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Influence of urea molasses mineral blocks having bentonite as binder on the feed intake, nutrient utilization and economics of feeding of crossbred calves

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ABSTRACT

This experiment was conducted to study the effect of supplementation of urea mineral molasses block (UMMB) containing variable levels of urea and bentonite on nutrient utilization and economics of feeding of crossbred calves. Twenty four male crossbred calves were divided into four equal groups following completely randomized design and fed individually for 120 days. In Group 1, 70% of crude protein (CP) requirement was met through feeding of concentrate mixture and remaining CP was supplied through UMMB and *ad lib.* wheat straw (control). In Groups 2, 3 and 4, the feeding regimen followed was same as that of control except that UMMB was replaced with UMMB-A, UMMB-B, UMMB-C which vary in physical composition (wheat bran, urea, cement and bentonite content). There was no significant difference in feed intake and digestibility of macro-nutrients among the groups. Intake of UMMB was significantly lower in Group 4 as compared to the other groups. The nitrogen and phosphorus intake, excretion and retention was non-significant among the groups. A significant increase in calcium intake in Group 1 was observed. The excretion of calcium through faeces and calcium balance was non-significant among the groups. The feeding cost per kg bodyweight gain (₹) was higher in Group 1 followed by 3, 2 and 4, respectively. On basis of present results, it may be concluded that supplementation of UMMB containing 15% urea and 10% cement can replace 30% crude protein of concentrate mixture without any adverse effect on feed intake, digestibility and nutrient utilization of crossbred calves.

Keywords: Bentonite, Crossbred calves, Economics, Nutrient utilization, Urea molasses mineral blocks

Exorbitant cost and limited availability of oil cakes as protein supplement had led to use of non-protein nitrogen (NPN) based supplements to overcome nitrogen deficiency and to improve performance of ruminants fed fibrous feeds (Dutta *et al.* 2009, Ankita *et al*. 2016, Ankita *et al*. 2018, Kumari *et al*. 2019 a, b). Intake, digestibility and availability of nutrient from poor quality roughages can be enhanced through NPN and molasses based supplements that aid in optimization of rumen fermentation (Sahoo *et al*. 2009). This offers several advantages such as easy transport, storage and handling, and reduced risks of poisoning as compared with other approaches, such as giving a small amount of urea in drinking water, sprinkling of urea solution on fibrous feeds before feeding, or urea-ammonization of crop residues (Dutta *et al*. 2009). These advantages, together, with enhanced energy and nutrient utilization, reduced enteric methane emission and improvement in productivity in terms of increased milk and meat production and higher reproductive efficiency in ruminant animal species had encouraged use of such multi-nutrient bloks (Ankita *et al.* 2016, 2018a, Kumari *et al.* 2019a,b).

However, the consistency of the block remained an issue. If the block is too soft, it will be licked out rapidly and if it is too hard, it may not be consumed at all (Kunju 1986). Thus, selection of an appropriate binder is necessary to optimally solidify the blocks. As a binder, bentonite has many advantages than that of other binders. It is one of the common natural clays used in animal diets to improve digestibility of nutrients and daily gain and feed intake (Salem *et al*. 2001). Bentonite has a high capacity to adsorb toxins such as aflatoxins and other substances (Magnoli *et al.* 2010).The addition of bentonite to the diet can partly synchronize the supply of nitrogen to the rumen microorganisms. As an alternative to bentonite, cement can also be used to make urea molasses based multi-nutrient block. However, information regarding the combined effect of bentonite and cement as a binder in the urea molasses mineral block on performance of animals and keeping quality of the block is rather scanty. Keeping the above

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facts in view, this experiment was undertaken to see the influence of urea molasses mineral blocks having different levels of bentonite and cement as binder on the feed intake, nutrient utilization and economics of feeding of crossbred calves.

MATERIALS AND METHODS

Selection of animals, experimental design and dietary treatments: Twenty four healthy crossbred calves (9-12 month age; body weight of 134±1.0 kg) were randomly distributed into four groups of six each in an experiment based on completely randomization design and were fed as per Ranjhan (1998) to meet the maintenance and growth requirement. In Group 1, 70% of crude protein (CP) requirement was met through feeding of concentrate mixture and remaining CP was fed through urea molasses mineral block (UMMB) and *ad lib.* wheat straw (control). In Groups 2, 3 and 4, the feeding regimen followed was same as that of control except that UMMB was replaced with UMMB-A, UMMB-B, UMMB-C which contained varied proportion of bentonite and cement (Table 1). The concentrate mixture consisted of crushed maize, 43; wheat bran, 42; deoiled soy bean, 12; mineral mixture, 02 and common salt, 01%. Animals were housed in a separate shed having provision of both open and close space at Animal Nutrition Shed, ICAR-Indian Veterinary Research Institute, Izatnagar. Prior to the experimental feeding, all animals were dewormed and vaccinated against various diseases. Proper health management and sanitation conditions were maintained throughout the experimental period.

