Effect of Different Source of Energy on Urea Molasses Mineral Block Intake, Nutrient Utilization, Rumen Fermentation Pattern and Blood Profile in Murrah Buffaloes (*Bubalus bubalis*)

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ABSTRACT : In order to investigate the effect of different sources of energy on intake and nutrient utilization from urea molasses mineral block (UMMB), rumen fermentation pattern and blood biochemical constituents, 18 intact and 9 rumen fistulated male Murrah buffaloes aged about 3 years and average weight 310.8 kg were randomly allocated into three groups of 9 animals in each, thus each group having 6 intact and three rumen fistulated buffaloes. All animals were fed individually for 90 days. All buffaloes were offered wheat straw as basal roughage and urea molasses mineral block for free choice of licking. Three different energy sources viz., barley grain, (group I), maize grain (group II) and jowar green (group III) were offered to meet their nutrient requirement as per Kearl (1982). At the end of feeding trial, a metabolism trial of 7 days duration was carried out on intact animals to determine the digestibility of nutrients. Rumen fermentation studies were carried out on rumen fistulated animals. After the metabolism trial blood was collected from intact animals to estimate the nitrogen constituents in blood serum of animals fed on different sources of energy. Results revealed no significant difference in the intake of UMMB in three groups. Similarly, the intake of DM (kg), DCP (g) and TDN (kg) per day was similar in three groups statistically. The apparent digestibility of dry matter (DM), organic matter (OM), ether extract (EE) and nitrogen free extract (NFE) was significantly ($p<0.05$) more in group II than group III, whereas the digestibility of DM, OM and NFE was similar in group I and II. The digestibility of crude fiber (CF) and all the fiber fractions i.e. NDF, ADF, cellulose and hemicellulose was alike in 3 groups. Nitrogen balance (g/d) was significantly ($p<0.05$) more in group III as compared to group I and II, which were alike statistically, though the N intake (g/d) was similar in 3 groups but N balance (g/d) was significantly ($p<0.05$) less in group III as compared to other 2 groups. Significantly ($p<0.05$) higher concentration of total volatile fatty acids (TVFA), total nitrogen (TN) and its fractions were observed in group I and II as compared to group III. There was no effect on rumen pH, rumen volume and digesta flow rate due to different sources of energy in 3 groups. Similarly the blood serum biochemical parameters (NH_3-N, urea-N and total protein) were statistically identical in 3 groups. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 6 : 818-822)***

Key Words : Urea Molasses Mineral Block, Nutrient Utilization, Rumen Fermentation Pattern, Blood Profile, Murrah Buffaloes.

INTRODUCTION

Ruminants in third world countries including India are fed on poor quality crop residues, which are not only deficient in nitrogen, minerals and vitamins, but also have poor digestibility due to the presence of lignin in them (Leng and Preston, 1983; Jayasuriya, 1987; Van Soest, 1994). Ruminants have the unique ability to convert NPN compounds in their diet to a microbial protein of high biological value. Keeping this fact in mind urea containing blocks known as urea molasses mineral block (UMMB) were developed to supplement the diet of ruminants fed on poor quality roughages (Garg and Gupta, 1992; Mehra et al., 1993; Hosamani et al., 1995; Toppo et al., 1997; Hosamani et al., 1998;Thu and Uden, 2000, 2001). The main problem with the supplementation of block lick is great diurnal variation in its lick by the animals (Leng, 1984; Neric et al., 1985; Singh and Mehra, 1986; Singh and Mehra, 1990; Mehra et al., 1993). This variation may be due to the composition and degree of hardness of the block (Sudana and Leng, 1980; Leng, 1984; Hande, 1989). It is not only the texture of the block but also the energy and protein content of the basal diet may also influence the daily block intake (Ali and Mirza, 1986). Therefore, present investigations were carried out to find the effect of same level of energy supplied through different sources on the UMMB intake, nutrient utilization, rumen fermentation pattern and blood biochemical constituents in adult male Murrah buffaloes fed UMMB along with wheat straw as a basal roughage.

