FEEDING RICE STRAW SUPPLEMENTED WITH UREA-MOLASSES LICK BLOCK TO LACTATING COWS IN BHUTAN

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Summary

Twelve cross bred cows (300 ± 20 kg) were fed a basal ration consisting of 1 kg concentrate and untreated or urea treated rice with or without urea-molasses-wheat bran lick block supplementation. The lick blocks were prepared locally using cement as a binding agent. The experiment lasted for 48 days consisting of a preliminary period of 14 days and a measurement period of 34 days. Daily dry matter intake (DMI) of straw and lick block, and daily milk yield were recorded during the measurement period. Intake of lick block when fed with untreated straw (US) was significantly higher ($p < 0.01$) than with urea treated (TS) straw (397 vs 307 g 100 kg^{-1}), but lick block supplementation did not significantly affect the intake of US (1.80 vs 1.83 kg 100 kg^{-1} day^{-1}) or TS (2.27 vs 2.17 kg 100 kg^{-1} day^{-1}). Both urea treatment and lick block supplementation significantly increased ($p < 0.01$) the milk yield of cows, and the increase due to urea treatment was higher than that due to lick block supplementation. Benefit/cost ratio obtained for feeding US or TS with 1 kg dairy concentrate was similar (5.4), but the marginal return favours TS (5.4:1.0). The benefit/cost ratio for US and TS supplemented with lick block was 3.4 and 3.7, respectively, but the marginal return with US was higher than with TS (1.6:1.0 and 0.9:1.0, respectively).

(Key Words: Rice Straw, Urea Treatment, Lick Block, Cows)

Introduction

Like in most developing countries, feed shortage is one of the main constraints in Bhutan's livestock development. In Bhutan, ruminants are traditionally fed on natural community pastures, fallow lands and are also given straw. The problem becomes more critical during winter season (5-6 months cold period), during which there is no green matter and animals have to depend on old standing hay from natural pastures, fallow lands and/or paddy straw (Dorji, 1987). To overcome the livestock feed problem, several attempts has been made by the department, such as introduction of pasture and fodder tree development, urea treatment of straw and methods of fodder conservation to farmers through extension programs. Attempts have been made in Bhutan to manufacture molasses-urea blocks as an alternative supplement feed for cattle (van Wageningen et al., 1985; Premasiri, 1985).

Molasses provides the animal with readily fermentable carbohydrates which might enhance the digestion of fibre in the rumen (Dixon, 1986). Besides that it is also rich in minerals. Feeding molasses-urea mixture in liquid form is less practical and uneconomical to farmers in developing countries, due to high cost and difficulty in handling molasses in liquid form. Solidifying of molasses is a way of solving the problem of transportation, distribution and feeding to animals (Sansoucy et al., 1988). The use of molasses-urea lick block to provide nutrients and its manufacturing has been described by several authors (Leng and Preston, 1983; Kunju, 1986; Sansoucy, 1986; Schiere et al., 1989).

The objective of this study was to evaluate the performance of lactating cows fed untreated or urea treated rice straw with or without urea molasses block supplementation.

Materials and Methods

Block formulation and manufacture

The composition of the block used in the present study is given in table 1. Molasses (40 kg) was heated to 70℃ and while stirring crushed urea (10 kg) was added. Once the urea dissolved, salt (5 kg) and mineral mixture (5 kg) was added and mixed thoroughly. Cement (12 kg) was used as

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a binding agent in the form of paste (cement:water ratio of 3:1 by weight). Finally, wheat bran (28 kg) was added and thoroughly mixed till the whole mixture was of a uniform colour. The mixture was moulded in a wooden frame of 1 m × 1.2 m × 0.7 m which was divided into block size partitions of 20 cm × 15 cm × 7 cm. Blocks remained in the box for at least 48 hours after which they were sun dried for two successive days before covering with plastic.

Neither the degree of Brix of the molasses nor the hardness of the block was measured due to lack of measuring equipment. The hardness of the blocks was determined subjectively by pressing with hand after sun drying for two days. The blocks which passed the hardness test (no impression of hand on block) were used for feed intake trial.

