



## Effect of replacement of concentrate mixture with a multi-nutrient liquid supplement on performance of bufflao heifers

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### ABSTRACT

The primary objective of this experiment was to study the effect of replacement of concentrate mixture with molasses based multi-nutrient liquid supplements that contained either 2 (MMLS) or 4% mineral mixture (MMLS plus) on performance of buffalo heifers. Female Murrah buffalo heifers (18), 12 to 14 months of age and weighing 290±2 kg were randomly distributed into 3 groups of 6 each in an experiment based on randomized block design. All animals were supplied with green forages (2 kg DM/d) and wheat straw *ad lib*. In addition, animals in group T<sub>1</sub> (control) were fed a concentrate mixture to meet their nutrient requirements. However, 20% of the concentrates were replaced with MMLS and MMLS plus in groups T<sub>2</sub> and T<sub>3</sub>, respectively. Digestibility of NDF and hemicelluloses was higher in T<sub>3</sub> as compared to T<sub>2</sub> and control. Digestibility of other nutrients, excretion of purine derivatives and growth performance were comparable among the groups. It was concluded that multi-nutrient liquid supplements can safely replace 20% concentrate mixture without any adverse effect on nutrient utilization and growth performance of buffalo heifers.

**Key words:** Digestibility, Growth, MMLS, Molasses, Purine derivative index

Due to the increasingly high cost of concentrate, low quality roughages such as, cereal straws and stovers form the major part of the ruminant ration in India. These roughages from the potential source of feed energy, but are poorly digested because of the resistant fiber and low nitrogen content, and thus cannot meet even the maintenance needs of the animals. Urea and molasses are well known supplements that improve the utilization poor quality roughages. Increased supply of nitrogen, easily fermentable energy and minerals in the form of a combined supplement may improve fermentation and utilization of organic matter. Urea molasses liquid diets used earlier during scarcity periods to keep the animal surviving (Ranjhan *et al.* 1973, Verma *et al.* 1995, Dass *et al.* 1996). However, liquid supplements with added NPN, minerals and vitamins were shown to improve nutrient utilization, enhance growth rate and reproductive performance in cattle (Pate *et al.* 1990, Kunkle *et al.* 1997). Considering that there are difference between cattle and buffalo in terms of metabolism and utilization of nutrients (Jetana *et al.* 2009) the response of supplementation of MMLS could also vary according to the species. Keeping this in view, the present experiment was designed to study the effect of replacing

20% of concentrate mixture by molasses based multi-nutrient liquid supplements on nutrient utilization and growth performance of buffalo heifers.

### MATERIALS AND METHODS

*Experimental site, animals and housing:* Healthy buffalo heifers (18) of about 12 to 14 months of age and BW 290±2 kg, were used for the experiment. All the animals were ear tagged and housed in the cattle and buffalo farm in a separate shed having provision of both open and close space. Prior to the experimental feeding, all animals were dewormed with albendazole at 5 mg/kg body weight. Proper health management and sanitation was maintained throughout the experimental period. Experimental animals were reared under uniform conditions throughout the experimental period of 240 days.

*Sampling, experimental design and dietary treatments:* Animals were divided into 3 groups of 6 each according to their age and live body weights following randomized block design (RBD). All animals were supplied with green forages (2 kg DM/d) and wheat straw *ad lib*. In addition, animals in group T<sub>1</sub> (control) were fed a concentrate mixture to meet their nutrient requirements. However, 20% of the concentrates were replaced with MMLS and MMLS plus in groups T<sub>2</sub> and T<sub>3</sub>, respectively. The multi-nutrient liquid supplement consisted of urea (10%), molasses (74%), deoiled mahua seed cake (5%), guar meal (5%), mineral mixture (2% in MMLS and 4% in MMLS plus), salt (1%)

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and remaining water. Animals in all the groups were supplied with nutrients to meet their requirements (ICAR 2013). The animals were maintained on standard diet comprised of concentrate mixture (maize 40, wheat bran 40, soybean meal 17, mineral mixture 2, and salt 1% each), green fodder (oats) and wheat straw without inclusion of MMLS and MMLS plus, for 20 days before the start of proper experiment. Each animal received weighed amount of feed (concentrate mixture, green fodder and wheat straw) once daily at 9:00 AM. Green fodder and wheat straw was provided daily after completion of concentrate mixture by the heifers. All animals had free access to clean drinking water throughout the day.

