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Effect of Feeding Molasses Based Multi-nutrient Liquid Supplement on Lactation Performance, Nutrient Utilization and Blood Metabolic Profile of Crossbred Cows

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ABSTRACT

An experiment was conducted to assess the lactation performance and intake and digestibility of nutrients of mid-lactating crossbred dairy cows fed with molasses based multi-nutrient liquid supplement (MMLS). Eighteen mid-lactating cows were divided into three groups (T_1, T_2 and T_3) with 6 cows in each group on the basis of body weight and milk yield. Cows were fed concentrate mixture, green fodder and wheat straw. T_1 group was fed basal diet without MMLS, T_2 and T_3 groups were fed MMLS replacing 15 and 30% concentrate mixture, respectively. MMLS feeding did not show any significant change (P>0.05) in average intake of dry matter (DM), organic matter (OM), crude protein (CP), Neutral detergent fibre (NDF) and Acid detergent fibre (ADF) as compared to control. The ether extract (EE) intake of MMLS fed groups was lower (P<0.05) due to high EE content of concentrate mixture as compared to MMLS. The digestibility of DM, OM, CP, EE, NDF and ADF was comparable (P>0.05) among all three groups. MMLS feeding did not show any significant change in lactation performance of the animals. The fortnightly DMI, body weight changes and blood metabolic profile were also found to be comparable among the groups. The data indicated that there was no adverse effect on nutrient intake and digestibility, lactation performance, DMI, body weight changes and blood metabolic profile due to feeding of MMLS to mid-lactating dairy cows replacing up to 30% of concentrate mixture.

HIGHLIGHTS

- Lactation performance, nutrient digestibility of mid–lactation cows fed with molasses based multi-nutrient liquid supplement.
- Effect of molasses based multi-nutrient liquid supplementation on blood profile of lactating cows.

Keywords: Blood metabolic profile, Dairy cow, Lactation performance, Molasses based multi-nutrient liquid supplement, Digestibility

Dairying has become an important secondary source of income for millions of rural families and has assumed the most important role in providing employment and income generating opportunities particularly for marginal and women farmers. Availability of oil cakes as protein supplement for animals in developing countries is very poor and at a very high price, this has led to use non-protein nitrogen source as urea, to compensate for the nitrogen deficiency of fibrous feeds (Dutta *et al*., 2004). Thus, enhancing intake, digestibility and availability of nutrient from poor quality roughages are only possible through optimization of rumen fermentation. Urea in combination with readily available energy source (molasses) was found promising when either fed with or sprayed over poor

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quality roughages, or used as urea-molasses supplement (Dass *et al.,* 1996; Kyawt *et al*., 2023).

Among the various dietary supplementations, urea molasses minerals can improve the utilization of low-quality roughages because it satisfies the requirements of the rumen microorganisms and creates a better environment for the fermentation of fibrous material which eventually increases the production of microbial protein and volatile fatty acids (Wongnen, 2007). Lestari *et al.* (2016) reported that urea molasses mineral supplementation can provide energy, non-protein nitrogen, minerals and vitamins and other nutrients to ruminants. Lawania and Khadda (2017) inferred that the supplementation of urea molasses minerals to the zebu lactating cows under field conditions improved their milk yield and reproductive performance besides reducing cost of milk production. Molasses based liquid supplements have been used as a source of non-protein nitrogen, energy, minerals and vitamins for dairy cows. Liquid feed supplements offer an alternative delivery vehicle for supplemental fat, protein, and rumen-fermentable carbohydrates, minerals and vitamins in rations for lactating dairy cows. Therefore, an attempt was made to evaluate the effect of feeding molasses based multi-nutrient liquid supplement (MMLS) on lactation performance, nutrient utilization, blood metabolic profile in crossbred dairy cows in mid stage of lactation.