TABLE 1. COMPOSITION OF THE LICK BLOCK

Ingredients	(%, by weight)
Molasses	40
Wheat bran	28
Urea	10
Common salt	5
Mineral mixture	5
Cement	12

Treatments

The basal diets used in this study were either untreated or urea ammonia treated rice straw. The rice straw was collected from farmers around the farm. Urea ammonia treated straw was prepared by spraying urea solution (4 kg urea dissolved in 100 litres of water per 100 kg air dry straw) onto straw. While spraying the straw was thoroughly mixed and stored under airtight conditions for 2 weeks. After 2 weeks the straw was fed to animals.

The straw diets were offered *ad libitum*, and all animal were given 1 kg/day commercial dairy concentrate in the morning (08:00 H). The lick block was placed on one side of the feed trough so that animals can lick free of choice. Animals had free access to drinking water.

Animals and experimental design

Twelve cross bred (Indigenous × Jersey) cows (mean live weight 300 ± 20 kg) were selected from a dairy herd at the National A.I. & Semen Processing Centre, Wangchutaba farm. The cows were housed in a shed with a concrete floor and provided with individual feed troughs. Everyday for 2 hours (12:00 14:00 H) the animals were kept in an outside pen for sunshine and exercise.

The design used was stratified completely randomized design. The 12 cows were blocked into 3 groups based on their milk production (high, medium and low). The cows in each production class were randomly allocated to the 4 experimental diets (untreated straw without lick block; untreated straw with lick block; treated straw without lick block; treated straw with lick block).

Measurements

The experiment lasted for 48 days consisting of 14 days adaptation period and 34 days of measurement period. Individual straw dry matter intake and lick block dry matter intake was measured during the last 34 days. The dry matter (DM) intake of each animal was determined by measuring the straw offered and refused each day. The DM content of straw offered and refused was determined by drying in a forced draft oven at 70°C for 24 hours.

Lick blocks of known weight were offered and daily intake was determined by weighing once in 24 hours (at 07:00 H). The difference in weight was recorded as daily fresh intake. Samples from the same batch of lick blocks were crushed and oven dried at 70°C to determine dry matter intake. Daily milk yield of individual cows was measured by milking the cows twice daily (07:00 H and 16:00 H).

Sub samples of straw, lick block and concentrate were dried, ground and analyzed for dry matter, ash and crude protein (AOAC, 1981).

Statistical analyses

Dry matter intake of straw and lick block, and milk yield were analyzed using the analysis of variance statistical package (Brouwer, 1986). Treatment (US/TS) and lick block (−/+) were taken as main factors and dry matter intake of straw and lick block was used as covariates.

Economic analysis

Economic evaluation was based on the total cost of production (lick blocks, basal diets and supplements) and returns from daily milk yield. The cost of untreated straw was valued at 0.05 Nu kg^{-1}, and urea treated straw at 0.15 Nu kg^{-1}.

Manufacturing cost of lick block including profit margin was fixed at 2.44 Nu kg^{-1}, and the price of dairy concentrate was 2.60 Nu kg^{-1}. Input costs are calculated based on the amount of fresh feed consumed. Milk price paid to farmers was 7.00 Nu per litre.

Results and Discussion

The chemical composition of lick block, untreated and treated straw and the concentrate used in the experiment is given in table 2. The crude protein contents of the dairy concentrate and the lick block used were 19 and 43%, respectively. The use of 12% cement as a binding agent to manufacture lick block resulted in blocks of the required hardness and also did not cause any health problems with the cows. The 12% used in this experiment is equivalent to 0.99-1.97% of the total feed intake, and is well within the 1-3% (of total feed intake) level recommended by Sansoucy et al. (1988).

