Indian Journal of Animal Sciences **84** (5): 544–548, May 2014/Article

Nutritional evaluation of urea molasses multi-nutrient blocks containing agro-industrial wastes in buffaloes

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Received: 1 June 2012; Accepted: 30 December 2013

ABSTRACT

The present study was undertaken to formulate and compare the nutritional worth of conventional urea molasses multinutrient block (UMMB) with UMMB containing spent sugar syrup (SSP) from aamla (*Phyllanthus emblica*) preserve (*murabba*) industries, sundried waste bread (WB) and/or tomato pomace (TP) in buffaloes. The wheat flour and oil mustard cake in the conventional UMMB were replaced, respectively, with WB and TP on nitrogen basis, while molasses was replaced by SSS on weight by weight basis. The blocks were iso-nitrogenous and iso-caloric as indicated by comparable CP and EE contents in different UMMBs. Male Murrah buffaloes (12; 5–6 yr old; 456.8±5.3 kg body weight) randomly distributed into 3 equal groups were offered either conventional-UMMB, UMMB containing SSS (SSS-UMMB) or UMMB containing SSS, WB and TP (SSS-WB-TP-UMMB) for 45 days. In addition to the respective UMMBs, the animals in all the groups were offered 1 kg conventional concentrate mixture, 5 kg green fodder and 9 kg wheat straw. The daily intake of block varied from 0.49 kg (SSS-UMMB) to 1.08 kg (conventional-UMMB). Simultaneously, each diet was fed to 3 rumen fistulated male buffaloes to assess the impact on rumen metabolites. The DM and water intake, digestibility of nutrients, concentration of rumen metabolites, blood profile, urinary purine derivatives and N-retention were statistically comparable in all the groups. All the animals maintained their body weights. It was concluded that agro-industrial wastes like spent sugar syrup, waste bread and tomato pomace could be incorporated into UMMBs without any adverse effect on palatability, nutrient utilization or health of animals. Above all the preparation of UMMB could be economized and conventional ingredients could be spared for more vulnerable species.

Key words: Blood profile, Buffaloes, *In-vivo* evaluation, Nutrient availability, Rumen metabolites, Tomato pomace, Spent sugar syrup, Urea molasses multinutrient block, Waste bread

The urea molasses multinutrient block (UMMB) an excellent blend of energy, protein and minerals (Wadhwa and Bakshi 2011), improved the efficiency of nutrients utilization in poor quality crop residues based diets (Mubi *et al.* 2011) which constitute the bulk of DM consumed by ruminants under field conditions (Bakshi and Wadhwa 2011). Supplementing the straw based diets with UMMB increased milk production and its fat content, increased lactation length, decreased inter-calving period and age at first calving (Alam *et al.* 2006, Makkar 2007, Uperti *et al*. 2010). Feeding of UMMB has proved highly beneficial and effective during natural calamities when there is acute shortage of feedstuffs, except lean availability of lingo-cellulosics (Unal *et al.* 2005, Faftine and Zanetti 2010, Upreti *et al*. 2010). But the cost of conventional UMMB has escalated, leading to exorbitant cost of UMMB, which is beyond the reach of landless/marginal/small dairy farmers. Therefore, there is a need to explore non conventional energy and protein resources for incorporation in UMMBs. Some agro industrial wastes available in this region of India are spent sugar syrup (SSS) from industries manufacturing aamla (*Phyllanthus emblica* or Indian gooseberry) preserve (*murabba*); waste bread (WB)—leftover, unsold, fungal-infested bread, an excellent source of cooked bypass starch and protein; and tomato pomace (TP), a waste after extraction of pulp. It is a good source of lycopene that gives colour to meat and a known antioxidant. However, till date, neither of these wastes has been exploited as livestock feed, especially in the formulations of UMMB. This study was therefore, planned to formulate UMMBs containing agro-industrial wastes like SSS, WB and/or TP and compare these with conventional UMMB and to assess the effect of such UMMBs on nutrient utilization in buffaloes