MATERIALS AND METHODS

Animals and diets

The experiment was conducted on a total of 18 multiparous crossbred dairy cows in the mid stage of lactation at Cattle and Buffalo Farm, Indian Veterinary Research Institute, Izatnagar. All the dairy cows were fed to meet out nutrient requirement as per ICAR (2013). The dairy animals were distributed into three groups (T_1, T_2 and T_3) of 6 dairy cows in each group using completely randomized design on basis of milk yield per day and body weight. The animals of T_1 group were fed basal diet of green maize (5 kg dry matter) and *ad libitum* wheat straw. Along with green maize and wheat straw, the required amount of concentrate mixture to meet their nutrient requirements for maintenance and milk production were also provided in T_1. In group 2 (T_2), the concentrate mixture was replaced by MMLS by 15% based on crude protein whereas in treatment group 3 (T_3), the concentrate mixture was replaced by MMLS by 30%. The composition of concentrate mixture included crushed maize, 35%; de-oiled soybean meal, 17%; mustard cake, 5%; wheat bran, 40%; mineral mixture, 2% and common salt, 1%. MMLS consisted of molasses, 64%; urea, 9%; de-oiled mahua cake, 10%; guar meal, 10%; mineral mixture, 4%; common salt, 1%; vitamin E, 7500 mg and water (for dissolving urea), 2%. Throughout the experimental period of 100 days, clean and fresh drinking water was provided *ad libitum.* They were maintained under uniform management and hygienic conditions.

Data recording and sampling

A digestion trial on all the animals was conducted after 90 d of feeding. The feed offered and the residue left were weighed after 24 hours of feeding daily. Body weight of each animal was recorded at monthly intervals. The chemical composition of concentrate mixture, MMLS, green maize and wheat straw is given in Table 1. During digestion trial of six days duration, faecal samples were collected after 24h of feeding. The samples of feed offered, residue and faeces were analyzed according to standard procedures (AOAC, 2000) to calculate nutrient digestibility. Daily milk yield of all the animals were recorded morning and evening throughout the experimental period. Milk samples were collected at fortnightly intervals to analyze the various milk constituents namely fat, lactose, protein, solids not fat (SNF) and total solids (TS). Blood samples were collected at the start and end of the experiment and analyzed for various blood metabolites.

Table 1: Chemical composition of concentrate mixture, MMLS, wheat straw and green fodder (% DM basis)

Attributes	Concentrate Mixture	MMLS	Wheat Straw	Green Maize
Organic Matter (OM)	93.76	87.84	91.06	91.58
Crude Protein (CP)	18.4	30.1	2.98	9.46
Ether Extract (EE)	2.18	1.31	1.28	2.06
Neutral Detergent Fiber (NDF)	32.43	7.87	75.31	66.85
Acid Detergent Fiber (NDF)	11.26	6.26	57.48	40.12
Total Ash (TA)	6.24	12.16	8.94	8.42

STATISTICAL ANALYSIS

The data were analyzed using General Linear model ANOVA procedures and means were compared using Duncan Test (SPSS Version 16.0, SPSS Inc., Chicago, USA). The difference between means was declared significant at $P<0.05$.

