

Monensin Enriched Urea Molasses Mineral Block on Feed Intake, Nutrient Digestibility and Blood Glucose in Cattle Fed on Wheat Straw Based Diet

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ABSTRACT : Twelve adult male crossbred (Sahiwal×Holstein Friesian) cattle were distributed into four groups of three each on body weight basis. Animals were given wheat straw as a basal diet. The animals of group I and II were supplemented with concentrate mixture and animals of group III and IV were supplemented with cold processed urea molasses mineral block (UMMB). Thirty mg monensin/day/animal was supplemented to the animals of group II and 35 ppm monensin were incorporated in the UMMB supplemented to the animals of group IV. Vit.A and D mixture was given to all the animals once a week. Dry matter (DM) intake (kg/d) through wheat straw was 19.0 percent higher in the UMMB (without monensin) supplemented group (group III) than those of the concentrate mixture (without monensin) supplemented group i.e. group I. Total DM intake (kg/d) was lower in the monensin supplemented groups than those of non-supplemented groups though differences were not statistically significant. Digestible dry matter, organic matter (OM), crude protein (CP) and total digestible nutrients (TDN) intake were similar in all the groups. Average block consumption for 45 d period in the group III (0.95 kg/d) and group IV (0.84 kg/d) did not differ significantly. DM digestibility (%) was significantly ($p<0.01$) higher in the group II (58.9) as compared to the group I (52.7) and group III (54.0) but similar to the group IV (57.2). OM digestibility was also significantly ($p<0.05$) higher in the group II (63.2) as compared to that of the group I (54.9) but similar to the group III (57.8) and IV (59.2). Ether extract (EE) digestibility was significantly ($p<0.01$) higher in the group I (76.9) and II (80.3) as compared to the group III (59.87) and IV (55.77). Nitrogen free extract (NFE) digestibility was significantly ($p<0.05$) higher in the group II (62.38) as compared to that of the other groups. Crude protein (CP) and crude fibre (CF) digestibilities were not affected either due to UMMB or monensin. Nitrogen balance did also not differ significantly among the groups. However, Ca and P balance (g/d) in the group III (3.1, 1.3) and IV (3.0, 1.4) were significantly ($p<0.01$) higher than those of the group I (0.6, 0.2) and II (0.4, 0.3). Blood glucose (mg/100ml) was significantly ($p<0.01$) higher in the group II (65.2) and IV (65.2) as compared to the group I (55.2) and group III (53.9). Plasma urea-N level (mg/100 ml) in the group III (19.0) and IV (17.8) were significantly ($p<0.01$) higher than that of the group I (10.5) and II (12.3). So, monensin supplementation either with cold process UMMB or concentrate mixture did not show any additional effect on feed intake and digestibility but increases blood glucose level in adult cattle. (*Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 11 : 1579-1584*)

Key Words : Monensin, UMMB, Feed Intake, Digestibility, Blood Glucose

INTRODUCTION

Cattle are mainly dependent on poor quality roughages or crop residues in all tropical and sub tropical countries including India. Generally these feeds are deficient in fermentable nitrogen, carbohydrate and minerals to support rumen microbial growth and the host animal. One of the ways of increasing the utilization of this poor quality roughages is supplementation of these deficient nutrients in the form of urea molasses mineral block (UMMB) (Garg and Gupta, 1993), which is handy and can meet the requirement of rumen microbes thereby enhance rumen microbial growth which, in turn, enables the ruminant to consume more roughages. Feeding of these high cellulose and hemi cellulose containing feed to ruminant also helps to

produce more methane (Singh et al., 1995) which not only reduce the feed energy available to animal (Blaxter, 1962; Preston and Leng, 1989) but also causes global warming. Ionophore is an antimethanogenic carboxylic polyether antibiotic, which helps to increase propionic acid production and reduce methanogenic volatile fatty acids thereby reduce methane production (Goodrich et al., 1984; Andrae et al., 1995; De, 1998). As a general property of antibiotic, ionophore's activity is lost due to high temperature. Ionophore can not be incorporated in UMMB prepared through hot process as it involves use of high temperature. In the present study, an attempt has been made to prepare ionophore (monensin) enriched cold process UMMB to study the effect of ionophore on feed intake and digestibility when supplemented with UMMB or concentrate mixture.