MATERIALS AND METHODS

Procurement of non conventional feed supplements: The confectionary retailers return the unsold, fungal-infested bread unfit for human consumption to the manufacturer as waste bread (WB). It is available in plenty from big

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confectionary manufacturers and is being sold to the livestock farmers at very nominal price. The WB was procured from one of the big bread/biscuit manufacturers and was sun dried for 14 h to eliminate the aflatoxin, if any (Gowda *et al.* 2005). The sun-dried, ground WB was got tested for the level of mycotoxins, from the Department of Veterinary Microbiology, GADVASU, Ludhiana. The tomato pomace (TP) containing tomato peels, seeds, left over pulp and damaged tomatoes was procured from a fruit and vegetable processing industry. The TP was sun dried and finely ground. The spent sugar syrup (SSS) available after manufacturing aamla (*Phyllanthus emblica* or Indian gooseberry) preserve (*murabba*) was procured from a aamla processing industry. The waste bread (WB) was procured @ Rs 3.00/kg, while spent sugar syrup and tomato pomace were procured free of cost.

Preparations of UMMBs: Iso-nitrogenous and iso-caloric UMMBs were prepared by manipulation of feed ingredients (Table 1) in a block-making machine. In experimental blocks wheat flour was replaced with WB, mustard cake with TP on nitrogen basis and molasses by SSS on weight by weight basis. The required quantity of molasses/SSS and urea were weighed and mixed in a 25 kg capacity iron pan. The guar gum was added to the urea-molasses mixture. Guar gum was used as binder in UMMBs. A premix of other ingredients was prepared (CaO was the last ingredient to be added in the premix) and mixed in a iron pan. Heat generated at this stage, converted the contents into a semi-solid mass, which was put into rectangular die of block making machine. The solidified UMMBs were packed into polythene bag.

In vivo *evaluation*: Male Murrah buffaloes (12; 5–6 yr old, 456.8±5.3 kg body weight) were randomly distributed into 3 equal groups. The animals in the control group were offered *ad lib.* conventional UMMB, while in the experimental groups the animals were offered UMMB containing either SSS (SSS-UMMB) or SSS, WB and TP (SSS-WB-TP-UMMB) for 45 days. In addition to the respective UMMBs, the animals in all the groups were offered 1 kg conventional concentrate mixture (maize 30, mustard cake 10, solvent extracted mustard cake 20, rice bran 15, solvent extracted rice bran 22, mineral mixture 2 and common salt 1% each), 5 kg green fodder and 9 kg wheat straw (NRC 2001). The animals were weighed for 3 consecutive days at 15 days interval before feeding and the feeding schedule was adjusted accordingly. At the termination of experimental period, a 7-day metabolism trial was conducted. The samples of WB, TP, different UMMBs, concentrate mixture, wheat straw, green fodder, feed residue and faeces were analyzed for their proximate constituents (AOAC 2005), cellulose (Crampton and Maynard 1938) and other cell wall constituents (Robertson and Van Soest 1981). The urine sample (10 ml) was kept in a vial containing 0.5 ml of 20% H_2SO_4 to keep the pH below 3 and analyzed for allantoin (Young and Conway 1942), uric acid (Trivedi *et a1.* 1978) and creatinine (Folin and Wu 1916). Purines absorbed were calculated from the daily urinary PD excreted (IAEA 1997).

Table 1. Ingredient composition (g/3kg UMMB) of different urea molasses multinutrient blocks

Ingredients	UMMBs		
	Conventional	SSS	SSS-WB-TP
Molasses	900	-	-
Spent sugar syrup	-	900	900
Urea	300	305	315
Mustard cake	300	300	-
Deoiled rice bran	300	300	300
Wheat flour	450	450	-
Waste bread	-	-	450
Tomato pomace	-	-	300
Mineral mixture	450	450	450
Calcium oxide	120	120	120
Salt	120	115	105
Guar gum	60	60	60

WB,Waste bread; TP, tomato pomace; SSS, spent sugar syrup.

