Effect of Restricted and *Ad libitum* Feeding of Urea Molasses Liquid Diet (UMLD) on the Performance of Adult Crossbred Cattle

U. R. Mehra[1], A. K. Verma and R. S. Dass
Nuclear Research Laboratory, Indian Veterinary Research Institute,
Izatnagar-243 122 (U.P.), India

ABSTRACT : To compare response of feeding concentrate mixture and wheat straw (Group I) with either urea molasses liquid diet (UMLD) as sole ration (group II) or UMLD (similar to protein equivalent of concentrate mixture) plus wheat straw (group III) on intake and utilisation of nutrients and overall performance, twelve crossbred adult male cattle (Holstein Friesian × Hariana) aged about 2.5 years and weighing 342 kg were randomly allotted into three equal groups following completely randomised design and fed respective diets for a period of 60 days. Thereafter, a metabolism trial of seven days duration was conducted to assess nutrient utilisation and nitrogen balance. Animals fed UMLD as sole ration consumed significantly ($p < 0.01$) less amount of most of the nutrients as compared to other two groups, except crude protein, intake of which was higher in this group but it was comparable between II and III and III and I. On the other hand, digestibilities of nutrients were higher ($p < 0.01$) in group II, though it was comparable between other two groups, except ADF, the digestibility of which was lower in group II. Inspite of positive nitrogen balance in all the three groups, being significantly ($p < 0.01$) higher in group I, animals of group II and III lost their body weight especially to the utmost extent in group II, although the amount of energy (TDN) intake were similar statistically. Results indicate that during a scarcity period and economic compulsions, feeding of UMLD can be practised to replace only concentrate mixture from the maintenance ration of adult crossbred cattle for shorter duration as roughage part seems to be essential for the normal functioning of the rumen microbes and overall performance of the animals.
(**Key words**: Urea Molasses Liquid Diet, Crossbred Cattle, Restricted Feeding Nutrient Utilisation)

INTRODUCTION

In India, drought and floods are common features leading to shortage of feeds and fodders for livestock, which has an adverse impact on animal production. Sugarcane molasses, which is available in many countries like India, has been used widely as the main feed source for beef cattle (Preston and Willis, 1974; Preston and Leng, 1987). However, its inclusion at higher levels in the diet of ruminants leads to toxicity resulting in digestive disturbances, nervous symptoms, blindness, damage to the brain (Rowe et al., 1979) thereby reduces animal production (Karalazos and Swan, 1976). Soluble carbohydrates given at moderate levels increase the amount of readily fermentable energy in the diet, improve the utilisation of nitrogen in the rumen especially the nitrogen of the NPN compound like urea and may increase outflow rate of digesta (Stern and Hoover, 1979; Huhtanen, 1987; Rooke et al., 1987; Khalili and Huhtanen, 1991). On the other hand, soluble carbohydrates at higher levels have been found to have negative effect on fibre digestibility (England and Gill, 1985) and forage intake (Lofgreen and Otagaki, 1960a,b; Ahmed and Key, 1975).

Feeding urea molasses liquid diet (UMLD) as a sole diet has been reported to disturb nutrient utilisation and growth performance in crossbred heifers (Verma et al., 1995) and growing Murrah buffaloe heifers (Sengar et al., 1995), may be due to the absence of fibre component in the diet. Dass et al. (1996) observed good response of UMLD feeding in adult buffaloes in respect of nutrient utilisation and rumen fermentation pattern, when a little amount of wheat straw was incorporated in the diet. However, no systematic study has been carried out to develop a suitable way of feeding UMLD. Therefore, the study reported herein was conducted to compare the utilisation of nutrients in adult crossbred cattle fed UMLD as a sole diet and along with wheat straw.