MATERIALS AND METHODS

Preparation of UMMB

The following ingredients were used for preparing 10.0 kg UMMB-molasses 3.8 kg; urea 1.0 kg; salt 0.5 kg;

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mineral mixture 0.6 kg; calcium oxide 0.8 kg; sodium bentonite 0.4 kg; deoiled rice bran 1.9 kg; and cotton seed cake 1.0 kg.

The ingredients were mixed in the following sequences. First of all, the fixed amount of molasses was taken in a large plastic container and then monensin (in case of monensin enriched UMMB) was added to molasses and mixed properly. Then urea and salt were added with proper mixing. In separate container, mineral mixture, bentonite and calcium oxide were taken, mixed together and then poured into urea molasses slurry and mixed thoroughly. In another container deoiled rice bran and cotton seed cake were mixed and added to urea molasses mixture and mixed thoroughly with hand so that there was no lump in the semi solid mixture. Finally, mixed material was poured into plastic mould covered with polythene sheet. The blocks were allowed to settle for a period of 48 h.

Animals and management

Twelve male crossbred (Sahiwal×Holstein Friesian) adult (2.5-3.0 Yr.; 247.6 ± 2.33 kg body weight) cattle were divided into four groups of three each on body weight basis. The animals were kept in well-ventilated byre where there was provision for keeping UMMB licks separately. The animals were made free from external and internal parasite by applying butox 0.5% (v/v) and feeding albendazole (0.5 mg/kg body weight), respectively.

Feeding

The animals in the group I were fed concentrate mixture comprised of maize 320.0 g kg^{-1} , ground nut cake 350.0 g kg^{-1} , wheat bran 300.0 g kg^{-1} , mineral mixture 25.0 g kg^{-1} , and salt 5.0 g kg^{-1} . Animals of the group II were offered concentrate mixture supplemented with monensin (30 mg/d). Animals of the group III and IV were given UMMB and monensin (35 mg/kg block) enriched UMMB (UMMMB), respectively, for licking at free choice. Wheat straw was offered *ad libitum* to animals of all the groups. Quantity of monensin (i.e. 30 mg/d/animal) for animals of the group II was based on the consumption of monensin from UMMMB by animals of the group IV to keep the monensin consumption level as close as possible in both the groups. Feed was offered once daily at 9:00 AM. Blocks were kept in plastic container in a slanting position to avoid biting the block by animals. Licking pattern of block by animals were recorded through out the experimental period. Drinking water was freely available to all the animals. The animals of all the groups were given vitamin A and D mixture once a week to meet Vit. A and D requirement.

Metabolism trial

After a preliminary feeding of 35 d a metabolism trial of 7 d duration was conducted to determine nutrients intake,

digestibility and N, Ca and P balances. Animals were kept in metabolism stalls with provision for separate collection of faeces and urine. Cattle were placed in the metabolism stalls 5 d before the start of sample collection to acclimatize. Weighed amounts of feeds were offered daily to the animals, and samples of individual feeds offered and feed refusals, were collected for analysis. Amount of faeces and urine voided by experimental animals during the 24 h period was recorded for 7 d. Faeces were mixed thoroughly in a plastic trough and representative samples were taken to the laboratory for sub-sampling and further analysis. Similarly, the 24 h collection of urine was mixed thoroughly before sampling into a clean dry plastic bottle and brought to the laboratory each day for sub-sampling.