RESULTS AND DISCUSSION

Intake and digestibility of various nutrients

The plane of nutrition of dairy cows during digestion trial is presented in table 2. The mean body weight (kg) of animals during digestion trial was 347±7.6, 353±8.3 and 368±14.4 in groups T_1, T_2 and T_3 respectively, which were similar among the groups. Daily intake (kg/d) of DM, OM, CP, NDF, ADF, DCP and TDN by crossbred dairy cows did not differ significantly ($P>0.05$) among different treatment groups. However, the EE intake was significantly lower ($P<0.05$) in the treatment groups as compared to control group. This might be due to the higher ether extract content of concentrate mixture as compared to MMLS as evident from chemical composition (Table 1). The results indicated that the mean dry matter intake did not vary significantly among the three groups. Our results corroborate well with those of Patil *et al.* (2019), Sahoo *et al.* (2004) and Hosamani *et al.* (1998) who also observed that there was a non significant increase in intake of DM and TDN due to urea molasses mineral supplement feeding in buffaloes. Mohini and Singh (2010) also observed no significant difference in intake of DM, CP, DCP and TDN in crossbred dairy cows fed urea molasses mineral block replacing 35% of concentrate mixture and those fed standard ration without urea molasses mineral block. The digestibility of various nutrients is presented in Table 2. The digestibility of DM, OM, CP, EE, NDF and ADF was comparable ($P>0.05$) among the different dietary treatments. In the present study, feeding of MMLS did not affect the digestibility of DM, OM, CP, EE, NDF and ADF in treatment groups. Patil *et al.* (2019) also noted no significant influence in nutrient digestibility of dairy buffaloes fed urea molasses mineral supplement at the rate of 250 gram per animal. Mohini and Singh (2010) also observed non-significant changes in digestibility of DM, OM and CP in crossbred dairy cows fed urea molasses mineral block replacing 35% of concentrate mixture and those fed standard ration without urea molasses mineral block. Similar results were also observed by Singh and Kishan (1994) fed urea either mixed with concentrate mixture or wheat straw or as urea-ammonia treated straw to buffalo in order to meet out 30% of the protein requirement through urea, and observed that urea supplementation in either mode did not influence the dry matter intake and digestibility of OM, EE, NFE and total carbohydrates except urea ammoniated straw group. Similarly, Chauhan *et al.* (1995) also reported that the digestibility of DM, OM, CP, CF and NFE were similar in all the experimental groups in comparison to control when 20% concentrate mixture was replaced by feeding urea molasses mineral block at 600-700 gram to buffalo heifers along with wheat straw and berseem fodder.

Table 2: Nutrient intake and digestibility of dairy cows in various groups

Attributes	Groups †			SEM	P value
	T_1	T_2	T_3		
Intake (kg/d)					
DM	11.01	10.69	10.84	0.06	0.092
OM	10.16	9.84	9.93	0.05	0.056
CP	1.55	1.56	1.59	0.01	0.078
EE (g/d)	234.50^{a}	224.57^{b}	220.53^{b}	1.06	0.011
NDF	5.19	5.10	5.12	0.04	0.089
ADF	3.15	3.04	3.19 b	0.03	0.094
Apparent digestibility (%)					
DM	69.84	69.67	69.74	0.36	0.986
OM	71.69	71.42	71.39	0.34	0.944
CP	68.91	69.82	69.95	0.37	0.465
EE	78.34	77.91	77.26	0.26	0.258
NDF	63.68	62.67	62.87	0.47	0.656
ADF	54.74	54.17	55.92	0.62	0.516
Plane of nutrition (kg/day)					
DOMI	7.28	7.02	7.09	0.06	0.156
DCPI	1.07	1.09	1.11	0.01	0.089
TDNI	7.51	7.24	7.31	0.06	0.134

DOMI: digestible OM intake; DCPI: digestible CP intake; TDNI: total digestible nutrient intake.

[ab]Mean values with different superscripts within a row differs significantly ($P<0.05$).

† Cows in group T_1 received standard diet of concentrate, green & wheat straw to meet the requirement (ICAR, 2013). However, 15 & 30% of the concentrate was replaced with MMLS in T_2 and T_3, respectively.

Lactation performance

The fortnightly changes in milk yield are given in Table 3a. There was no significant difference among the three groups (P>0.05) with respect to milk yield, 4% fat corrected milk, energy corrected milk, fat yield and protein yield, indicating that feeding of MMLS to replace 15% and 30% of concentrate mixture to crossbred dairy cows did not have any adverse effect (P>0.05) on the milk yield. The non-significance in the milk yield between the groups showed that the MMLS provided enough nutrients to compensate the reduced intake of concentrate mixture in the MMLS fed groups. The results are in agreement with Mohini and Singh (2010) who also observed non-significant difference in milk yield in crossbred dairy cows fed urea molasses mineral block replacing 35% of concentrate mixture and those fed standard ration without urea molasses mineral block.

