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Nutrient utilization by Murrah buffaloes (*Bubalus bubalis*) as influenced by varying levels of urea molasses mineral block on wheat straw based diets

A.K. Verma*, U.R. Mehra, R.S. Dass

Animal Nutrition Division, Indian Veterinary Research Institute, Izatnagar-243 122, India

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Abstract

To ascertain the optimum intake of urea molasses mineral block (UMMB) as a supplement on wheat straw based diets, twelve adult male Murrah buffaloes (*Bubalus bubalis*) (390±9.0 kg; 4 y) were assigned to three equal groups in a completely randomized design. To minimize individual diurnal variation, the animals on Diets 1, 2 and 3 were fed fixed quantity of UMMB at the level of 400, 600 and 800 g, dissolved in 1000 ml of water and mixed manually with 5600 g chaffed wheat straw uniformly, for a preliminary period of 21 days followed by a metabolism trial of seven days duration. An increased ($P<0.05$) intake of crude protein and decreased intake of ether extract, acid detergent fibre (ADF), cellulose (g day^{-1}), dry matter and total digestible nutrients (TDN) per unit metabolic body size (kg $W^{0.75}$) were observed on 800 g UMMB as compared to similar intake on other diets. The animals from all the three treatments digested most of the nutrients to a similar extent, except dry matter and organic matter, the digestibility of which was depressed on feeding 800 g UMMB daily. Inspite of significantly ($P<0.05$) lower digestible intake of ADF and cellulose in animals offered 800 g UMMB, their digestibility were comparable among the diets. All the animals were, though, in positive nitrogen, calcium and phosphorus balance, animals fed 800 g UMMB daily lost body weight probably due to the insufficient energy supply. Since supplementation of UMMB at 400 and 600 g levels exhibited similar results and it's inclusion beyond that had no beneficial effect, it can be concluded that a level of 400 g UMMB seems to be optimum to maximize utilization of nutrients from wheat straw based diets to meet maintenance requirements of adult male buffaloes. © 1998 Elsevier Science B.V.

Keywords: Urea molasses mineral block; Nutrient utilization; Buffalo; *Bubalus bubalis*

* Corresponding author.

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1. Introduction

Crop residues (straws/stovers), low quality fibrous agro-industrial by-products and grasses alone are insufficient to ensure even maintenance requirements (Ghosh et al., 1993) without supplementation of the deficient nutrients required by the microorganisms in the rumen and by the animal (Preston and Leng, 1984). These crop residues are most readily available fermentable carbohydrate sources, least expensive and constitute basal diet of the ruminant animals in most of the developing countries (Jayasuriya, 1987). The concept of supplementing such unbalanced diets to maximize their efficient utilization with urea molasses mineral blocks (UMMB) was pioneered by Professor R.A. Leng of the University of New England, Armidale, Australia (Preston, 1995). Since then work on various aspects of feeding UMMB has been carried out in various parts of the world including India by various workers (Leng, 1984; Neric et al., 1985; Kunju, 1986; Sansoucy, 1986; Singh and Mehra, 1986, 1990; Sudana and Leng, 1986; Mehra et al., 1987, 1991, 1993; Tiwari et al., 1990; Hosamani et al., 1995; Toppo et al., 1997). However, a lot of diurnal variation was noticed by above cited authors in the intake and utilization of UMMB by ruminants. Since these blocks are hygroscopic in nature and become too soft during rainy season due to humidity, thus, instead of licking, they are gobbled rapidly by the animals, which may lead to urea toxicity. Apart from the texture, the basal diet also influences the block intake (Ali and Mirza, 1986). Mehra et al. (1991) observed an increased intake of 532 g UMMB with an increase of 500 g wheat bran in the diet of buffalo calves. Keeping these facts in view, present experiment was undertaken to ascertain the feasibility of feeding UMMB dissolved in water and mixed with wheat straw in order to minimize diurnal variation in its intake and to ascertain optimum level of UMMB supplementation on wheat straw based diets to maximize nutrient utilization.