Blood glucose and plasma urea

Immediately after metabolism trial blood was collected by jugular vein puncture before offering feed and water to the animal. Blood samples were collected in 30 ml capacity tubes containing a drop of heparin solution (0.2 mg/ml). Immediately after collection, the tubes were gently rotated between palms in order to mix the blood uniformly with anticoagulant. One ml of blood was deproteinized immediately after collection for glucose estimation (Nelson, 1944). Remaining blood was centrifuged to separate plasma urea estimation (Rahmatullah and Boyde, 1980).

Chemical analysis

Wheat straw, UMMB, concentrate mixture and their residues and faeces were analyzed for proximate principles and urine was analyzed for N content (AOAC, 1984). Estimation of calcium in feed, water, faeces and urine was done according to Talapatra (1940). Phosphorus content in feed, faeces and urine was estimated as per method of Ward and Johnston (1962).

Statistical analysis

Differences between treatment effects were tested using analysis of variance in a 2×2 factorial design (Snedecor and Cochran, 1986).

RESULTS

Chemical composition

Drymatter (DM), organic matter (OM), ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE) content of UMMB were lower than those of concentrate mixture. However, nitrogen (N), calcium (Ca) and phosphorus content of block were higher than those of concentrate mixture (Table 1).

Feed intake

Total DM intake (kg/d) was less ($p > 0.05$) in the

Table 1. Chemical composition of feed¹

Parameter (%)	Concentrate mixture	Wheat straw	UMMB
DM	87.9	90.5	82.6
OM	90.8	89.8	70.1
N	3.1	0.5	6.4
EE	4.4	0.8	0.5
CF	9.5	38.4	6.8
NFE	57.8	47.3	56.4
Total ash	9.2	10.2	29.9
Ca*	0.7	0.2	4.0
P	0.6	0.1	1.7

* Ca content of water 0.0019 g/100 ml.

monensin treated groups (i.e. group II and IV) as compared to the monensin non-supplemented groups though differences were not statistically significant (Table 2). Total DM intake was 21.6 and 22.9 percent lower in the group II and 14.0 and 15.4 percent lower in the group IV as compared to that of the group I and III, respectively. DM intake kg/100 kg body weight (bw) and g/w^{0.75}kg did not differ significantly between the groups.

Digestible DM intake (DDMI) (kg/d), DDMI (kg/100 kg bw), DDMI (g/w^{0.75} kg) were statistically similar among different groups. Digestible OM intake (DOMI) (kg/d, kg/100 kg bw, g/w^{0.75}kg), digestible CP (DCP) and total digestible nutrients (TDN) intake also did not differ significantly between the groups (Table 2).

Licking pattern of block

The amount of block licked by animal per day for a period of 45 d has been given in Figure 1. UMMB consumption (fresh basis) by animals of the group III varied

in the range of 0.7-1.2 kg/d. Whereas UMMMB consumption (fresh basis) of animals of the group IV varied between 0.5-1.3 kg/d. Average consumption (kg/d) of block through out the period in the groups III and IV was 0.95 and 0.84, respectively, which did not differ significantly.

Digestibility of nutrients

DM digestibility of the group II was significantly ($p < 0.05$) higher than that of the groups I and III but similar to the group IV (Table 3). Although higher as compared to that of the group III, DM digestibility of the group IV did not significantly differ. DM digestibility in the group I and III also did not differ significantly. OM and NFE digestibilities were higher ($p < 0.05$) in the group II as compared to that of the group I. No significant difference in OM and NFE digestibility was observed between the group III and IV. CP and CF digestibilities were similar in all the groups. But, EE digestibility was significantly ($p < 0.01$) higher in the groups I and II as compared to that of the groups III and IV, however, no significant differences were observed between the group I and II and between the group III and IV.