All the animals were weighed at the beginning of the experiment and subsequently at fortnightly intervals. A digestion trial of 6 days collection period was conducted during days 120–126 of the experimental period to determine intake and digestibility of nutrients. Dry matter content of feed, refusals and faecal samples was determined by drying to a constant weight in an oven at  $100\pm 2^\circ\text{C}$  for 24 h. At the end of trial, each animal's refusals and faecal samples were pooled across the 6-day trial period. Dried samples of feed, refusals and faecal samples were grinded to pass through a 1 mm screen and stored for further laboratory analysis. The urine sample (10 ml) was collected after 4–6 h of feeding for 6 days during the digestibility trial from each animal, the sample of each animal was pooled and kept in a vial containing 20%  $\text{H}_2\text{SO}_4$  to keep the pH below 3 and analyzed for allantoin (Young and Conway 1942), uric acid and creatinine using commercial kit. Samples of feed offered, residues left and faeces were analyzed for proximate principles (AOAC 2005) and fibre fractions (Van Soest *et al.* 1991).

*Statistical analysis:* Data pertaining to feed intake, body weight, nutrient intake and utilization were subjected to one way ANOVA. Treatment means were separated by Duncan's, multiple range test and the differences were considered to be significant at  $P < 0.05$ . All analysis were performed using statistical package SPSS (20.0).

## RESULTS AND DISCUSSION

Nutrient composition of the wheat straw and oat fodder used in this experiment was comparable to the reference value of these two feed ingredients (ICAR 2013). The proximate composition of the concentrate mixture (mainly CP and ash) was different in all the three groups (Table 1) due to mixing of MMLS and MMLS plus in different proportion.

Our results indicated that DMI was comparable among the groups (Table 2). Several factors like breed, age, season, quality of feed, physiological state, etc. influenced feed consumption in ruminants. In this experiment, all the animals were of similar age, productive stage, and were maintained under uniform environmental conditions and were fed diets having a similar energy density. The sudden introduction of urea into the diet was sometimes associated with palatability problems (Koster *et al.* 1997). However,

Table 1. Chemical composition of concentrate mixture, green fodder (oats) and wheat straw

Attributes	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Oat	Wheat straw
Dry matter	88.43	83.32	83.77	19.97	94.06
On % DM basis					
Organic matter	93.96	92.89	92.20	87.24	93.47
Crude protein	18.90	23.70	23.50	9.30	4.10
Ether extract	2.44	2.15	2.23	1.53	0.61
Ash	6.04	7.11	7.80	12.76	6.53
NDF	39.54	39.21	39.14	49.35	85.26
ADF	8.89	8.28	7.73	45.09	57.12
Hemicellulose	30.65	30.93	31.41	4.26	28.14
Cellulose	7.81	6.86	6.06	39.60	49.49
Lignin	1.08	1.42	1.68	5.50	7.63

NDF, Neutral detergent fibre; ADF, acid detergent fibre. T<sub>1</sub>, control diet; T<sub>2</sub>, concentrate with MMLS; T<sub>3</sub>, concentrate with MMLS plus.

in this experiment MMLS and MMLS plus were introduced gradually over a period of 20 days that allowed the animals to be adapted. Thus, similar DMI among the groups was in the expected line. Our findings collaborated well with those available in literature (Lall and Prasad 1990, Sawant *et al.* 2013). Most notable effect of MMLS supplementation that we observed in this experiment was, intake of N as intake of both CP and DCP (g/d and g/kgW<sup>0.75</sup>/d) was higher ( $P < 0.05$ ) in both T<sub>2</sub> and T<sub>3</sub> than control. The higher crude protein content of the multi-nutrient liquid supplement was reflected in higher crude protein content of the supplemented diets. The MMLS and MMLS plus contained 10% urea, which caused higher intake of crude protein in the supplemented groups. Similarly, supplementation of urea molasses mineral improves the nitrogen content of the basal diet (Khadda *et al.* 2014).