2. Materials and methods

2.1. Ingredient composition and preparation of diets

The UMMB prepared using hot process as described by Toppo et al. (1997) were procured from Regional Co-operative Dairy Federation, Varanasi, U.P., India. The UMMB consisted of molasses, urea, cotton seed meal, mineral mixture, common salt, calcite powder and bentonite at the level of 450, 150, 100, 150, 80, 40 and 30 g kg^{-1} on as fed basis, respectively. To minimize individual diurnal variation fixed quantity of UMMB viz; 400, 600 and 800 g was soaked in 1000 ml water in plastic troughs overnight. Next morning, manually it was stirred and mixed with 5600 g chaffed wheat straw thoroughly to prepare Diets 1, 2 and 3, respectively. This process of soaking and mixing with chaffed wheat straw continued throughout the experimental period. Feed mixes so prepared were offered to the animals of respective groups.

2.2. Animals and feeding

Twelve adult male Murrah buffaloes (*Bubalus bubalis*) (390±9.0 kg; 4 y) were assigned to three equal groups in a completely randomized design and fed Diets 1, 2 and

3, respectively. The animals were housed individually in well ventilated concrete floored stalls and were offered their respective diets daily at 9.00 a.m. throughout the 30 days of experimental feeding. The diet offered and left over residue of each animal was weighed after 24 h consumption and dry matter was estimated to arrive at its daily intake. Clean and fresh drinking water was provided ad libitum daily. At the end, a seven day metabolism trial involving total quantitative collection of faeces and urine and recording of feed and residue was carried out on all the animals by harnessing them in metallic cages. The animals were weighed at the start of experiment as well as before and after metabolism trial.

2.3. Chemical analysis

The proximate composition of feed and faecal samples were determined as per AOAC (1980) methods. The contents of neutral detergent fibre (NDF), acid detergent fibre (ADF) and cellulose were analysed using methods described by Van Soest et al. (1991). Nitrogen content in feed, faeces and urine was determined by micro-Kjeldhal method and crude protein calculated as $N \times 6.25$. These samples were also analysed for calcium as per Talapatra et al. (1940) and for phosphorus colorimetrically involving molybdovanadate reagent (AOAC, 1980). Total digestible nutrients (TDN) of the diets were calculated as described by Maynard et al. (1979).

2.4. Statistical analysis

A completely randomized design was used to determine dietary effect. One way analysis of variance (ANOVA) was carried out on the experimental data using treatments as independent variable. The significance of difference between means was compared using Duncan's new multiple range test (Steel and Torrie, 1980).

3. Results and discussion

3.1. Dietary composition

The analysed chemical composition of diets and their ingredients are presented in Table 1. There was a linear increase in crude protein (CP), Ca and P and a decrease in ADF content of the diets as the UMMB inclusion in the diets increased. However, inclusion of UMMB at various levels did not have any significant effect on other chemical constituents.

3.2. Intake and digestibility of nutrients

The mean intake (g day^{-1}) of dry matter (DM) and other nutrients alongwith their digestibility coefficients are given in Table 2. The mean daily dry matter consumption varied insignificantly from 4475 g on Diet 3 to 5303 g on Diet 1. However, it was significantly ($P<0.05$) higher on Diets 1 and 2 as compared to Diet 3 with respect to per kg metabolic body size (kg $W^{0.75}$) (Table 3). The higher crude protein content resulting in lower palatability of diet might be the probable reason for lowered dry matter intake on

Table 1
Chemical composition of diets and their ingredients (percent on dry matter basis)

Attributes	Diet 1	Diet 2	Diet 3	UMMB	Wheat straw
Organic matter	90.92	89.79	89.41	58.60	92.90
Crude protein	6.96	8.23	9.86	52.63	3.75
Ether extract	0.95	0.91	0.92	0.61	0.96
Neutral detergent fibre	76.87	75.83	75.38	12.75	81.72
Acid detergent fibre	64.36	63.32	58.80	6.23	63.40
Cellulose	46.41	46.35	42.17	1.93	49.36
Calcium	1.10	1.36	1.60	9.00	0.54
Phosphorus	0.17	0.22	0.27	1.71	0.06

Table 2
Nutrient intake (g day^{-1}) and digestibility (percent) in buffaloes fed different diets