Table 3a: Average milk yield per day (kg) of dairy cows in various groups

Fortnights	Groups			SEM	P value
	T_1	T_2	T_3		
1	13.67	14.17	13.42	0.30	0.603
2	12.6	12.9	13.05	0.32	0.858
3	11.21	11.66	12.37	0.45	0.584
4	10.35	10.6	11.23	0.46	0.742
5	9.75	10	10.43	0.41	0.802
6	9.51	9.38	9.73	0.36	0.933
7	9.06	8.86	9.16	0.33	0.938
Average	10.87	11.09	11.34	0.35	0.873

In contrary to our study, Akter *et al*. (2004) reported that supplementation of urea molasses mineral block to dairy cows also receiving straw based diets increased the milk production from 2.86 to 4.43 l/d (P<0.01). The increase in milk yield is mainly explained by the increased intakes of energy and nitrogen. Wanapat *et al.* (1999) observed significant increase in milk yield of lactating dairy cows due to feeding of urea molasses mineral block. Plaizier *et al*. (1999) also reported that supplementation of urea molasses blocks in dairy cows also receiving *ad libitum* grass hay and 6 kg/d of maize bran showed increased milk production from 6.7 l/d to 11.2 l/d (P<0.05). Patil *et al.* (2019) also noted increased milk yield in dairy Murrah buffaloes supplemented with 250 g urea molasses supplement. Ramesh *et al*. (2009) also observed that feeding of urea molasses mineral block improved milk yield both in buffaloes and cows. This is because of urea molasses mineral block supplementation over and above concentrate mixture and feeds offered to lactating animal in control group. However, in the present study, concentrate mixture was replaced by 15 and 30% with equi-protein basis so treatment groups T_2 and T_3 were iso-nitrogenous and iso-caloric diets, daily milk production in all the three groups was comparable.

The percent lactose, protein, fat, total solids, SNF in milk did not differ significantly (P>0.05) between T_1, T_2 and T_3 groups (Table 3b). From the results it was clear that there was no significant effect of dietary treatment on the composition of the milk. Similar results were also observed by Patil (2017) when milch buffaloes were supplemented with urea molasses multi-nutrient supplement (MMS). Mohini and Singh (2011) who observed no significant difference in milk fat and SNF in crossbred dairy cows fed UMMB replacing 35% of concentrate mixture and those fed standard ration without UMMB. Plazier *et al*. (1998) also reported that supplementation of urea molasses blocks in dairy cows also receiving *ad libitum* grass hay and 6 kg/d of maize bran showed no significant effect on milk composition. Akter *et al*. (2004) also reported that supplementation of urea molasses mineral block to dairy cows also receiving straw based diets improved the milk yield but did not cause any significant changes in milk composition in dairy cows. On contrary to our findings, Ramesh *et al.* (2009) observed that feeding of UMMB significantly improved milk fat and SNF yield both in buffaloes and cows. Yadav *et al*. (2011) reported significant increase in fat percentage in milk of lactating buffaloes supplemented with UMMB @ 300 g/day/head. Similar result is also reported by Chauhan *et al.* (1997).

Fortnightly DMI and Body weight changes

The fortnightly pattern of dry matter intake of the milch cows in the three different groups is presented in Table 4. The fortnightly dry matter intake was similar (P>0.05) among all the three groups. Akter *et al.* (2004) also observed no significant difference in dry matter intake when provided urea molasses multi-nutrient blocks to crossbred dairy cows fed rice straw and green grass. Zile *et al.* (2007) also reported no change in the total dry matter intake in

Table 3b: Fat yield, protein yield, 4% FCM, ECM, lactose, protein, fat, total solids and SNF of dairy cows in various groups