The digestibility of DM, OM, CP, EE, ADF and cellulose was similar among the groups (Table 2). Earlier reports showed that supplementation of urea molasses mineral blocks improved the digestibility of nutrients (Tiwari *et al.* 1990, Toppo *et al.* 1997, Choubey *et al.* 2015). However, such supplements are more effective when the basal ration contained less CP. In the present study, the animals were fed standard diets containing 18–23% CP which was adequate to meet their requirements. Our findings corroborated well with those of Kakkar and Makka (1995) and Sihag *et al.* (2007) in UMMB supplemented groups. Digestibility of NDF and hemicelluloses was significantly higher in T<sub>3</sub> than T<sub>1</sub> and T<sub>2</sub> group that might be due to the shift in fermentation pattern by the rumen microbes by feeding of multi-nutrient liquid supplement containing urea and minerals. Likewise, Wu and Liu (1996) reported that supplementation of urea-mineral lick blocks improved the digestion of fiber. It was further reported that supplementation of urea molasses block mostly improved the digestibility of hemicelluloses without any effect on digestibility of ADF (Mohini and Gupta 1993, Can *et al.* 2004, Sharma *et al.* 2008, Raman *et al.* 2010, Choubey *et al.*

Table 2. Nutrient intake and digestibility, average daily gain and purine derivatives excretion in experimental groups

Attributes	Treatments			SEM	P- value
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>		
Nutrient intake and digestibility during digestibility trial					
DMI (kg/d)	5.20±0.27	5.62±0.21	5.18±0.18	0.13	0.31
g/kgW <sup>0.75</sup> /d	64.92±1.36	68.50±1.17	64.11±2.15	0.99	0.16
CP intake (g/d)	613.05 <sup>b</sup> ±23.11	718.15 <sup>a</sup> ±17.26	698.83 <sup>a</sup> ±16.88	15.24	0.004
g/kgW <sup>0.75</sup> /d	7.67 <sup>b</sup> ±0.11	8.76 <sup>a</sup> ±0.10	8.65 <sup>a</sup> ±0.19	0.14	<0.001
DCP intake (g/d)	352.07 <sup>b</sup> ±18.12	417.69 <sup>a</sup> ±13.92	438.95 <sup>a</sup> ±20.01	13.07	0.008
g/kgW <sup>0.75</sup> /d	4.40 <sup>b</sup> ±0.18	5.11 <sup>a</sup> ±0.22	5.43 <sup>a</sup> ±0.22	0.15	0.009
TDN intake (g/d)	3306.83±184.21	3542.58±94.41	3385.81±101.45	75.99	0.46
g/kgW <sup>0.75</sup> /d	41.26±0.97	43.21±0.63	41.93±1.24	0.57	0.38
Nutrients digestibility (%)					
Dry matter	66.21±1.62	67.14±1.27	68.84±1.31	0.81	0.43
Organic matter	68.01±1.12	68.11±1.27	70.56±0.90	0.67	0.22
Crude protein	57.35±1.83	58.33±2.31	62.84±2.54	1.35	0.22
Ether extract	63.13±1.92	64.35±1.20	67.23±1.33	0.92	0.18
NDF	57.23 <sup>b</sup> ±1.16	58.35 <sup>b</sup> ±0.93	61.62 <sup>a</sup> ±1.13	0.74	0.03
ADF	54.74±1.80	55.20±1.23	57.24±1.52	0.87	0.49
HC	61.29 <sup>b</sup> ±0.77	63.65 <sup>b</sup> ±1.00	68.48 <sup>a</sup> ±1.02	0.89	0.00
Cellulose	59.78±1.73	60.26±1.14	62.05±1.52	0.84	0.54
Body weight gain (kg) during entire 240 days					
Initial BW (kg)	291.67±16.57	292.50±14.65	291.67±11.16	7.75	0.99
Final BW (kg)	416.67±17.45	431.67±20.92	432.50±11.16	9.39	0.76
Total BW gain	125.00±8.56	139.17±14.97	140.83±5.83	5.95	0.52
ADG (g)	518±0.04	581±0.06	587±0.02	0.02	0.46
Urinary excretion of purine derivatives in spot urine of buffalo heifers (mmol/l)					
Allantoin	2.86±0.44	2.96±0.41	3.044±0.22	0.20	0.94
Uric acid	0.93±0.09	1.05±0.10	0.96±0.09	0.05	0.63
Purine derivatives	3.78±0.50	4.01±0.40	3.99±0.17	0.21	0.90
Creatinine	8.70±0.34	8.84±0.22	8.98±0.74	0.27	0.92
PD index	34.83±4.66	36.58±2.96	37.80±4.51	2.25	0.88