Rumen studies: The rumen studies were conducted on 3 rumen fistulated male buffaloes for assessing the effect of supplementing different blocks on the rumen metabolites. At a time one diet was tested on the 3 rumen fistulated animals. After 30 days adaptation on a particular ration, the rumen liquor samples from each animal were collected for 3 consecutive days at 2 h intervals, starting from zero and continuing up to 12 h post-feeding. The rumen liquor samples were strained through 4- layered muslin cloth and few drops of saturated mercuric chloride solution were added to arrest the microbial activity. The samples of strained rumen liquor (SRL) were pooled for the respective animal and the pH was measured immediately by using a digital pH meter and the samples were stored in a refrigerator till analyzed. The SRL samples were analyzed for TCA- precipitable nitrogen, non-protein nitrogen (NPN), ammonical nitrogen (AOAC 2005) and total VFAs (Barnett and Reid 1957).

Blood profile: At the termination of metabolism trial, the blood samples were collected (in heparin and sodium fluoride-oxalic acid vials) from the juglar vein of animals at 4 h post parandial. The serum was separated and stored at 0°C till analyzed. The serum collected with sodium fluoride and oxalate was used for assay of blood glucose (Trinder 1969), total protein (Henry *et al.* 1974), albumin (Doumas *et al.* 1971), globulin (calculated by difference between total protein and albumin), urea (Evans 1968), calcium (Henry and Dryer 1963) and phosphorus (Amador and Urban 1972).

Statistical analysis: The data were analyzed by simple ANOVA (Snedecor and Cochran 2004) by using SPSS (2007) version 16 and means were compared by using Tukey’s b test.

RESULTS AND DISCUSSION

Chemical composition of feedstuffs: The WB used in this study had negligible level of mycotoxins. The WB and TP

Table 2. Chemical composition of different feedstuffs (% DM basis)

Constituents	WB	TP	Conc. mix	UMMBs			Green fodder	Wheat straw
				Conventional	SSS	SSS-WB-TP		
Total ash	2.8	6.9	9.5	27.6	29.0	27.8	13.2	7.5
OM	97.2	93.1	90.5	72.4	71.0	72.2	86.8	92.5
CP	12.5	20.9	21.4	41.2	41.0	40.3	20.8	3.4
EE	1.3	11.0	4.1	1.4	1.4	1.9	2.0	1.0
NDF	10.0	68.0	30.0	11.0	12.0	15.0	46.0	78.0
ADF	2.0	53.0	14.0	6.3	5.0	7.5	35.0	50.5
Cellulose	1.5	38.0	8.0	2.0	2.0	3.0	18.0	41.0
Hemicellulose	8.0	15.0	15.5	4.8	7.0	7.5	11.0	27.5

WB,Waste bread; TP, tomato pomace; SSS, spent sugar syrup.

contained 12.5 and 20.9% CP; 1.3 and 11.0% EE, respectively, on dry matter basis (Table 2). WB is an excellent source of cooked bypass starch (Bhargava 2008). Besides energy and protein, TP is a good source of phosphorus, essential fatty acids (linoleic acid), lysine, vitamin E and lycopene, a pigment which gives a typical colour to meat and acts as an antioxidant (Kravchenko *et al*. 2003). The CP content of TP was higher than that in cereal grain but less than that in conventional oil seed cakes. The NDF, ADF, cellulose and hemi cellulose contents were much higher in TP as compared to that in WB. The sugar content in the SSS was 65–66°Bx, which was comparable with that of molasses available in the market. Total ash content in different UMMBs varied between 27.6 and 29.0%. The high ash content in the blocks could be due to high level of mineral mixture used as compared to that used in conventional conventional concentrate mixtures (150g/kg vs. 20g/kg). The comparable CP and EE in different UMMBs indicated that the blocks were iso-nitrogenous and iso-caloric. The WB had the lowest cell wall constituents followed by different blocks and other feedstuffs.