The intake of straw, lick block and concentrate together with milk yield is presented in table 3. Intake of lick block when fed with untreated straw (US) was significantly higher ($p < 0.01$) than with urea treated (TS) straw (397 vs 307 g 100 kg^{-1}). The lick block intake found in our study is much higher than those reported from Sri Lanka (155 -226 g 100 kg^{-1}; Badurdeen et al., 1993; Schiere et al., 1989) and India (151-187 g 100 kg^{-1}; Kunju, 1986). However, Schiere et al. (1989) reported that the intake of lick block was 40% more with US straw diets as compared to TS diets, and is in agreement with the 30% increase found in our study.

With both US and TS diets, lick block supplementation showed no significant effect on straw intake. Supplementation with lick block marginally increased the intake of US (1.80 vs 1.83 kg 100 kg^{-1} day^{-1}), while it decreased the intake of TS (2.27 vs 2.17 kg 100 kg^{-1} day^{-1}). Several other workers have also found no effect on the intake of basal ration as a result of urea-molasses or lick block supplementation (Church and Santos, 1981; Dixon, 1984; Schiere et al., 1989), whereas others found increased intakes (Ernst et al., 1975; Losada et al., 1979; Sudana, 1985; Kunju, 1986; Badurdeen et al., 1993). Kunju (1986) reported an increase in intake of straw from 4.4 to 5.7 kg day^{-1} when he replaced 1 kg concentrate with 560 g lick block, while intake of straw marginally increased from 6.4 to 6.8 kg day^{-1} when lick block was offered with a ration which included 1 kg concentrate. The results of our study are in agreement with the findings of Kunju, (1986) and Sansoucy et al.

TABLE 2. CHEMICAL COMPOSITION (DRY MATTER BASIS) OF EXPERIMENTAL DIETS

Feed stuff	Dry matter (%)	Crude protein (%)	Ash (%)
Untreated straw	92.3	4.4	13.6
Treated straw	61.3	7.0	14.1
Lick block	88.1	43.1	23.8
Dairy concentrate	87.3	19.3	16.1

TABLE 3. MEAN DAILY DRY MATTER INTAKE (DMI) AND MILK PRODUCTION

Treatment	DMI (per 100 kg LW)		Milk yield	Milk production
	Straw (kg)	Lick block (g)	(kg cow^{-1} day^{-1})	per kg straw (kg)
Untreated straw				
Without lick	$1.80^{a} \pm 0.31$	–	$2.2^{a} \pm 1.15$	1.22
With lick	$1.83^{a} \pm 0.30$	$397^{a} + 121$	$3.0^{b} \pm 1.21$	1.64
Treated straw				
Without lick	$2.27^{b} \pm 0.32$	–	$3.3^{bc} \pm 1.21$	1.45
With lick	$2.17^{b} \pm 0.38$	$307^{b} + 130$	$3.6^{c} \pm 1.50$	1.66

Within columns, figures with dissimilar superscripts are significantly different ($p < 0.01$).

TABLE 4. BENEFIT: COST RATIO AND MARGINAL RETURNS OF EXPERIMENTAL DIETS (1 US $ = 16 Bhutanese Nu)

	Feed	Intake (fresh basis) (kg)	Feed* cost (Nu)	Income from milk (Nu)	Benefit/ Cost ratio	Marginal return**
Untreated straw						
Without lick (−)	Straw	5.86	0.29	15.54	5.38	
	Conc.	1.00	2.60			
With lick (+)	Straw	5.97	0.30	21.00	3.36	
	Lick	1.37	3.34			
	Conc.	1.00	2.60			
Lick + vs. Lick −						1.61 : 1.0
Treated straw						
Without lick (−)	Straw	11.1	1.66	22.96	5.39	
	Conc.	1.00	2.60			
With lick (+)	Straw	10.6	1.59	25.20	3.74	
	Lick	1.04	2.54			
	Conc.	1.00	2.60			
Lick + vs. Lick −						0.90 : 1.0
Treated vs. Untreated straw						5.42 : 1.0

* Untreated straw = 0.05 Nu/kg; Treated straw = 0.10 Nu/kg; Concentrate = 2.60 Nu/kg; lick block = 2.44 Nu/kg.