Attributes	Diet 1	Diet 2	Diet 3	SEM
Dry matter				
Intake	5303	5254	4475	337.2
Digestible intake	2620	2653	1962	197.0
Digestibility**	49.2[a]	50.4[a]	43.7[b]	1.09
Organic matter				
Intake	4822	4718	4001	299.0
Digestible intake	2563	2553	1909	187.3
Digestibility**	53.1[a]	54.0[a]	47.6[b]	1.03
Crude protein				
Intake*	370[a]	433[ab]	441[b]	24.0
Digestible intake	143	194	169	17.4
Digestibility	38.5	45.3	38.0	3.60
Ether extract				
Intake*	51[a]	48[ab]	41[b]	2.5
Digestible intake	27	22	22	3.4
Digestibility	49.3	45.6	38.3	4.44
Neutral detergent fibre				
Intake	4076	3984	3373	250.1
Digestible intake	2171	2127	1695	156.1
Digestibility	53.1	53.4	50.2	1.29
Acid detergent fibre				
Intake*	3413[a]	3327[ab]	2631[b]	274.1
Digestible intake*	1715[b]	1670[b]	1276[a]	190.3
Digestibility	49.8	50.9	48.5	2.21
Cellulose				
Intake*	2461[a]	2435[a]	1887[b]	132.2
Digestible intake*	1473[b]	1498[b]	1121[a]	98.5
Digestibility	59.6	61.7	58.9	1.96

Means with different superscripts in a row differ significantly: * $P<0.05$; ** $P<0.01$.

higher UMMB supplementation. Similar lower intake was also noticed by Sahoo et al. (1992) when urea molasses liquid supplement was offered at higher levels. Almost similar dry matter intake was reported by Sengar et al. (1995) who supplemented 393 g UMMB as sani to adult male Murrah buffaloes similar to the UMMB inclusion level on

Table 3
Plane of nutrition and mean daily retention of various nutrients in buffaloes fed different diets

Attributes	Diet 1	Diet 2	Diet 3	SEM
Initial body weight (kg)	390.3	390.0	390.3	17.32
Final body weight (kg)	392.8	390.0	378.8	17.99
Days in experiment	30	30	30	–
Plane of Nutrition during metabolism trial				
Metabolic body weight (kg)	88.2	87.7	85.8	3.07
Dry matter intake (g kg $W^{-0.75}$)*	60.2[a]	59.7[a]	51.9[b]	2.62
Crude protein intake (g kg $W^{-0.75}$)**	4.2[a]	4.9[ab]	5.1[b]	0.16
TDN intake (g kg $W^{-0.75}$)*	29.5[a]	29.3[a]	22.4[b]	1.70
Intake and balance of nutrients (g day^{-1})				
Nitrogen intake*	59.1[a]	69.2[ab]	70.6[b]	3.84
Faecal excretion	36.2	38.3	43.5	3.05
Urinary excretion	20.6	24.0	24.7	2.58
Nitrogen retention**	2.3[b]	6.9[a]	2.4[b]	0.82
Calcium intake	58.4	71.5	71.6	4.83
Faecal excretion	50.5	62.6	63.1	4.73
Urinary excretion	2.0	1.9	1.9	0.17
Calcium retention	5.9	7.0	6.6	0.67
Phosphorus intake*	9.0[a]	11.6[b]	12.1[b]	0.80
Faecal excretion*	7.2[a]	9.4[b]	9.9[b]	0.67
Urinary excretion*	0.3[a]	0.5[b]	0.5[b]	0.05
Phosphorus retention	1.5	1.7	1.7	0.17

Means with different superscripts in a row differ significantly: * $P<0.05$; ** $P<0.01$.