A digestion trial of six days collection period was conducted after 60 days of experimental feeding. During the digestion trial, daily samples of feeds and faeces were collected and oven dried whereas the aliquots of fresh faeces and urine were preserved in 10% H_2SO_4. These samples were analysed for proximate principles (AOAC 2005) like dry matter (DM), organic matter (OM), ether extract (EE), crude fibre (CF), cell wall fractions (Van Soest *et al*. 1991) like neutral detergent fibre (NDF) and acid detergent fibre (ADF). Samples were also analyzed for their Ca (Talapatra *et al*. 1940) and P (AOAC 2005) (Table 2).

Statistical analysis: The experimental data generated were analyzed using statistical package SPSS 11.0 adopting standard statistical procedures (Snedecor and Cochran 1994). Significance was declared at P<0.05 unless otherwise stated.

Table 1. Physical composition of solid multi nutrients block

Ingredient	UMMB (%)	UMMB-A (%)	UMMB-B (%)	UMMB-C (%)
Molasses	40	40	40	40
Wheat bran	38	38	33	33
Urea	10	10	15	15
Mineral mixture	1	1	1	1
Common salt	1	1	1	1
Portland cement	10	5	5	10
Bentonite	–	5	5	–
Vitamin A (IU/kg)	25,000	25,000	25,000	25,000
Vitamin D_3 (IU/kg)	2500	2500	2500	2500

Table 2. Chemical composition of feed and fodder (% DM basis)

Attributes	UMMB	UMMB -A	UMMB -B	UMMB -C	Concentrate mixture	Wheat straw
DM	89.58	88.79	87.5	90.03	93.24	91.21
OM	77.59	77.42	73.81	78.56	90.17	90.16
CP	32.12	31.67	48.36	49.92	16.12	3.02
CF	0.92	0.91	0.79	0.81	2.12	1.13
NDF	20.4	23.76	22.94	20.1	23.43	86.01
ADF	14.8	15.92	15.01	13.11	7.70	55.01
Calcium	5.27	3.95	3.88	5.34	0.66	0.35
Phosphorus	1.72	1.47	1.43	1.62	1.03	0.028

RESULTS AND DISCUSSION

Effect of feeding UMMB having bentonite as binder on the feed intake of crossbred calves: Results indicated that the voluntary dry matter intake did not vary significantly among the four groups. Similar intake of DM is suggestive of no adverse effects of molasses based multinutrient supplements on palatability (Table 3). Earlier finding showed that the sudden introduction of urea into the diet sometimes was associated with palatability problems (Koster *et al.* 1997). However, in the present experiment, UMMB-A, UMMB-B and UMMB-C were introduced gradually over a period of 10 days that allowed the animals to be adapted smoothly. It is in accordance with Kumari *et al.* (2019a) who reported no significant change in the total DMI of buffaloes calves fed molasses based multi-nutrient herbal supplements. The consumption of UMMB and straw decrease linearly with increasing urea levels in the block due to low palatability and excessive ammonia concentration in the rumen (Geleta *et al.* 2013) and is in agreement with our study where a non-significant decrease (P>0.05) in DMI in Groups 3 and 4 was observed. However, DMI was not affected by bentonite inclusion at 5% in UMMB. Further, it was also reported earlier that the inclusion of bentonite at 3% in UMMB supplemented with diet of rice straw increased the flow rate of rumen protozoa and DMI in Murrah buffalo calves (Tiwari *et al.* 2008). On the contrary, Tripathi *et al.* (2006) reported that the dry matter intake improved (P<0.05) both in cows (14.13%) and buffaloes (22.76%) as a result of UMMB supplementation, which was reflected in improved (P<0.05) milk yield in cows (31.58%) and buffaloes (35.18%). There was no significant difference in intake of digestible crude protein (DCP) and total digestible nutrients (TDN) among the groups. The comparison of plane of nutrition with Ranjhan (1998) feeding standard revealed that all the experimental calves of different UMBBs supplemented group met their DCP and TDN requirements for maintenance and growth (500 g/day).