** Increased return/Increased cost.

(1988). They reported that the effect of lick block supplementation on intake of straw based ration was more pronounced (25-30% increase) when no other concentrates are offered with the basal ration, and the increase in marginal (5-10%) when it is fed together with concentrates high in protein. These effects could not be explained due to confounding of possible stimulation of straw intake by lick block and substitution of straw by concentrate. However, in experiments where roughage has consisted of only cereal straw or low quality hay, stimulation in roughage intake by supplements can be usually attributed to addition of nitrogen (Crabtree and Williams, 1971; McLennan et al., 1981).

Urea treatment significantly increased ($p < 0.01$) straw dry matter intake from 1.80 to 2.27 kg 100 kg^{-1} day^{-1}. Urea treatment can improve feeding value of rice straw by increasing feed intake (Jaiswal et al., 1983, Wanapat et al., 1982), by increasing its digestibility (Saadullah et al., 1981; Wanapat et al., 1984) or by a combinations of these effects (Doyle et al., 1986; Schiere et al., 1989). In our study, even though digestibility measurements was not made due to lack of facilities, the increase in milk production achieved could be partly due to such effects.

Both urea treatment and lick block supplementation significantly increased ($p < 0.01$) the milk yield of cows. However, the increase due to urea treatment was higher (increase of 1.1 kg cow^{-1} day^{-1}) than that due to lick block supplementation (increase of 0.8 kg with US and 0.3 kg with TS diets). Also, the increase in milk production between the animals fed US with lick block and those fed TS without lick block was similar. Feeding urea treated straw with lick block supplementation increased milk yield by 1.4 kg cow^{-1} day^{-1}. The data indicates that the effect of lick block on milk yield is greater with US diets than with TS diets taking all other conditions being similar. Sansoucy et al. (1988) concluded that addition of lick block to straw based diets reduced the amount of concentrate needed by about 1.5 kg cow^{-1} day^{-1}, while the milk yield increased by 25 to 30%.

Benefit/cost ratio and the marginal returns for

the different treatment groups are given in table 4. Even though the ratio obtained for feeding US or TS with 1 kg dairy concentrate was similar (5.4), the amount of milk produce per kg straw (table 3) was 20% higher for the TS group as compared to the US group (1.45 vs 1.22). Although the benefit/cost ratio was similar for both US and TS diets supplemented with lick block, the marginal return (increased return/increased cost) was higher with US (1.62:1.0) than with TS (0.9:1.0). Economics of feeding dairy cows are very much depended on cost of basal diet, type and level of supplementary feeding, and price of milk. The price ratios of straw to supplements are even more important, and it has been shown that cheap rations may not always give financially attractive gains (Schiere and Ibrahim, 1989). The second most important factor is the production level of the cows. At increasing levels of production, the amount of supplement required also increase, thus making savings of concentrate or lick block possible by using larger amounts of US or TS. In a more elaborate economic calculation (Schiere and Ibrahim, 1989) clearly showed that in Sri Lanka for low-producing animals (milk production less than 4 litres per day) a US ration needs only minor supplementation and therefore becomes cheaper, and at higher levels (8 litres per day) of production savings on supplements resulting from higher intake of better quality TS over US becomes apparent. In Bhutan, the cost of 1 kg crude protein from concentrate and lick block is 13.68 Nu and 5.67 Nu, respectively. As such, there seems to be an economic advantage in using lick block as a protein supplement. Unfortunately due to the inclusion of a dairy concentrate (which was more expensive than lick block) in the diets, the effects are not evident.

Conclusions

1. The intake of straw and milk production was higher for TS than US and although the benefit/cost are the same, feeding TS produced 20% more milk per kg straw. Lick block supplementation increased milk production on US but not on TS.

2. The milk production of cows fed US with lick block was similar to those fed TS without lick and although the marginal return was moderate (1.6:1.0) in the former, it does show a 34% increase in milk production/kg straw.

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