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Effect of replacement of concentrate mixture protein with stylo meal on intake, nutrient utilization and growth performance of crossbred heifers

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ABSTRACT

Growing crossbred (15) heifers (average BW 201.96±4.2 kg), randomly divided into 3 equal groups of 5 animals each, were offered a composite ration of wheat straw and concentrate mixture and/or stylo meal to investigate the effect of replacing concentrate mixture with stylo meal on feed intake, nutrient utilization and growth performance. The animals of control group (T_1) were fed wheat straw and concentrate based diets as per requirement while in T_2 and T_3 groups, CP of concentrate mixture was replaced with stylo meal by 50% and 100%, respectively. All the animals were under this feeding regime for 120 days and a metabolism trial was conducted towards the end of experimental feeding. Average daily dry matter intake (DMI) was higher in T_2 and the values being 5.89, 6.34 and 5.93 kg in T_1, T_2 and T_3, respectively. DCP intakes in T_1 and T_2 were sufficient for daily gain of 600g, while it was sufficient for 500g only in T_3. TDN intake was significantly higher in T_2 than T_1 or T_3. N balance (g/d) and daily live weight gain (g) was nonsignificantly higher in T_1 and T_2 than T_3. Plasma glucose, protein and urea N were within the normal physiological range in all the groups. It was concluded that 100% concentrate crude protein could be replaced with stylo meal safely and inexpensively, however, for achievement of optimum growth performance, 50% CP of concentrate should be replaced with stylo meal in the diet of crossbred heifers.

Key words: Crossbred heifers, Growth performance, Nutrient utilization, Stylo meal

The crop residues like paddy and wheat straw, stovers and grasses form the major component of ruminant diet in India. However, the nutritional value of these feedstuffs needs to be improved to achieve high productive performance. Leguminous fodders were identified as potential suitable supplements (Richards *et al.* 1994). The production requirement is often met through protein supplements like groundnut cake, mustard cake or cottonseed cake and very seldom from concentrate mixture. But the cost of concentrate and oilcakes, limit their widespread use. Under such circumstances, the most economic way to improve protein and energy intake and subsequently to improve the performance of animals fed on crop residues is to supplement with good quality legume forages such as *Stylosanthes hamata* meal. Hence, the objectives of this experiment were to investigate effect of supplementation with stylo meal to replace the concentrates on nutrient utilization and growth performance of crossbred heifers fed wheat straw based ration.

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MATERIALS AND METHODS

Fifteen crossbred (Tharparkar×Jersey) heifers (BW 201.96±4.2kg) were randomly divided into 3 equal groups comprising 5 in each. The average body weights were 201.97±6.19, 200.91±11.36 and 203.00±7.40 kg in T_1, T_2 and T_3, respectively. The animals of group T_1 served as control and were maintained on the diets consisting of wheat straw and concentrate mixture (mustard cake 35 parts, barley 25 parts, wheat bran 38 parts, mineral mixture 1 part, salt 1 part), while crude protein content of the concentrate mixture was replaced with stylo (*Stylosanthes hamata*) meal to the extent of 50% and 100% in T_2 and T_3 for 120 days. Weighed quantities of feed were offered in separate troughs to individual animal once daily at 10.00 h for the entire experimental periods. Leftover was quantified daily. Clean drinking water was provided twice daily (11.00 and 16.00 h). Weekly body weight changes were recorded. Fifteen days before the end of the experimental feeding, a metabolism trial of 7-day duration was conducted. Dry matter in feed and faeces was determined by oven drying at 100°C overnight. For chemical analysis, pooled samples of feed offered, refusals and faeces were dried at 60°C and ground to pass through a 2 mm sieve. Wet faeces and urine samples,

preserved in diluted and concentrated sulphuric acid, respectively, were analyzed for N by the standard micro Kjeldhal method. Feed and faeces samples were analyzed for CP, EE and total ash contents (AOAC 1995) and fiber fractions (Van Soest *et al*. 1991). Blood samples were collected towards the end of experimental feeding in heparinized test tubes to study the various metabolites, viz. glucose (Somogyi 1945), urea (Rahmatullah and Boyde 1980) and protein (Reinhold 1953). The data was subjected to analysis of variance for statistical significance among the treatment means (Snedecor and Cochran 1969).