Diet 1 of the present experiment. The intake of organic matter also followed a similar pattern. Linearly increased crude protein intake with an increase in the level of UMMB in the diets resulting in higher dietary crude protein content corroborated with the earlier reports of Singh and Talapatra (1971), Sharma and Jhanwar (1973) and Kurar (1977). The intake of all other nutrients was significantly higher on Diet 1 as compared to Diet 3, however, it was comparable between Diets 1 and 2 and Diets 2 and 3, except cellulose, which was significantly higher on Diets 1 and 2 than Diet 3. Therefore, it clearly indicates that inclusion of UMMB upto 600 g on wheat straw based diets did not impart any adverse affect on the palatability of the diets. The animals on all the three diets digested most of the nutrients in similar fashion except dry matter and organic matter, the digestibility of which were depressed by increasing UMMB to 800 g in the diet. It shows that UMMB at 400 and 600 g inclusion facilitated similar and better availability of readily fermentable nitrogen for optimum proliferation of rumen microbes (Preston and Leng, 1984; Jayasuriya, 1987) for efficient fermentation and utilization of nutrients on wheat straw based rations. Inclusion of UMMB beyond 600 g exhibited depressed digestibility of dry matter and organic matter, probably due to the shift of rumen microbes to ferment more readily fermentable nutrients available through UMMB as reported earlier in cattle (Singh et al., 1991; Garg and Gupta, 1992; Toppo et al., 1997) and buffaloes (Elangovan et al., 1991; Hosamani, 1992; Madhu Mohini and Gupta, 1993) which substantially indicated no advantage of its further addition. Observed similar digestibility of crude protein on all the three diets, inspite of linearly increased nitrogen intake, contradicted the earlier observations (Singh and Talapatra, 1971; Sharma and Jhanwar, 1973; Kurar, 1977) that crude protein digestibility is directly proportional to it's level in the ration. Inspite of significantly ($P<0.05$) reduced digestible intake of ADF and cellulose in 800 g UMMB supplemented group, the digestibility were comparable among the diets probably owing to the tendency of animals to become more efficient in digesting feed and metabolizing nutrients as well (Bondi, 1987). Almost similar trend in the digestibility of most of the nutrients has also been reported by earlier workers (Sahoo et al., 1992; Mehra et al., 1993) in buffaloes with UMMB supplementation with respect to level of intake.

3.3. Plane of nutrition and retention of nutrients

Plane of nutrition and nutrient retention by adult male buffaloes are given in Table 3. The requirements for maintenance (Kearl, 1982) of adult male buffaloes per unit metabolic body size are 76.3, 5.2 and 33.4 g for dry matter, crude protein and energy (TDN), respectively. The availability of DM, CP and TDN was significantly lower on 800 g UMMB supplemented group as compared to similar intake on other two diets. However, the intake of these nutrients was respectively lower by 21.1%, 19.2% and 14.2% on Diet 1, 21.8%, 5.8% and 14.8% on Diet 2 and 32.0%, 1.9% and 34.9% on Diet 3 as compared to the stipulated standards (Kearl, 1982). Inspite of lower intake of DM, CP and TDN on all the three diets, except comparable intake of crude protein on Diet 3, animals on all the three diets were in positive nitrogen, calcium and phosphorus balance. Significantly ($P<0.05$) increased nitrogen retention on Diet 2 due to an increase of 200 g UMMB in the diet was in agreement with the findings of Lofgreen and Loosli (1947) who reported increased level of nitrogen intake resulted in higher daily retention. The animals of all the three dietary groups, though, consumed considerably less nutrients than maintenance requirements as suggested by Kearl (1982), yet two groups maintained their body weight which might be due to less nutrient requirement of Indian buffaloes for maintenance as suggested by Ranjhan and Pathak (1983). However, animals on Diet 3, though received higher level of nitrogen lost their body weight probably due to either incorporation of UMMB at higher level resulting in poor palatability of the diet or insufficient energy (TDN) supply affecting nitrogen utilization. Inspite of significantly higher nitrogen retention by animals on Diet 2, the body weights of animals on Diets 1 and 2 were statistically alike. This might be an indication of comparable availability of fermentable nitrogen and energy for microbial fermentation resulting in similar availability of nutrients at tissue level on both the diets.

4. Conclusion

Since supplementation of UMMB at 400 and 600 g levels exhibited similar results and its inclusion beyond that had no beneficial effect, it can be concluded that a level of 400 g UMMB seems to be optimum to maximise utilization of nutrients from wheat straw based diets to meet maintenance requirements of adult male buffaloes.

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