MATERIALS AND METHODS

The study was conducted on 27 male Murrah buffaloes (*Bubalus bubalis*) of about 3 years of age, weighing about 310 kg, divided randomly into 3 groups of 9 animals in each. Out of these 27 animals, 9 were operated upon to make a permanent rumen fistula. Thus, each group was having 6 intact and 3 rumen fistulated animals. All the animals were offered wheat straw as basal roughage and UMMB for free choice of licking. In addition animals in 3 groups were given barley grain, maize grain and green

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Table 1. Chemical composition of feeds and fodder (% on DM basis)

Particulars	UMMB	Barley grain	Maize grain	Jowar green	Wheat straw
Organic matter	67.10	95.92	97.57	84.89	91.44
Crude protein	50.21	10.75	9.48	11.80	3.45
Ether extract	0.42	1.83	3.14	3.62	1.07
Crude fiber	1.52	6.88	2.51	24.25	35.51
Nitrogen free extract	14.95	76.46	82.46	45.22	51.41
Neutral detergent fibre	6.01	41.14	19.71	66.05	79.91
Acid detergent fibre	4.40	17.06	4.02	40.97	49.92
Cellulose	2.06	14.80	3.41	29.52	38.22
Hemicellulose	1.61	24.08	15.69	25.08	29.99

jowar to meet out their energy requirement (Kearl, 1982). The ingredient composition of UMMB was urea 15%, molasses 45%, mineral mixture 15%, cotton seed meal 10%, common salt 8%, calcite powder 4% and sodium bentonite 3%. During the experimental feeding period the animals were kept in sheds with cement floors and with individual feeding arrangements and during the digestion trial they were kept in metabolic crates. Clean drinking water was offered to all the animals at 9.00 and 15.00 h daily. The animals were weighed at the start and after every fortnight to assess the change in body weight. This feeding practice continued for a period of 40 days, at the end of which a metabolism trial of 7 days duration was conducted on intact animals to know the digestibility of nutrients.

During the collection period, feed intake and leftover were measured, samples of feed offered and residues left over were taken in separate polythene bags for each animal daily for chemical analysis. 24 h collection of faeces and urine was recorded at 10.00 h and a suitable aliquot of the thoroughly mixed faecal samples was taken for dry matter (DM) and nitrogen (N) estimation. Similarly, a suitable aliquot of urine was preserved in sulphuric acid for N excretion through urine. For chemical analysis, faecal material was dried at 60°C and ground to pass through a 1 mm screen in a wiley mill and preserved in air tight bottles. Feeds were also processed similarly for analysis. All the intact animals were bled by puncturing the Jugular vein before feeding and watering the animals after metabolism trial, serum was separated and stored frozen till analysis. Strained rumen liquor (SRL) was drawn for three consecutive days before feeding (oh) and at different intervals of time post-prandially (2, 4, 6, 8 h) with the help of metallic probes whose multiple holes were wrapped with nylon cloth and located at four different sites in the rumen after adapting the animals on this diet for 40 days. After 3 days sampling of SRL for rumen fermentation studies, Polyethylene glycol (PEG) 6,000 (60 g in 200 ml water) was infused into the rumen of all the fistulated animals with the help of a hard PVC rubber tubing having a funnel at the outer end and rumen liquor samples were collected at an hourly interval upto 8 h after infusion to determine the rumen fluid volume (Smith and McAllan, 1970). After measuring pH with a digital pH meter, SRL samples were acidified and frozen for further analysis.

Chemical analysis

Chemical composition of biological samples was determined using methods recommended by Association of Official Analytical Chemists (1985) and cell wall constituents (Van Soest et al., 1991). Hemicellulose and cellulose were calculated as NDF-ADF and ADF-ADL respectively. Total-N and its fractions in rumen liquor were estimated by micro-kjeldhal technique (AOAC, 1985) and total volatile fatty acids (TVFA) as per the method of Barnett and Reid (1957). Ammonia-N (NH_3-N) in rumen liquor and blood serum was estimated (Conway, 1957). Blood serum urea (Rahmatullah and Boyde, 1980) and total protein (Annino, 1976) were also estimated.