RESULTS AND DISCUSSION

Crude protein contents were 10.75, 3.40 and 18.62 in stylo meal, wheat straw and concentrate mixture, respectively (Table 1). Protein and fiber contents of stylo meal were comparable with earlier report of Pailan *et al*. (2005). However, Iyeghe-Erakpotobar (2006) reported higher CP content in stylo hay which might be due to early stage of harvest as evident from its lower fiber contents. Amino acid content of stylo meal indicated that it was richer in methionine and comparable in lysine when compared with *Stylosanthes seabrana* and *S. scabra* (Gupta *et al*. 1992).

DM intake was improved (P>0.05) by replacement of concentrate with stylo meal in T_2 as compared to T_1 and T_3. Thang *et al*. (2008) reported that there were no significant differences in total feed intake in growing cattle with increasing levels of replacement with mixed legume foliages. Kiyothong and Wanapat (2003) also concluded that supplementation of cassava hay, solely or in combination with stylo hay, did not increase total DM and forage intake. However, Das and Singh (2005) reported increased feed intake in growing crossbred male calves where groundnut cake was replaced with green berseem in wheat straw based diet. On the contrary, Richards *et al*. (1994) recorded reduced total DMI when concentrate was replaced with *Gliricidia sepium* leaves, which was probably due to some palatability problem and varied levels of condensed tannin. Hence, the variable responses observed in different experiments on replacement of concentrates with leguminous forages could be due to differences in the form of supplemental feeding, whether it is green or dry, the nature of basal diet or presence of anti-nutritional factors etc. DMI (%BW) or DMI/kg$W^{0.75}$ in all the groups was comparable with the suggested value (ICAR 1998). DCP intake was significantly (P<0.05) higher in T_1 and T_2 than T_3, whereas TDN intake was higher in T_2 than T_1 or T_3. However, Rao *et al*. (2003) reported no effect on DCP and TDN intake in goats. DCP intake was sufficient to support 600 g daily gain in T_1 and T_2 and 500 g daily gain in T_3 (ICAR 1998). TDN intake in T_1 and T_3 was closed to

Table 1. Chemical composition of different feedstuffs (% DM basis)

Parameters	Wheat straw	Stylo meal	Concentrate mixture
CP	3.4	10.75	18.62
OM	93.18	89.25	89.98
NDF	69.84	44.72	26.80
ADF	50.76	33.78	8.18
EE	1.40	1.82	5.78
CF	38.60	32.00	5.34
Ash	6.82	10.02	10.75
Amino acids (mg/g)			
Asp	-	12.16	-
Glu	-	13.31	-
Ser	-	4.86	-
Gly	-	4.59	-
His	-	1.95	-
Arg	-	5.00	-
Ala	-	5.74	-
Pro	-	8.98	-
Tyr	-	5.40	-
Thr	-	2.40	-
Val	-	6.55	-
Met	-	3.85	-
Cys	-	0.87	-
Ileu	-	2.83	-
Leu	-	7.43	-
Phe	-	5.06	-
Lys	-	3.17	-

Table 2. Nutrient utilization of crossbred heifers fed different treatment rations