Effect of feeding UMMB having bentonite as binder

Table 3. Intake and digestibility of nutrients in crossbred calves fed different types of blocks

Attribute	Group 1	Group 2	Group 3	Group 4	SEM	P value
BW (kg)	167.50±13.75	171.8±15.92	164.83±12.7	170.17±13.4	6.55	0.98
BW (kgW$^{0.75}$)	46.40±2.91	47.25±3.39	45.87±2.68	46.98±2.79	1.38	0.98
WS intake (kg/day)	2.52±0.20	2.725±0.31	2.469±0.38	2.415±0.15	0.13	0.86
Concentrate intake (kg/day)	1.79±0.0 5	1.78±0.05	1.76±0.04	1.79±0.050	0.022	0.96
UMMB intake (kg/day)	0.669^{a}±0.05	0.673^{a}±0.089	0.507 ^{ab}±0.05	0.432^{b}±0.04	0.035	0.02
TDMI (kg/day)	4.98±0.25	5.183±0.437	4.738±0.444	4.64±0.230	0.171	0.7
DOMI (kg/d)	2.84±0.16	3.01±0.21	2.71±0.19	2.573±0.0 9	0.085	0.34
CPI (g/d)	563.21±22.8	571.84±45.08	585.04±37.35	560.59±29.1	16.26	0.95
CPI (g/kg W$^{0.75}$/d)	12.52±1.28	12.32±0.97	12.81±0.60	12.10±0.820	0.45	0.95
DCPI (g/d)	346.77±25.4	363.32±26.1	380.33±22.6	336.89±26.1	12.19	0.63
DCPI (g/kg W$^{0.75}$/d)	7.78±1.05	7.83±0.61	8.37±0.51	7.38±0.84	0.37	0.84
TDNI (kg/d)	2.984±0. 166	3.155±0.221	2.848±0.202	2.701±0.10	0.09	0.34
TDNI (g/kg W$^{0.75}$/d)	66.23±6.69	68.30±5.70	62.04±2.42	58.43±3.71	2.43	0.54
Nutrient digestibility (%)						
DM	60.91±1.32	60.47±1.73	60.47±1.96	59.03±2.27	0.88	0.89
OM	61.99±1.25	63.80±1.58	63.18±1.90	60.96±2.10	0.84	0.66
CP	61.18±2.33	64.28±3.54	65.48±3.09	60.13±3.30	1.59	0.62
EE	67.92±3.53	68.34±2.79	70.44±1.77	67.71±1.73	1.22	0.86
NDF	55.59±1.21	54.59±1.67	52.20±1.11	50.62±2.75	0.94	0.23
ADF	50.53±2.06	50.63±1.58	47.2±1.790	47.66±2.69	1.02	0.51

^{ab}Mean value with different superscript with in row differ significantly.

Table 4. Nitrogen, calcium and phosphorus metabolism in crossbred calves fed different types of blocks

Attribute	Group 1	Group 2	Group 3	Group 4	SEM	P value
N intake (g/d)	90.11±3.65	91.49±7.21	93.61±5.98	89.70±4.66	2.6	0.95
N excretion (g/d)						
Faeces	34.63±1.30	33.36±5.06	32.75±4.33	35.79±3.87	1.84	0.94
Urine	26.07±2.19	26.85±4.56	27.86±4.62	22.88±3.36	1.82	0.81
Total	60.70±2.46	60.22±8.04	60.61±7.89	58.68±4.84	2.92	0.99
N retention						
(g/d)	29.41±4.26	31.28±7.04	32.99±5.32	31.02±4.28	2.51	0.97
% of intake	32.08±3.78	34.26±6.87	35.92±5.82	34.49±4.19	2.49	0.96
% of absorbed	51.88±4.76	51.94±9.08	53.87±8.18	57.31±5.36	3.34	0.94
Ca intake (g/d)	56.73^{b}±3.1	48.23^{ab}±4.83	40.25^{a}±3.02	43.38^{ab}±2.63	2.09	0.01
Ca excretion						
Faeces (g/d)	42.91±3.54	36.07±3.70	30.02±3.92	32.14±3.82	2.02	0.1
Urine (g/d)	0.89±0.11	1.04±0.23	0.88±0.15	0.82±0.14	0.08	0.81
Total (g/d)	43.80±3.53	37.11±3.79	30.90±3.92	32.96±3.82	2.03	0.11
Ca retention(g/d)	12.93±4.49	11.13±2.22	9.35±2.40	10.42±2.13	1.41	0.85
P intake (g/d)	30.92±1.10	29.35±1.90	26.31±1.15	26.38±1.04	0.75	0.06
P excretion						
Faeces (g/d)	18.93±0.80	18.49±2.22	15.80±1.14	15.86±1.03	0.72	0.26
Urine (g/d)	2.69±0.52	2.76±0.85	2.81±0.98	2.53±0.39	0.34	0.99
Total (g/d)	21.62±0.71	21.25±2.01	18.61±1.44	18.39±0.94	0.71	0.23
P retention (g/d)	9.16±1.28	7.89±0.94	7.57±1.19	7.85±0.93	0.53	0.06