Statistical analysis

The data were subjected to test of significance between the different sources of energy using the analysis of variance technique (Snedecor and Cochran, 1967) and treatment means were compared using Duncan's multiple range test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The intake of urea molasses mineral block was statistically non-significant between groups, however it was increased from group I to III (table 2). It has been reported that the basal diet influenced the block intake, the maximum block intake was observed when animals were fed green fodder (Ali and Mirza, 1986) but present results were contrary to this as there was no statistically significant difference in block intake in group III, where the source of energy was green jowar. It may be due to the limited supply of DM through green jowar (990 g/d). The intake of dry matter, digestible crude protein and total digestible nutrients were statistically similar in all the three groups. The digestibility of dry matter and organic matter was significantly ($p<0.05$) higher in maize fed group than jowar green fed group. The availability of better fermentable energy (starch) from maize grain might have enhanced the

Table 2. Nutrient intake, digestibility and balance of nitrogen in buffaloes

Attributes	Group I	Group II	Group III
Body weight (kg)	315.33±18.91	311.33±12.17	306.0±6.81
Nutrients intake			
DM intake through			
UMMB (kg.)	0.476±35.82	0.483±25.10	0.498±29.26
Concentrate/Jowar green (kg.)	0.894±20.22	0.86±23.5	0.99±21.7
Wheat straw (kg.)	3.740±0.45	3.810±0.34	3.69±0.36
Total DM intake (kg)	5.11±0.60	5.15±0.46	5.18±0.46
DCP intake (g)	310.83±15.52	315.50±13.01	302.69±9.65
TDN intake (kg)	2.75±0.60	2.84±0.22	2.55±0.18
Nutrient digestibility (%)			
Dry matter *	54.49^{ab}±2.20	56.21^{a}±2.14	50.96^{b}±1.70
Organic matter *	57.68^{ab}±2.19	59.71^{a}±2.02	54.13^{b}±1.30
Crude protein	55.19±2.52	56.63±2.59	54.88±1.97
Ether extract *	56.00^{a}±1.49	66.73^{b}±2.43	51.37^{a}±1.44
Crude fiber	58. 34±2.76	60.15±1.78	59.70±1.56
Nitrogen free extract*	60.39^{a}±2.60	61.15^{a}±2.22	51.39^{b}±2.03
Neutral detergent fiber	51.77±2.04	53.83±1.86	50.94±1.44
Acid detergent fiber	48.60±2.23	46.21±1.95	48.93±.238
Cellulose	62.55±3.03	62.53±2.97	66.20±1.38
Hemicellulose	56.44±4.11	60.84±227	54.46±2.22
Nitrogen intake (g/d)	85.72±6.01	95.93±1.78	88.22±1.39
Excretion (g/d)			
Through faeces	39.03±7.30	45.39±0.27	39.79±0.76
Through urine*	21.03^{a}±2.65	27.06^{ab}±0.17	32.38^{bc}±2.26
Nitrogen balance (g) *	25.66^{a}±4.14	23.49^{a}±1.88	16.05^{b}±2.76