Effect of UMMBs on feed intake and digestibility of nutrients: The daily intake of concentrate mixture was comparable in all the groups (Table 3), while the daily intake of UMMBs varied ($P<0.05$) from 0.49 kg (SSS-UMMB) to 1.08 kg (conventional-UMMB). The intake of conventional-UMMB was higher ($P<0.05$) than that of SSS-UMMB, but comparable with that of SSS-WBTP-UMMB. Makkar (2007) also reported that the daily consumption of UMMB in cattle and buffaloes varied between 0.5 and 0.8kg/day. The comparable DM intake in all the groups suggested that incorporation of SSS, WB and/or TP did not have any negative impact on palatability of blocks. Toppo *et al*. (1997) observed increased consumption of dry matter in the UMMB supplemented groups. The roughage to concentrate ratio varied ($P<0.05$) from 14.5:85.5 (SSS-UMMB) to 18.9:81.1 (conventional-UMMB). The wider R:C ratio in SSS-UMMB group as compared to conventional-UMMB was mainly due to significantly ($P<0.05$) low intake of UMMB containing SSS as compared to conventional-UMMB. The water intake ($P>0.05$) was comparable in all the groups. The digestibility of nutrients

Table 3. Effect of supplementing the diet with UMMBs on feed consumption (kg/d)

Feedstuffs	UMMBs			PSE
	Conventional	SSS	SSS-WB-TP	
Conc. mixture	0.92	0.93	0.93	0.02
UMMB	1.08^{b}	0.49^{a}	0.88^{ab}	0.10
Wheat straw	7.78	7.27	6.96	0.19
Green fodder**	0.80^{a}	1.43^{b}	1.43^{b}	0.09
Total roughage	8.58	8.65	8.39	0.17
Total DM	10.58	9.81	10.51	0.20
Water, l/d	62.10	57.66	56.97	1.23
Roughage to concentrate ratio				
Concentrate*	18.90^{b}	14.48^{b}	17.22^{ab}	0.77
Roughage*	81.10^{a}	85.52^{ab}	82.78^{b}	0.77
Digestibility of nutrients, %				
DM	55.86	59.58	59.81	1.06
OM	58.73	60.81	60.94	0.88
CP	65.90	68.24	64.69	1.12
NDF	53.49	57.72	59.08	1.13
ADF	49.19	54.91	56.17	1.43
Cellulose	61.19	66.71	66.98	1.19
Hemicellulose	61.78	62.89	64.05	0.95

Figures with different superscripts in a row differ significantly ($P<0.05$).

improved ($P>0.05$) in the animals offered SSS-UMMB and SSS-WBTP-UMMB as compared to conventional blocks, but the differences were statistically nonsignificant. Faftine and Zanetti (2010) also reported increased digestibility of nutrients and ME availability in goats fed maize stovers supplemented with UMMB.

Effect of UMMBs on rumen metabolites and blood profile: The results revealed that TVFA production was comparable in all the groups while pH remained almost constant throughout the study (Table 4). Unal *et al.* (2005) observed higher TVFA concentration in the rumen of UMMB supplemented group. The NPN concentration was low ($P>0.05$) in the rumen liquor of animals offered diet supplemented with SSS-UMMB and SSS-WB-TP-UMMB. The efficient utilization of NPN resulted in considerably higher concentration of TCA-N in experimental UMMBs as compared to conventional-UMMB. These parameters

Table 4. Effect of supplementing the diet with UMMBs on rumen metabolites and blood profile