N, Ca and P balances

N intake was significantly ($p < 0.01$) higher in the UMMB fed groups as compared to those of concentrate mixture fed groups (Table 4). N loss through faeces was lower ($p < 0.05$) in the monensin treated concentrate fed group (i.e. group II) than that of its respective control group (i.e. group I). N loss through faeces in the group III and IV did not differ significantly. N loss through urine was significantly ($p < 0.01$) higher in the UMMB fed groups as compared to concentrate fed groups. Total N excretion (g/d) in group II and IV were significantly ($p < 0.01$) lower than that of their respective control groups. N balance (g/d) was positive in all the four groups but did not differ significantly to each other. N absorbed (g/d) was significantly higher in the group III as compared to that of the group I. When monensin was supplemented no significant difference in N absorption was observed among monensin treated groups. The net protein utilization (NPU) and biological value (BV) were higher in the group II and IV as compared to their respective controls but the differences were not statistically significant.

Ca and P intake was significantly ($p < 0.01$) higher in the UMMB fed groups (Table 4). Ca loss through faeces and urine was also higher ($p < 0.01$) in the UMMB fed groups as compared to the concentrate mixture fed groups. Ca balance was positive in all the groups but significantly higher ($p < 0.01$) in the UMMB fed groups. P loss through faeces and urine was higher ($p < 0.05$) in the group III than that of the group I and II but P loss through urine was though in monensin treated groups but did not differ significantly

Table 2. Nutrients intake in cattle fed on concentrate and urea molasses mineral block based diet with or without monensin during metabolism trial

Parameter	G-I	G-II	G-III	G-IV
Feed intake (kg/d)				
Conc. mix.	1.4	1.4	-	-
UMMB	-	-	0.9	0.7
Wheat straw	2.9	2.0	3.5	3.0
TDMI (kg/d)	4.4	3.4	4.4	3.8
DMI (kg/100 kg bw)	1.8	1.4	1.8	1.5
DDMI (kg/d)	2.3	2.0	2.4	2.1
DOMI (kg/d)	2.0	1.9	2.2	1.9
DCP intake (g/d)	297.7	329.1	325.5	269.9
TDN intake (kg/d)	2.4	2.1	2.5	2.1

DDMI-Digestible dry matter intake; DOMI-Digestible organic matter intake; DCP-Digestible crude protein intake.

Treatments: G-I Wheat straw *ad lib.*+Concentrate mixture

G-II Wheat straw *ad lib.*+Concentrate mixture+monensin (30 mg/d)

G-III Wheat straw *ad lib.*+UMMB at free choice

G-IV Wheat straw *ad lib.*+monensin (35 ppm) enriched UMMB.

SEM values: Wheat straw intake-0.41; TDMI-0.40; DMI(kg/100 kg bw)-0.14; DDMI-0.21; DOMI-0.11; DCP intake-22.08; TDN intake-0.20.