[1] Address reprint requests to U. R. Mehra.
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MATERIALS AND METHODS

A study was carried out on twelve adult male crossbred (Holstein friesian × Hariana) cattle aged about 2.5 years, divided into three groups of four animals each following completely randomised design. Animals in group I (control) were fed on a concentrate mixture and wheat straw as per Kearl (1982). Concentrate mixture consisted of ground nut cake, wheat bran and crushed maize in equal proportions and 2 kg mineral mixture and 1 kg common salt were also added per 100 kg feed. Animals in group II were fed *ad libitum* UMLD (molasses, urea, protein pellets, mineral mixture (containing Ca, P, I, Cu and F 28.4, 14.9, 0.031, 0.12 and 0.38 percent, respectively) and phosphoric acid, 84, 3, 10, 2 and 1 part, respectively), whereas, animals in group III were given wheat straw *ad libitum* and UMLD to provide crude protein equivalent to concentrate mixture in group I. High protein pellets, which were part of the UMLD, were offered separately as a source of bypass protein. Vitablend as a source of vitamin A and D_3 was also added 25 g per 100 kg feed in all the three diets. This feeding practice continued for a period of 60 days thereafter, a metabolism trial of seven days was conducted to study the nutrient digestibility and nitrogen balance. Samples of feed, faeces and urine were analysed for chemical composition (AOAC, 1980). Fibre fractions, neutral detergent fibre (NDF) and acid detergent fibre (ADF), in feed and faeces were determined as per the method of Van Soest et al. (1991). Fortnightly body weights were recorded to assess body weight change. The data were analysed statistically following one way analysis of variance (ANOVA) technique and treatment means were compared for significance using Duncan's multiple range test (Snedecor and Cochran, 1967).

RESULTS

The chemical composition of ration ingredients is shown in table 1. Nutrient intake through different dietary ingredients and their digestibilities are presented in table 2. Mean intake of dry matter, organic matter, total carbohydrates (TCHO) and NDF were significantly ($p < 0.01$) lower and their digestibility were higher in group II as compared to group I and III. Significantly ($p < 0.01$) increased CP intake was observed in group II as compared to group I, while its digestibility was significantly ($p < 0.01$) higher in group II as compared to other two groups. Intake of ether extract was significantly ($p < 0.01$) higher in group I than groups II and III, whereas, its digestibility differed significantly ($p < 0.01$) among the groups. The trend of ADF intake was similar to NDF but its digestibility was significantly ($p < 0.01$) lower in group II as compared to other two groups.

Change in body weight and plane of nutrition of animals are given in table 3. Results indicated that animals of group I maintained their body weight and showed a gain of 5 kg during experimental period, while a significant ($p < 0.01$) loss in body weight was observed in animals of groups II and III. The animals of all the three groups did not consume dry matter as per the recommendations of Kearl (1982). It was 84.0, 53.7, 81.7 percent of the requirements for groups I, II and III, respectively, indicating a significantly ($p < 0.01$) higher DM intake in groups I and III than group II. The CP intake as percent of requirement in groups I, II and III was 98.6, 137.7, 113.2, respectively, showing a significantly ($p < 0.01$) higher intake in group II than I. Intake of TDN in respective groups was 99.8, 81.3 and 94.0 percent suggesting no statistical difference among the groups.

Table 1. Chemical composition of feed ingredients

Attributes	UMLD	Protein Pellets*	Concentrate mixture	Wheat straw
Organic matter	88.70	87.67	93.04	91.47
Crude protein	17.22	31.82	16.30	3.40
Ether extract	0.33	3.98	3.51	1.17
Total carbohydrates	71.15	52.87	73.23	86.90
NDF	–	50.11	34.71	74.87
ADF	–	7.97	16.32	53.85
Calcium	1.80	1.10	1.00	0.40
Phosphorus	0.50	1.00	0.60	0.05

* Pellets consisted of deoiled rice bran, mustard oil cake (MOC), deoiled MOC, deoiled ground nut cake, jowar, malt sprout, rice polish, maize gluten, guar corma, cotton seed meal, molasses, wheat bran, mineral mixture and common salt, 2, 11, 23, 7, 10, 3, 6, 3, 9, 8, 10, 4, 2 and 2 parts, respectively.