Feedstuffs	UMMBs			PSE
	Conventional	SSS	SSS-WB-TP	
Rumen metabolites				
pH	6.85	6.80	6.78	0.02
TVFAs, meq/dl	9.47	9.12	9.43	0.17
Total-N	74.97	75.12	72.35	1.90
TCA-N, mg/dl	41.83	48.72	46.44	1.53
NPN, mg/dl	33.13	26.40	25.91	1.89
NH_3-N, mg/dl	15.46	14.91	15.13	0.76
Blood profile, mg/dl				
Glucose	49.75	50.10	53.63	1.16
BUN	47.47	55.55	43.58	3.07
Total protein, g/dl	7.30	6.73	6.84	0.23
Albumin (A), g/dl	2.90	3.37	3.16	0.11
Globulin (G), g/dl	4.40	3.36	3.68	0.22
A:G	0.66	1.05	0.88	0.07
Creatinine	2.25	2.22	2.18	0.12
Calcium	10.82^a	13.16^b	12.91^b	0.35
Phosphorus	9.31	11.40	9.23	0.65

Figures with different superscripts in a row differ significantly (P<0.05).

Table 5. Effect of supplementing the diet with UMMBs on urinary purine derivatives (mM/day) in buffaloes

Parameter	UMMBs			PSE
	Conventional	SSS	SSS-WB-TP	
Allantoin	31.86	25.92	38.28	3.08
Uric acid	7.74	4.54	6.42	1.48
Purine derivatives (PD)	39.60	30.45	44.70	4.27
Creatitine	44.19	35.01	59.02	4.51
Allantoin as % of PD	83.26	83.93	86.53	2.25
Uric acid as % of PD	16.74	16.07	13.47	2.25
Purines absorbed	164.70	82.48	202.24	36.45
MNS, g/d	119.75	59.97	147.04	26.50

MNS, Microbial nitrogen synthesized in the rumen.

confirmed that experimental blocks provided nutrients synchronized in energy and protein. The blood profile of animals was comparable in all the groups, except that Ca level in the blood of animals offered diet supplemented with SSS-UMMB and SSS-WB-TP-UMMB was higher (P<0.05) than those offered diet supplemented with conventional-UMMB. The BUN concentration was high in all the groups (43.6 to 55.6mg/dl). Similar trend was observed by Unal *et al.* (2005) in UMMB supplemented group. The plasma concentration of different parameters was within the normal physiological range (Jain 1996, Kaneko 1997).

Impact on urinary excretion of purine derivatives: Allantoin, uric acid and the total purine derivatives excreted in urine of animals were comparable in all the groups (Table 5). Allantoin constituted the major (83.26–86.53%) proportion of total PD excreted in urine. The purine derivates absorbed and microbial protein synthesized in the rumen and in turn utilized in the lower gastro-intestinal tract were also comparable in all the groups, but considerably higher in SSS-WB-TP-UMMB offered group. The PDs excreted in urine were used to assess the microbial protein synthesized in the rumen. The comparable PDs excreted in the urine and microbial protein synthesized in the rumen in all the groups indicated that nutrients from different UMMBs were utilized effectively.

Table 6. Effect of supplementing the diet with UMMBs on nitrogen retention in buffaloes, g/d

Parameter	UMMBs			PSE
	Conventional	SSS	SSS-WB-TP	
N-intake	171.04	171.90	143.95	5.85
Faecal-N	58.05	54.26	50.88	1.88
Urinary-N	61.59	63.05	53.47	3.54
N-retained	51.41	54.60	39.60	4.50
N-retained as % of intake	38.17	31.80	27.58	3.53

Nitrogen utilization and body weight changes: The diet supplemented with UMMBs containing SSS or SSS-WB-TP did not show any adverse effect on the daily N-intake, N-excretion, N-retention or apparent biological value as compared to diet supplemented with conventional UMMB (Table 6). The animals in all the groups were in positive nitrogen balance and maintained their body weights. Faftine and Zanetti (2010) observed that UMMB supplementation reduced the loss in weight in goats during dry season.

It was concluded that non-conventional feed resources like spent sugar syrup, waste bread and tomato pomace could be incorporated into UMMBs without any adverse effect on palatability, nutrient utilization, rumen metabolites or health of animals. Above all the preparation of UMMB could be economized and conventional ingredients could be spared for more vulnerable species.

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