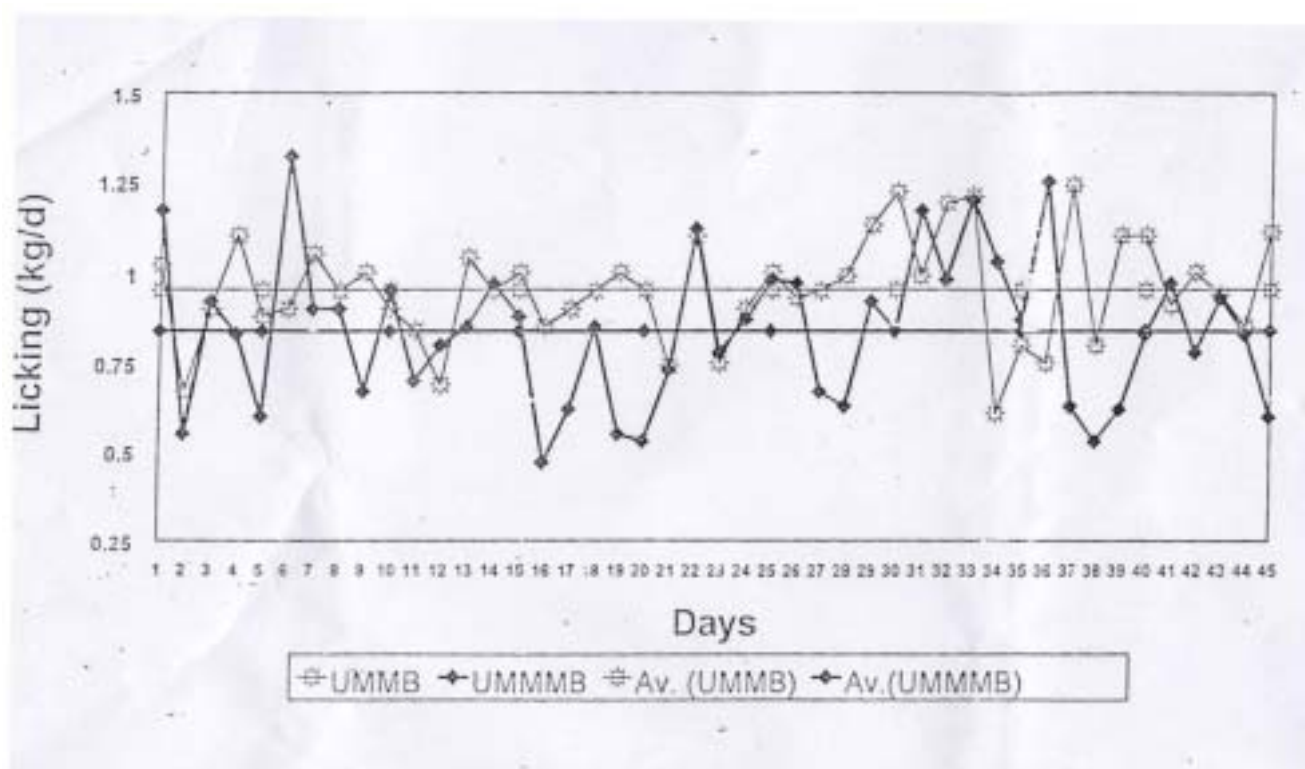


Figure 1. Licking pattern of UMMB in adult animals.

Table 3. Nutrient digestibility in cattle fed on concentrate and urea molasses mineral block based diet with or without monensin

Digestibility (%)	G-I	G-II	G-III	G-IV
DM**	52.9 ^a	58.9 ^c	54.0 ^{ab}	57.2 ^{bc}
OM*	54.9 ^a	63.2 ^b	57.8 ^{ab}	59.2 ^{ab}
CP	58.5	69.8	63.6	63.4
EE**	76.9 ^b	80.3 ^b	59.9 ^a	55.8 ^a
CF	60.0	63.2	62.1	62.4
NFE*	56.4 ^a	62.4 ^b	55.4 ^a	56.8 ^a

^{a,b,c} Values bearing different superscripts in a row differ significantly.

* $p < 0.05$, ** $p < 0.01$.

Treatments: G-I Wheat straw *ad lib.*+Concentrate mixture

G-II Wheat straw *ad lib.*+Concentrate mixture+monensin (30 mg/d)

G-III Wheat straw *ad lib.* + UMMB at free choice

G-IV Wheat straw *ad lib.*+monensin (35 ppm) enriched UMMB.

SEM values: DM digestibility-1.24; OM digestibility-1.85; CP digestibility-3.26; EE digestibility-1.91; CF digestibility-1.79 and NFE digestibility-1.48.

when compared with their respective control groups. P balance was higher ($p < 0.01$) in the UMMB fed groups as compared to that of concentrate fed groups.

Blood glucose and plasma urea

Blood glucose (mg/100 ml) level was significantly ($p < 0.01$) higher in the monensin supplemented groups (i.e. group II and IV) as compared to that of the monensin non-supplemented groups (i.e. group I and III) (Table 5). However, no significant difference in blood glucose level was observed between the groups I and III and between II

and IV. Plasma urea N level was significantly ($p < 0.01$) higher in the UMMB fed groups as compared to that of the concentrate fed groups. No significant difference was observed in plasma urea N level due to monensin treatment.

