPD on untreated maize stovers but did not influence these parameters on diets containing ammoniated maize stovers. The analysis of variance revealed significant effect of treatment (P<0.001), MUB (P<0.001) and treatment X MUB (P<0.001) on DMD, OMD and CPD.

The present findings agree with Oliveros *et al.* (1993), who also reported that ammoniation significantly increased DMD of maize stovers. Such effect could be attributed to increased solubilization of hemicelluloses and breaking of lingo-cellulose bonds (Baldwin *et al.*, 1977; Jackson, 1978; Steeter and Horn, 1980).

A 28% increase in DMD due to MUB when supplemented to untreated maize stovers agrees with Habib *et al.* (1991), who reported that *in sacco* DMD of wheat straw in buffalo steers increased by 11.59% in response to MUB supplementation. Recently, Saeed *et al.* (2002) found that *in vivo* DMD of maize stovers increased by 27% with MUB supplementation in sheep. The positive effect of MUB on digestibility may be attributed to supply of nitrogen, energy and minerals for stimulating microbial activity in the rumen (Leng and Nolan, 1984; Garg *et al.*, 1992).

Failure of MUB to increase DMD and OMD in calves receiving ammoniated maize stovers (Diet D) suggested that MUB supplementation was not required when animals received ammoniated maize stovers. It is assumed that fermentative digestion in the rumen of the calves fed ammoniated maize stovers was already optimum which could not be further improved with feeding. The optimum level of CP in treated maize stovers (9.49% in DM; Table 2) suggested that ammonia was presumably not limiting rumen digestibility in the calves and excluded the need for further N from MUB. In consensus to the present results, Badurdeen *et al.* (1994) also failed to find any difference in DMD due to MUB in bulls fed ammoniated rice straw.

These results show that the feeding value of maize stovers could be improved through ammoniation or MUB supplementation and both strategies were equally effective in improving the digestibility of maize stovers in the calves. Further studies are required to investigate economics and growth responses in calves to such diets.

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