<sup>ab</sup> Means bearing different superscripts in a row differ significantly (P>0.05).

al. 2015). Our results indicated that degradation of dietary fibres by rumen microbes is dependent on adequate supply of minerals and a super-dosing of minerals could be beneficial in terms of improving the digestibility of fiber. Even though published literature indicate the essentiality of minerals for maintenance and growth of micro-organisms, their dose for optimum growth of fibrolytic microorganisms needs to be standardized. More elaborate studies in this regard is warranted.

In spite of the improvement in digestibility of NDF in group T<sub>3</sub>, digestibility of OM and other nutrients were similar among the groups. It is of interest to note that even though there was a 21 % increase in N supply due to supplementation of MMLS and MMLS plus, TDN supply was similar among the groups. To reap the benefits of increased supply of N and minerals, a synchronized supply of energy from an appropriate source is pre-requisite (Kim *et al.* 1999). Our results showed potential of MMLS in improving digestibility of nutrients (especially fibre component), however, to realize these potentials an appropriate yet cheaper source of energy must be supplied. Even though it apparently seems unlikely that the supply of energy was limiting because all the diets supplied adequate amount of concentrates. It is noteworthy to

mention that extra supply of N through MMLS must be synchronized, preferably by adding a slowly degradable starch source in the supplement itself.

Excretion of allantoin, uric acid, creatinine and purine derivative index were comparable among the groups (Table 2). It is thus evident that replacement of concentrate mixture with either MMLS or MMLS plus had no effect on microbial synthesis. This corresponds well with our data that showed similar intake, organic matter digestibility and TDN intake among the animals of different groups. Similarly, Choubey *et al.* (2015) reported that supplementation of UMMB showed no effect on excretion of purine derivatives in buffalo. Excretion of purine derivative in urine is markedly used as a marker of microbial protein synthesis in ruminants (Chen *et al.* 1990). However, measurement of PD in urine is not considered to be an effective marker of microbial protein synthesis in buffalo because excretion of PD in urine of buffalo is rather less in comparison to other species (Wanapat *et al.* 2012). Considering these facts secondary objective of this experiment was to generate data on excretion pattern in buffalo that would supplement the small pool of data available in this species (Pimpa *et al.* 2003, Dipu *et al.* 2006).

Average daily gain was similar among the groups (Table

2). Our results clearly demonstrated that replacement of 20% of the concentrate mixture with either MMLS or MMLS plus had no adverse effect on growth performance of buffalo heifers. Thus, it seems to be a right feeding strategy to save valuable concentrates. This finding also corresponded well with our observation that replacement of concentrates with MMLS had no adverse impact on intake and utilization of nutrients. A similar growth performance that we observed in different group was thus expected. These findings are in accordance with those available in the literature (Plazier *et al.* 1999, Choubey *et al.* 2015). However, there were some reports which indicated that supplementation of minerals and vitamins increased body weight gain in ruminants including buffalo (Millan Cortes and Vignall 1990, Lall *et al.* 2002, Kalita *et al.* 2010, Sawant *et al.* 2013). In our experiment, supplementation of super dose of minerals increased the mineral and N supply that was reflected in higher digestibility of NDF. However, these benefits were not reflected in increased performance that could be mainly due to lack of synchronized increase in supply of the slowly fermentable source of energy.

Thus, it is a matter of interest for future research to ascertain the impact of the addition of a slowly degradable energy source to the MMLS or MMLS plus. From this study it is obvious that 20% of the concentrates can be safely replaced with either MMLS or MMLS plus in the ration of growing buffalo heifers.

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