Attributes	T_1	T_2	T_3	SEM	P value
Fat Yield (g/d)					
Initial	553.19±31.57	547.52±31.92	560.74±18.29	15.48	0.94
Final	476.13±18.07	486.13±34.96	495.14±25.97	15.11	0.88
Protein Yield (g/d)					
Initial	367.96±16.39	361.21±20.58	375.94±9.69	9.03	0.81
Final	313.62±17.60	319.38±21.91	325.89±15.58	10.29	0.89
4% FCM					
Initial	13.44±0.69	13.28±0.75	13.66±0.40	0.35	0.91
Final	11.49±0.49	11.73±0.82	11.96±0.59	0.36	0.87
ECM					
Initial	14.03±0.69	13.84±0.78	14.28±0.41	0.36	0.89
Final	11.99±0.54	12.23±0.85	12.48±0.62	0.38	0.88
Milk lactose (%)					
Initial	4.51±0.02	4.47±0.01	4.45±0.02	0.01	0.38
Final	4.46±0.03	4.50±0.02	4.48±0.04	0.02	0.36
Milk protein (%)					
Initial	3.36±0.08	3.37±0.10	3.29±0.06	0.04	0.74
Final	3.38±0.10	3.39±0.06	3.37±0.10	0.05	0.77
Milk fat (%)					
Initial	4.30±0.13	4.32±0.06	4.28±0.07	0.05	0.80
Final	4.42±0.08	4.39±0.09	4.38±0.05	0.04	0.82
Total solids (%)					
Initial	12.36±0.13	12.32±0.06	12.30±0.07	0.05	0.76
Final	12.46±0.09	12.48±0.10	12.43±0.07	0.06	0.74
Solids not fat (%)					
Initial	8.06±0.04	8.01±0.03	8.02±0.02	0.02	0.79
Final	8.04±0.02	8.09±0.03	8.06±0.02	0.01	0.82

UMMB fed groups of lactating buffaloes maintained on wheat straw and sorghum fodder. Ramesh *et al*. (2009) maintained crossbred dairy cows (control) on conventional diet of paddy straw and concentrate supplement while other group was fed conventional diet plus UMMB *ad libitum* for 60 days. They also observed that feeding of UMMB along with basal diet did not influenced the dry matter intake. On contrary to our findings, Chauhan *et al.* (1995) reported significant increase in dry matter intake in UMMB fed groups in lactating buffaloes. Plazier *et al*. (1998) reported supplementation of urea molasses blocks in dairy cows also receiving *ad libitum* grass hay and 6 kg/d of maize bran, increased dry matter intake from 10.1 kg/d to 12.0 kg/d ($P<0.05$).

Table 4: Fortnightly mean dry matter intake (kg/d) of dairy cows in various groups

Fortnights	T_1	T_2	T_3	SEM	P-value
0	12.02±0.22	11.56±0.10	11.8±0.21	0.11	0.25
1	11.48±0.25	11.69±0.15	11.74±0.18	0.11	0.62
2	11.29±0.16	11.57±0.18	11.69±0.19	0.10	0.29
3	11.19±0.11	11.28±0.09	11.31±0.28	0.09	0.90
4	11.10±0.17	11.13±0.21	11.32±0.26	0.12	0.75
5	10.94±0.09	11.02±0.32	10.97±0.28	0.14	0.98
6	10.70±0.08	10.92±0.09	10.75±0.19	0.07	0.52
7	10.44±0.17	10.49±0.13	10.69±0.19	0.09	0.52

The monthly body weight changes of milch cows during lactation trial are presented in Table 5. The live weights (kg) of dairy cows did not differ significantly among treatment groups throughout the trial period. The animals in MMLS fed groups were able to maintain the live body weight as similar as the control group. The MMLS provided NPN and other essential nutrients in right proportions to rumen microbes resulting in more conversion of fermentable nitrogen into microbial protein and cellulosic material to volatile fatty acids. Singh *et al.* (1994) have reported that supplementation of UMMB significantly ($p<0.05$) enhanced microbial population in buffaloes. Akter *et al.* (2004) also reported no significant change in body weight in crossbred dairy cows fed urea molasses multi-nutrient blocks when compared to control animals fed concentrate, rice straw and green grass.

Table 5: Monthly body weight changes (kg) of dairy cows in various groups

Months	T_1	T_2	T_3	SEM	P-value
0	335.00 ± 11.69	331.67 ± 11.67	344.17 ± 15.29	7.16	0.78
1	336.67 ± 11.45	331.67 ± 10.69	348.33 ± 15.26	7.06	0.64
2	341.66 ± 11.45	334.17 ± 11.14	346.67 ± 15.37	7.05	0.79
3	343.33 ± 10.78	336.67 ± 10.70	350.00 ± 15.17	6.85	0.75

Blood metabolic profile

The blood metabolic profile of the milch cows in the three different groups is presented in Table 6.