Table 2. Nutrient intake and digestibility in various groups

Attributes	Group I	Group II	Group III
Nutrient intake (g/day)			
Dry matter, through:			
Wheat straw	2,747.5±442.58	–	2,517.5±367.91
UMLD	–	2,590.0±229.64	1,900.0± 0.00
Protein pellets	–	470.0± 0.00	235.0± 0.00
Concentrate mixture	2,042.5±146.49	–	–
Total intake	4,790.0±505.85[b]	3,060.0±229.64[a]	4,652.5±367.91[b]
Organic matter	4,357.7±448.52[b]	2,709.4±203.68[a]	4,194.0±336.52[b]
Crude protein	426.3± 31.78[a]	595.5± 39.56[b]	487.6± 12.5[ab]
Ether extract	103.8± 8.32[b]	27.3± 0.77[a]	45.2± 4.30[a]
Total carbohydrates	3,883.3±428.89[b]	2,092.2±162.56[a]	3,662.4±319.26[b]
NDF	2,766.0±349.87[b]	235.5± 0.00[a]	2,002.7±275.44[b]
ADF	1,812.9±246.49[b]	37.5± 0.00[a]	1,374.4±198.11[b]
Digestibility (%)			
Dry matter	54.5± 1.54[a]	74.7± 2.35[b]	54.2± 3.39[a]
Organic matter	57.3± 1.03[a]	76.6± 2.27[b]	58.0± 3.22[a]
Crude protein	46.7± 1.83[a]	61.6± 1.15[b]	45.4± 3.78[a]
Ether extract	67.5± 2.31[c]	83.1± 1.31[b]	52.7± 1.98[a]
Total carbohydrates	58.8± 1.45[a]	80.9± 2.66[b]	59.8± 3.29[a]
NDF	48.7± 1.69[a]	65.0± 3.49[b]	49.5± 1.00[a]
ADF	39.9± 1.13[b]	32.0± 1.73[a]	40.1± 3.03[b]

Values bearing different superscripts in a row differ significantly: $p < 0.01$.

Table 3. Body weight change and plane of nutrition in adult crossbred cattle

Attributes	Group I	Group II	Group III
Initial body weight (kg)	341.3± 21.07	341.8± 16.41	342.0± 10.65
Final body weight (kg)	346.8± 25.27	294.3± 17.85	338.5± 9.31
Body weight gain/loss (kg)	+5.5± 4.33[a]	−47.5± 1.50[b]	−3.5± 3.17[c]
Dry matter intake			
g/day	4,790.0± 505.85[b]	3,060.0±229.64[a]	4,652.5±367.91[b]
g/kg $W^{0.75}$	59.5± 5.37[b]	43.7± 4.61[a]	58.5± 3.53[b]
Crude protein intake			
g/day	426.3± 31.78[a]	595.5± 39.56[b]	487.6± 12.50[ab]
g/kg $W^{0.75}$	5.3± 0.19[a]	8.5± 0.83[b]	6.2± 0.06[ab]
Energy intake			
TDN intake (g/day)	2,594.3± 288.72	2,114.9±208.49	2,447.6±158.86
TDN intake (g/kg $W^{0.75}$)	32.2± 3.04	30.2± 3.72	31.0± 1.49
ME (kcal/day)	9,391.4±1,045.17	7,655.9±754.73	8,860.3±575.07
ME (g/kg $W^{0.75}$)	116.6± 11.00	109.3± 13.47	112.2± 5.39
Nutrient density of diet			
CP (g/kg diet)	90.4± 5.32[a]	195.1± 1.89[b]	106.4± 5.61[a]
ME (kcal/kg diet)	1,956.1± 15.57[a]	2,489.4± 72.54[b]	1,915.0±104.52[a]
Energy : Protein ratio	21.9± 1.40[b]	12.8± 0.47[a]	18.1± 0.92[b]

Values bearing different superscripts in a row differ significantly: $p < 0.01$.