^{a,b}Mean values with different superscripts with in a row differ significantly.

on digestibility and nutrient utilization of crossbred calves: The digestibility of DM, OM, CP, EE, NDF and ADF was comparable among the groups (Table 3). However, the intake and digestibility of CP was more (8.9%) in UMMB-A and UMMB-B groups as compared to cement alone groups but it was non-significant (P>0.05). Similar

Table 5. Economics of feeding different types of blocks in crossbred calves

Attribute	Group 1	Group 2	Group 3	Group 4	SEM	P value
Feed cost/day						
Conc. mix (₹)	30.08±0.90	30.29±1.03	29.91±0.86	30.09±0.83	0.42	0.99
Wheat straw (₹)	10.46±0.44	10.55±0.73	10.11±0.74	9.97±0.46	0.29	0.89
SMB (₹)	7.01^{a}±0.43	7.28^{a}±0.61	5.10^{b}±0.37	4.40^{b}±0.30	0.33	0
Total cost (₹)	47.55±1.17	48.12±2.35	45.13±1.74	44.46±1.33	0.86	0.37
ADG (g)	447.22±31.08	497.22±48.96	433.33±35.03	502.78±31.16	18.50	0.46
Feed cost /kg gain(₹)	108.00±4.87	99.56±6.03	107.05±8.53	89.59±4.46	3.27	0.16

^{ab}Mean values with different superscripts with in a row differ significantly. *Ingredients rates: wheat straw: ₹4/kg; maize: ₹12.0/kg; wheat bran: ₹14.0/kg; de-oiled soybean meal: ₹36/kg; mineral mixture: ₹50/kg; salt: ₹5.00/kg; molasses: ₹8.50/kg; cement: ₹5.00/kg;bentonite: ₹5.00/kg; vitamin AD_3: ₹750/kg.

trends were reported by Ivan *et al*. (1992) who observed decreased (P<0.05) disappearance of nitrogen from the digestive tract by bentonite supplementation in faunated and fauna free sheep fed maize silage based diets for 21 days. However, the disappearance of OM and ADF was not affected. Our findings corroborated well with the observation of other researchers (Kumari *et al.* 2019a, Patil *et al.* 2019, Ankita *et al.* 2019). Contrary to this finding, Choubey *et al.* (2015) observed that the digestibility of various nutrients was significantly increased in UMMB fed groups; however, such supplements are more effective when the basal ration contained less CP.

The result of nutrients metabolism revealed that the nitrogen utilization pattern was similar in all the 4 groups (Table 4). Roy *et al.* (2014) in goat kids did not observe any significant change in nitrogen balance by feeding medicated urea molasses mineral block. The nitrogen retention was higher in bentonite supplemented groups as compared to cement based blocks, but it was non-significant. This might be due to the fact that bentonite adsorbs the nitrogen in the digestive tract. Similarly, the Ca and P balances were similar in all the groups and the animals were found to be in positive balance. Lohakare *et al.* (2006) reported that the daily intake and excretion of calcium and phosphorus remained unaffected by dietary protein supplements.

Effect of UMMB having bentonite as binder on economics of feeding of crossbred calves: Data pertaining to the economics of growing crossbred calves fed different types of blocks is presented in Table 5. The feeding cost/kg gain (₹) was maximum in the Group 1 and lowest in Group 4. This may be due to higher level of urea in the blocks that reduce the intake of straw and block as well. The block intake was higher in bentonite supplemented groups as compared to the cement supplemented groups. Thus, UMMB with 15% urea and 10% cement was economically comparable with 10% urea and 5% cement and 5% bentonite containing UMMB group.

From these results, it may be concluded that supplementation of UMMB (15% urea and 10% cement) can replace 30% crude protein of concentrate mixture without any adverse effect on feed intake, digestibility and nutrient utilization of crossbred calves.

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