DISCUSSIONS

Increase in the wheat straw intake in the UMMB fed groups was obviously because of continuous supply of N, energy and minerals available from UMMB which, in turn improved the rumen microbial activity and fermentation pattern and consequently increased the straw consumption (Campling et al., 1962). Moreover, UMMB constituted only 19.5 to 20.8 % of total DM intake as compared to consumption of 32.3 to 41.2 % of DM through concentrate mixture in the group I and II. So, to fulfil their requirement, animals of the UMMB fed group (i.e. group III and IV) consumed more straw. The reduction in total DM intake in the monensin supplemented groups as observed by many workers (Davis et al., 1976; Raun et al., 1976; Boling et al., 1977; Faulkner et al., 1985; Stock et al., 1995) might be related to increased concentration of ruminal propionic acid or blood propionic acid or reduction in passage rate of digesta or some other chemostatic mechanism in animal (Theurer et al., 1974; De, 1998).

Digestibility coefficients of CP and CF were similar in all the groups fed either concentrate mixture or UMMB, either with or without monensin. When monensin was

Table 4. N, Ca and P balance in cattle fed on concentrate and urea molasses mineral block based diet with or without monensin

Parameter	G-I	G-II	G-III	G-IV
N balance				
N intake (g/d)**	65.1 ^a	58.9 ^a	83.8 ^b	70.7 ^{ab}
N excretion (g/d)				
Faeces*	34.3 ^b	22.9 ^a	30.4 ^{ab}	25.8 ^{ab}
Urine**	25.8 ^a	26.8 ^a	45.9 ^b	38.4 ^b
Total N excretion**	60.0 ^b	49.7 ^a	76.4 ^c	64.3 ^b
N absorbed (g/d)**	30.9 ^a	36.0 ^{ab}	53.4 ^c	44.8 ^{bc}
N absorbed (% of intake)	47.9	61.3	63.6	63.3
N retained (g/d)	5.2	9.2	7.5	6.4
NPU (%)	8.0	15.5	8.4	9.2
BV (%)	16.0	25.6	13.2	14.8
Ca balance				
Ca intake (g/d)**	14.8 ^a	13.2 ^a	43.3 ^c	34.8 ^b
Ca excretion (g/d)				
Faeces**	10.9 ^a	7.7 ^a	26.3 ^b	23.1 ^b
Urine**	3.4 ^a	5.2 ^b	13.9 ^d	8.7 ^c
Total Ca excretion**	14.2 ^a	12.8 ^a	40.2 ^c	31.8 ^b
Ca retained (g/d)**	0.6 ^a	0.4 ^a	3.1 ^b	3.0 ^b
P balance				
P intake (g/d)**	11.4 ^a	10.4 ^a	19.7 ^c	15.8 ^b
P excretion (g/d)				
Faeces**	8.0 ^a	7.1 ^a	13.9 ^b	10.8 ^{ab}
Urine*	3.2 ^{ab}	3.0 ^a	4.5 ^b	3.6 ^{ab}
Total P excretion**	11.2 ^a	10.1 ^a	18.4 ^c	14.4 ^b
P retained (g/d)**	0.2 ^a	0.3 ^a	1.3 ^b	1.4 ^b

NPU-Net protein utilization.

BV-Biological value.

^{a,b,c,d} Values bearing different superscripts in a row differ significantly.Treatments: G-I Wheat straw *ad lib.*+Concentrate mixtureG-II Wheat straw *ad lib.*+Concentrate mixture+monensin (30 mg/d)G-III Wheat straw *ad lib.*+UMMB at free choiceG-IV Wheat straw *ad lib.*+monensin (35 ppm) enriched UMMB.