Table 4. Intake and balance of nitrogen

Attributes	Group I	Group II	Group III
Nitrogen intake (g/day)	68.2 ± 5.08[a]	95.3 ± 6.32[b]	78.3 ± 2.00[ab]
Nitrogen excretion			
Faeces (g/day)	36.7 ± 1.66	36.6 ± 2.48	42.9 ± 3.72
Urine (g/day)	24.3 ± 2.40[a]	58.4 ± 5.10[b]	34.3 ± 1.85[a]
Nitrogen absorbed (%)	46.7 ± 1.83[a]	61.6 ± 1.15[b]	45.4 ± 3.78[a]
Nitrogen balance (g/day)	7.7 ± 2.96[a]	0.5 ± 3.21[a]	0.8 ± 0.82[b]

Values bearing different superscripts in a row differ significantly: $p < 0.01$.

Intake and balance of nitrogen in three groups are presented in table 4. Nitrogen intake was significantly higher in group II than I while its intake was similar in groups II and III. Animals in all the three groups were in positive nitrogen balance being highest in group I.

DISCUSSION

The failure of animals in consuming the dry matter to their requirements could be due to the hot humid climate resulting in heat stress which adversely affects the dry matter consumption of crossbred animals (McDonald et al., 1981). However, significantly ($p < 0.01$) lower dry matter intake in group II as compared to other two groups may be attributed to either lack of fibre content in the diet (Campling, 1966; Aitchison et al., 1986) and higher nutrient density (McDonald et al., 1981) or physical characteristics of molasses (Karalazos and Swan, 1976) which is highly palatable and increases feed intake when fed at low levels, while it is unacceptable at high levels in the diet (Lofgreen, 1965). Significantly ($p < 0.01$) higher intake of crude protein in group II due to *ad libitum* UMLD feeding which contained 3 percent urea resulted in significantly ($p < 0.01$) higher digestibility due to high degradability of urea in the rumen which was the main source of protein in this group. Similar findings were reported earlier in adult buffaloes (Dass et al., 1996) and in growing crossbred heifers (Verma et al., 1995). Increased digestibility of crude protein with an increase in crude protein intake was also observed by Kurar (1977) and Sharma and Jhanwar (1973) in buffaloes and cattle, respectively. Due to high intake of molasses, the intake of total carbohydrates was significantly ($p < 0.01$) lower in *ad libitum* UMLD fed group. However, its digestibility was highest because of its high digestible carbohydrate content. Similar findings were noticed in growing crossbred heifers (Verma et al., 1995). The intake of NDF and ADF were similar and significantly higher in groups I and III than group II in which the protein pellets were the only source of fibre. Significantly ($p < 0.01$) higher digestibility of NDF in group II as compared to other two groups is probably due to the high digestibility of NDF in the protein pellets. On the other hand, the digestibility of ADF was lowest in group II. A similar digestibility of fibre fractions in group I and III suggests that wheat straw added to UMLD based ration was digested to the same extent with that of control diet as also reported earlier by Mehra et al. (1994) and Dass et al. (1996) in growing heifers and adult male buffaloes, respectively.

Nitrogen excreted through faeces was similar in all the three groups but urinary excretion was significantly ($p < 0.01$) higher in animals of group II owing to high intake of urea which is easily degraded and absorbed but remained unutilized in this group. Similarly, Lassiter et al. (1958) reported higher urinary nitrogen excretion with an increase in nitrogen intake through urea in cattle. Animals in groups II and III showed marginal positive nitrogen balance, but they lost their body weight especially to the utmost extent in group II, although the amount of energy (TDN) intake was similar statistically. The probable reasons are either significantly ($p < 0.01$) lower energy: protein ratio (table 3), less though insignificant intake of TDN/ME (kcal) and more nitrogen used as energy or imbalanced digestion of organic matter and crude protein in UMLD fed groups. Similarly, highly positive nitrogen balance accompanied with loss in body weight were observed in adult buffaloes fed UMLD as a sole ration (Dass et al., 1996).

Results indicate that during a scarcity period and economic compulsions, feeding of UMLD can be practised to replace only concentrate mixture from the maintenance ration of adult crossbred cattle for shorter duration as roughage part seems to be essential for the normal functioning of the rumen microbes and overall performance of the animals.

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