* ($p<0.05$); [a, b, c]: Figures bearing different superscripts in different rows differ significantly

digestibility of dry matter and organic matter when compared to green jowar feeding. Similar results have been reported by Kumar et al. (1984), Pate et al. (1985) and Mehra et al. (1991). The digestibility of ether extract was significantly ($p<0.05$) higher in maize grain fed group than barley grain and jowar green fed groups. The higher content of ether extract in maize grain might have digested better in the presence of urea molasses mineral block. Earlier report also indicated that increased level of protein in the diet increased the digestibility of ether extract (Mehra et al., 1991). The digestibility of nitrogen free extract in maize and barley grain fed groups was significantly ($p<0.05$) more over jowar green fed group. This is probably due to higher content of easily fermentable starch in maize and barley grains which might have been utilized better by the microbes in the presence of urea in the block. Similar results have been observed earlier (Tiwari, 1988; Mehra et al., 1991). The digestibility of crude protein, crude fiber and its constituents were non-significantly different between groups. The excretion of N through faeces was statistically alike in 3 groups whereas excretion of N through urine was significantly ($p<0.05$) more in group III as compared to group I, whereas group I and II, II and III had the similar urinary -N excretion. The nitrogen balance in maize and barley grain fed groups was significantly ($p<0.05$) improved over jowar green feeding. The easily fermentable source of energy in the form of starch in both the grains fed groups might have enhanced the utilization of urea from UMMB by the microbes in the rumen and in turn helped in the more nitrogen balance in the body (McLaren et al., 1965). Results of the present study are in accordance with the results of Pathak et al. (1984) and Mehra et al. (1991) in buffalo calves fed on similar diet. Rumen pH and ammonia nitrogen in rumen liquor, rumen fluid volume and its flow rate were slightly higher in green fed group than grains fed groups (table 3). The difference between groups was statistically non-significant. Slightly higher intake of UMMB and moisture content in green fodder could have increased the rumen pH, NH_3-N concentration, rumen fluid volume and its flow rate in group III as compared to other 2 groups. Similar results have been reported by Bhatia et al. (1980). Total and non-protein nitrogen concentration in rumen liquor was significantly ($p<0.05$) higher in jowar green fed group than both grain fed groups. It could be due to higher intake of UMMB and nitrate-N present in jowar fodder, whereas microbial protein and total volatile fatty acids were significantly ($p<0.05$) higher in groups fed with grains than green fodder. It clearly indicated that the microbes utilize the NH_3-N better in the presence of easily fermentable energy present in grains and yield higher microbial protein and energy (TVFA) for the host animal. Similar trend of results have been reported by Leng (1984),

Table 3. Rumen metabolites and blood biochemical constituents in buffaloes fed on different energy sources

Attributes	Group I	Group II	Group III
Rumen fermentation			
Rumen Fluid volume (litre)	62.03±1.08	65.90±2.80	68.93±2.00
Fluid flow rate (litre/hour)	3.63±0.70	3.66±0.21	3.85±0.55
pH	6.68±0.03	6.92±0.03	6.87±0.02
NH_3-N (mg/100 ml SRL)	18.13±0.81	18.94±1.09	19.03±0.97
Total –N (mg/100 ml SRL)*	50.56[a]±1.98	54.02[a]±1.52	57.65[b]±1.51
Microbial-N (mg/100 ml SRL)*	28.40[a]±2.32	29.01[a]±2.70	22.42[b]±2.50
NPN (mg/100 SRL)*	22.16[a]±1.80	25.01[a]±0.46	35.23[b]±0.21
TVFA (mM/100 ml SRL)*	10.33[a]±0.30	11.28[a]±0.46	8.25[b]±0.21
Blood serum constituents			
Serum NH_3-N (mg/100 ml)	1.37±0.25	1.38±0.23	1.26±0.21
Serum urea-N (mg/ 100 ml)	36.75±3.68	33.14±4.13	34.14±4.49
Serum total protein (g/ 100 ml)	7.05±0.55	7.16±0.18	6.90±0.34

* ($p<0.05$) ; [a, b, c]: Figures bearing different superscripts in different rows differ significantly

Mangat Ram and Kunju (1986) and Tiwari (1988). The blood biochemical constituents like serum NH_3-N, urea and total protein were similar in all the 3 groups and well within the normal physiological range. The serum total protein was slightly higher in grains fed group than green fed group indicating better utilization of UMMB.