SEM values: N intake-4.01; N excretion through faeces-2.99; N excretion through urine-2.73; Total excretion-1.73; N absorbed (g/d)-3.57; N absorbed (% of intake)-3.67; N retained- 2.85; NPU-3.81; BV-2.17; Ca intake-2.09; Ca excretion through faeces-2.07; Ca excretion through urine 0.45; Total Ca excretion-2.10; Ca retained-0.14; P intake-0.93; P excretion through faeces-1.12; P excretion through urine-0.39; Total P excretion-0.87; P retained-0.14.

added to concentrate mixture, it increased the DM, OM and NFE digestibility. This increase digestibility might be due to lower intake of DM by animals of the monensin supplemented groups (Goodrich et al., 1984; Schelling, 1984). Lower EE digestibility in both UMMB treated groups with or without monensin was due to very less amount of EE consumed by animals of both the groups as EE content of UMMB and wheat straw were very low. So, monensin supplementation with UMMB did not affect the digestibility coefficient of nutrients but improve DM, OM and NFE digestibility when added with concentrate mixture.

N intake and excretion were higher in the UMMB fed groups as compared to the groups fed concentrate mixture, which, in turn, resulted similar N balance in all the groups.

Table 5. Blood glucose and plasma urea N level in cattle fed on concentrate and urea molasses mineral block based diet with or without monensin

Parameter	G-I	G-II	G-III	G-IV
Blood glucose** (mg/100 ml)	55.2 ^a	65.2 ^b	53.9 ^a	65.2 ^b
Plasma urea N** (mg/ 100 ml)	10.5 ^a	12.3 ^a	19.0 ^b	17.8 ^b

^{a,b} Values bearing different superscripts in a row differ significantly (p<0.01).Treatments: G-I Wheat straw *ad lib.*+Concentrate mixtureG-II Wheat straw *ad lib.*+Concentrate mixture+monensin (30 mg/d)G-III Wheat straw *ad lib.*+UMMB at free choiceG-IV Wheat straw *ad lib.*+monensin (35 ppm) enriched UMMB.

SEM values: Blood glucose-2.74; Plasma urea N-1.12.

Monensin, when supplemented with concentrate mixture, reduced total N excretion as a result improved the N absorption and N balance in the group II. But when it was incorporated to block, it did not show any significant effect in terms of N absorption and N balance. This improvement in N absorption and balance might be due to improvement in lower tract digestibility (Haimoud et al., 1995). As N balances were positive in the groups fed UMMB and were similar to the groups fed concentrate mixture, it could be said that UMMB alone supplementation with wheat straw could be able to meet the maintenance requirement of animal.

Higher Ca, P balance in the groups III and IV might be due to higher Ca and P intake through UMMB lick which, after compensating the greater loss of Ca and P through faeces and urine, could help in higher retention of Ca and P. No significant (p>0.05) effect of monensin on Ca and P balance was observed, whereas, higher P retention in monensin fed steers was reported by Starness et al. (1984).

Increased blood glucose level in the monensin supplemented groups might be due to higher propionate production which is glucogenic in nature (Raun et al., 1976; Cinar and Sulu, 1995) or could be due to shifting of digestion of starch and other soluble sugar from rumen to lower tract from where it was absorbed as glucose (Haimoud et al., 1995).

Plasma urea N were significantly higher in UMMB fed groups irrespective of monensin treatment. Blood urea N levels indicate the adequacy or inadequacy of N in diet (Jindal et al., 1988). In this experiment it is clear from plasma urea N level of all the groups that N content of the diet was adequate in all the groups and as the N intake by animals of the UMMB fed groups were higher, plasma urea N level were higher in these particular groups. Monensin had no effect on alteration of plasma urea N level as observed in some previous experiments (Badawy et al., 1996; Stephenson et al., 1997).

From this experiment it can be concluded that monensin

supplementation either with UMMB or concentrate mixture do not have any effect on OM, CP, CF, EE and NFE digestibility and plasma urea N level but can increase blood glucose level in cattle.

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