Table 6: Hemato-biochemical parameters of dairy cows in various groups

Attributes	T_1	T_2	T_3	SEM	P-value
Hemoglobin (%)					
Initial	10.71 ± 0.25	10.65 ± 0.22	11.76 ± 0.27	0.13	0.74
Final	11.29 ± 0.16	11.57 ± 0.18	11.69 ± 0.19	0.15	0.69
PCV (%)					
Initial	31.00 ± 0.60	31.17 ± 0.81	30.50 ± 0.76	0.39	0.44
Final	29.83 ± 0.48	29.67 ± 0.84	29.33 ± 0.49	0.34	0.41
Glucose (mg/dl)					
Initial	50.91 ± 0.92	51.01 ± 0.73	51.18 ± 0.76	0.44	0.91
Final	52.43 ± 1.03	53.03 ± 0.23	52.79 ± 0.99	0.45	0.89
Urea (mg/dl)					
Initial	47.38 ± 1.36	50.55 ± 1.92	48.68 ± 1.28	0.89	0.64
Final	50.31 ± 0.75	47.56 ± 1.79	50.64 ± 1.73	0.88	0.58
BUN (mg/dl)					
Initial	22.14 ± 0.63	23.62 ± 0.90	22.75 ± 0.59	0.42	0.63
Final	23.51 ± 0.35	22.23 ± 0.84	23.66 ± 0.81	0.41	0.62
Total protein (g/l)					
Initial	72.01 ± 0.80	70.94 ± 1.03	70.51 ± 0.94	0.53	0.29
Final	71.29 ± 1.02	69.49 ± 0.86	69.92 ± 0.99	0.55	0.30
Albumin (g/l)					
Initial	35.26 ± 0.50	34.31 ± 0.39	34.43 ± 0.49	0.28	0.26
Final	34.05 ± 0.76	33.95 ± 0.35	33.69 ± 0.89	0.39	0.33
Globulin (g/l)					
Initial	36.68 ± 0.39	36.63 ± 0.84	36.07 ± 0.72	0.37	0.70
Final	37.24 ± 0.42	36.54 ± 0.35	36.21 ± 0.93	0.34	0.65
A/G ratio					
Initial	0.96 ± 0.01	0.94 ± 0.02	0.96 ± 0.02	0.01	0.81
Final	0.91 ± 0.02	0.96 ± 0.01	0.93 ± 0.02	0.01	0.79
ALT (IU/dl)					
Initial	31.82 ± 1.16	31.85 ± 1.02	31.49 ± 0.46	0.51	0.93
Final	30.24 ± 1.33	30.62 ± 0.78	31.09 ± 1.00	0.58	0.84
AST (IU/dl)					
Initial	88.65 ± 3.19	90.56 ± 5.68	88.85 ± 6.28	2.84	0.78
Final	91.71 ± 6.18	91.06 ± 6.06	91.79 ± 6.15	3.33	0.82
Calcium (mg/dl)					
Initial	9.95 ± 0.14	9.78 ± 0.09	9.83 ± 0.07	0.06	0.91
Final	9.61 ± 0.29	10.05 ± 0.13	9.93 ± 0.18	0.12	0.83

Phosphorus (mg/dl)					
Initial	6.06 ± 0.10	6.04 ± 0.12	6.03 ± 0.09	0.06	0.95
Final	5.94 ± 0.09	5.96 ± 0.14	5.99 ± 0.09	0.06	0.91

The hematological parameters, hemoglobin (Hb) and packed cell volume (PCV) was comparable among all groups. The serum biochemical parameters studied to understand the effect of dietary treatment on physiology of milch cows included serum glucose, urea and blood urea nitrogen (BUN), total protein, albumin, globulin (g/dl) and A:G ratio and serum concentration of ALT, AST, Calcium and Phosphorus. Neither of the hematological or biochemical parameters did exhibit any significant variation among the various treatment groups.

CONCLUSION

It may be concluded that 30% of concentrate mixture can be replaced with MMLS without having any significant effect on intake and digestibility of nutrients, lactation performance, body weight changes and blood metabolic profile of crossbred cows in mid-lactation.

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