It could be concluded that the urea molasses mineral block was utilized better in the presence of cereal grain maize followed by barley and jowar green fodder.

REFERENCES

Ali, A. and I. H. Mirza. 1986. Feeding of urea molasses block "buffaloes chocolate" to ruminants in the tropics. Asian Livestock, December, pp.160-164.

Annino, J. S. 1976. Determination of total proteins and albumins in serum. Clinic chem. Principles and Procedures, 4th edn., Little Brown and Company, Boston, pp.184-188.

AOAC. 1985. Association of Official Analytical Chemist, Official Methods of Analysis, 13th edn. Washington. D.C.

Barnett, A. J. G. and R. L. Reid. 1957. Studies on the production of volatile fatty acids from the grass by rumen liquor in an artificial rumen I. Volatile fatty acid production from grass. J. Agric. Sci. Camb. 48:315-321.

Bhatia, S. K., K. Pradhan and R. Singh. 1980. Rumen metabolic profile as influenced by dietary non-protein nitrogen and soluble carbohydrates. Indian J. Anim. Sci. 50:16-20.

Conway, E. S. 1957. Microdiffusion Analysis and Volumetric Error. Crossby Lockwood and Sons Ltd., University Press, Glasgow and London. pp.98-100.

Garg, M. R. and B. N. Gupta. 1992. Effect of supplementing urea molasses mineral block lick to straw based diet in DM intake and nutrient utilization . Asian-Aust J. Anim Sci. 5 (5):39-44.

Hande, P. S. 1989. Studies on the supplementation of cotton seed cake as an additive on a diet of urea-molasses mineral block and wheat straw in buffaloes. M.V.Sc. Thesis, Deemed University, IVRI, Izatnagar, India.

Hosamani, S. V., U. R. Mehra and R. S. Dass. 1995. Effect of dietary urea levels on intake of urea molasses mineral block (UMMB) and utilization of nutrients in adult buffaloes. Indian J. Anim. Nutr. 12:67-72.

Hosamani, S. V., U. R. Mehra and R. S. Dass. 1998. Effect of different planes of nutrition on urea molasses mineral block intake, nutrient utilization, rumen fermentation pattern and blood profile in Murrah buffaloes (Bubalus bubalis). Anim. Feed Sci. Technol. 76:117-128.

Jayasuriya, M. C. N. 1987. Improvement of Poor quality roughages. In: Advanced Animal Nutrition for Developing countries (Ed.U.B. Singh) Indo-vision Pvt. Ltd., Ghaziabad. pp.236-259.

Kearl, L. C. 1982. Nutrient Requirements of Ruminants in Developing Countries. International Feed Stuffs Institute, Utah State University, Logan, UT, p.82.

Kumar, N., U. R. Mehra, U. B. Singh and D. N. Verma. 1984. Effect of ammoniation of sugarcane bagasse and molasses supplementation on nutrient utilization in crossbred cattle. J. Vet. Physiol & Allied Sci. 3: 55-62.

Leng, R. A. 1984. The potential of solidified molasses based blocks for the correction of multi nutritional deficiencies in buffaloes and other ruminants fed low quality agro-industrial by products.In Use of Nuclear Techniques to Improve Domestic Buffalo Production in Asia. IAEA, Vienna. pp.135-150.

Leng, R. A. and T. R. Preston. 1983. Nutritional Strategies for the utilization of agro-industrial by products by ruminants and extension of the principles and technologies to the small farmers in Asia. Proc. 50th world conf. on Animal Production, Vol. 4, pp. 310-318.

Mangat Ram and P. J. G. Kunju. 1986. Effect of incorporating concentrate mixture with urea molasses mineral block feeding on rumen metabolites and digesta flow rate in buffalo calves. Indian J. Anim. Nutr. 3:244-248.

McLaren, G. S., G. C. Anderson, L. I. Tsai and K. M. Barth. 1965. Level of readily fermentable carbohydrates and adaptation of lambs to all urea supplemented rations. J. Nutr. 87: 331-336.

Mehra, U. R., J. Challa and U. B. Singh. 1991. Effect of supplementation of urea molasses mineral block and wheat bran in a wheat bhoosa based diet on growth performance and nutrient utilization in buffalo calves. Indian J. Dairy Sci. 44(8): 522-525.

Mehra, U. R., J. Challa and U. B. Singh. 1993. Nutrient utilization and rumen fermentation pattern in buffaloes fed rations supplemented with formaldehyde treated urea molasses mineral block. J. Appl. Anim. Res. 4:67-72

Neric, S. P., D. L. Aquino, P. C. Delacuz and S. K. Ranjhan. 1985. Effect of urea molasses mineral block lick on the performance of caracows (swamp buffaloes). Indian J. Anim. Nutr. 2:89-96.

Pate, F. M., P. M. Fairhurst and J. T. K. Munthali. 1985. Urea levels and supplemental energy sources in sugarcane diets, J. Anim. Sci. 61:252-259.

Pathak, N. N., S. K. Ranjhan and S. J. Daniel. 1984. Nutrient utilization and growth response of male buffalo calves fed ad-libitum urea molasses liquid feed with restricted oat forage and ground nut cake. J. Vety. Physiol. Allied Sci. 3 (1):31-35.

Rahmatullah, M. and T. R. C. Boyde. 1980. Improvements in the determination of urea using diacetyl monoxime method with and without proteinization. Clin. Chem. Acta. 107:3-9.

Singh, U. B. and U. R. Mehra. 1980. A preliminary note on the possibility of using cement and wheat flour as binding agents for preparing urea molasses block lick at ambient temperature. J. Vety. Physiol & Allied Sci. 5:43-44.

Singh, U. B. and U. R. Mehra. 1990. Utilization of ammoniated wheat straw given in a feed block and supplemented with varying quantities of fish meal and oil extracted rice bran. Anim. Feed Sci. Technol. 28: 129-134.

Smith, R. H. and A. B. McAllan. 1970. Nucleic acid metabolism in the ruminant. Br. J. Nutr. 24:545-556.

Snedecor, G. W. and W. G. Cocharan. 1967. Statistical Methods. 6th edn., Oxford and IBH publication, Calcutta, India, pp 258-259.

Steel, R. G. D. and J. H. Torrie. 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd edn. McGraw-Hill Book Company, New York.

Sudana, I. B. and R. A. Leng. 1988. Effect of supplementing wheat straw diet with urea or urea molasses block and/or cotton seed meal on intake and live weight changes of lambs. Anim. Feed Sci. Technol. 16:25-35.

Thu, N. V. and P. Uden. 2000. Effect of urea molasses cake supplementation on live weight and milk yield of Murrah buffalo cows. Asian-Aust J. Anim. Sci. 13(9):1329-36.

Thu, N. V. and P. Uden. 2001. Effect of work and urea molasses cake supplementation of swamp buffaloes fed rice straw or grasses on rumen environment, feed degradation and intake. Asian-Aust J. Anim Sci. 14(5):631-639.

Tiwari, S. P. 1988. Studies on solidified urea molasses based block lick in buffalo calves fed low quality crop residues. Ph. D. thesis I.V.R.I., Deemed University, Izatnagar. India.

Toppo, S., A. K. Verma, R. S. Dass and U. R. Mehra. 1997. Nutrient utilization and rumen fermentation pattern in crossbred cattle fed on different planes of nutrition supplemented with urea molasses mineral block. Anim. Feed Sci. Technol. 64: 101-112.

Van Soest, P. J. 1994. Nutritional Ecology of the Ruminant. Cormell University Press, Ithaca, New York, USA.

Van Soest, P. J., J. B.Robertson and B. S.Lewis. 1991. Methods for dietary fibre, neutral detergent fibre and non-starch polysacharides in relation to animal nutrition. J. Dairy Sci. 74: 3583-3597.