Parameters	Treatment group		
	T_1	T_2	T_3
Bodyweight (kg)	256.18±6.60	256.87±9.62	253.73±8.80
Total DMI (kg/d)	$5.89^{\pm}$0.10	$6.34^{\pm}$0.18	5.94±0.15
DMI (% B W)	2.30±0.08	2.47±0.08	2.34±0.11
DMI (g/kg $W^{0.75}$)	91.97±2.47	98.92±1.99	93.41±2.56
DOMI (kg/d)	3.38^{a}±0.12	4.11^{b}±0.21	3.62^{b}±0.17
DCPI (g/d)	421^{b}±0.01	407^{b}±0.02	349^{a}±0.01
TDNI (kg/d)	3.38^{a}±0.08	4.01^{b}±0.14	$3.55^{a\pm}$0.10
Digestibility of nutrients (%)			
DM	56.68^{a}±0.98	62.94^{b}±0.87	60.43^{a}±0.66
OM	$57.39^{a\pm}$0.86	64.83^{b}±0.80	60.95^{a}±0.53
CP	67.18^{b}±1.23	67.36^{b}±1.90	62.70^{a}±1.81
NDF	36.37^{a}±2.18	42.43^{b}±1.38	39.14^{b}±1.05
ADF	32.86^{a}±1.96	$36.92^{b\pm}$2.11	37.97^{b}±1.86
EE	73.82^{b}±0.52	70.06^{b}±0.60	62.45^{a}±0.63
NFE	63.79^{a}±0.98	73.19^{b}±0.87	69.20^{b}±0.66
N retention (g/d)			
N intake	100.22^{b}±1.70	96.84^{b}±1.29	88.76^{a}±0.83
Fecal N	30.99±1.16	30.88±1.79	28.84±2.20
Urine N	42.42^{b}±1.20	35.85^{a}±2.72	36.58^{a}±2.84
N balance	26.81±2.46	30.11±2.23	23.34±1.42
Nutrient density (%)			
DCP	7.16±0.11	6.43±0.12	5.89±0.22
TDN	57.36^{a}±0.71	63.34^{b}±0.71	59.82^{a}±0.47

[ab]Means with different superscripts in a row differ significantly (P<0.05).

the requirement; however, it was 10.42% higher in T_2. Digestibility of DM, OM was higher (P<0.05) in T_2 than T_1 or T_3, while CP digestibility was higher (P<0.05) in T_1 and T_2 than T_3 (Table 2). Similarly Richards *et al.* (1994) also recorded reduced CP digestibility when concentrate was replaced with *Gliricidia* leaves and might be associated with presence of tannins. Fiber digestibility was improved (P<0.05) with replacement of stylo meal in T_2 and T_3. Mahanta *et al.* (2010) also observed improvement in nutrient digestibility in adult sheep when mustard cake was replaced with green berseem in sorghum stover based diet. Replacing concentrate with stylo meal in T_2 resulted in increased OM digestibility owing to increase in digestibility of fibrous components without affecting the digestibility of protein. These results are in agreement with those of Chauhan (1986) who reported that replacing concentrate with berseem hay resulted in increased digestibility of OM. The significantly (P<0.05) lower EE digestibility in T_3 might be due to higher calcium content in legume leaves and also due to the higher levels of pigments of low digestibility like chlorophyll, volatile oils and resins in the EE fraction in legumes. N balance was relatively higher in T_2 group when compared with T_1 or T_3 groups. In the present experiment, contrary to the earlier reports indicating higher fecal nitrogen losses in animals given taniferous forages (Srivastava and Sharma 1998), the fecal nitrogen excretion of crossbred calves on replacement of concentrate with stylo meal at different levels were not more than the control group. The N utilization patterns observed in this study were in accordance with Anbarasu *et al*. (2001). DCP content of the diet in different groups was comparable but TDN content was significantly (P<0.05) higher in T_2 which might be due to comparatively higher DM intake as well digestibility in this group. Das *et al*. (2009), however, reported comparable DCP and TDN content of the diet in ewes fed natural grass replaced with stylo leaf meal.

The change in average total live weight was not statistically significant among the groups. However, comparatively higher daily weight gain (g/d) was observed in T_2 group where 50% of concentrate CP was replaced with stylo meal though not statistically significant (Table 3). Thang

Table 3. Growth performance of heifers fed experimental rations during study period

Parameters	Treatment group		
	T_1	T_2	T_3
Initial B W (kg)	201.97±6.19	200.91±11.36	203.00±7.40
Final B W (kg)	266.10±6.60	266.9±12.06	262.54±10.20
Gain (kg)	64.17±0.75	65.99±1.64	59.54±2.79
Gain/d (g)	535±6.23	550±13.71	496±23.12
Total feed intake (kg)	657.10±17.22	662.32±27.33	654.13±20.42
Feed intake/kg gain	10.24±0.22	10.04±0.45	10.99±0.22

Table 4. Plasma metabolites of crossbred heifers fed different treatment rations

Parameters	Treatment group		
	T_1	T_2	T_3
Glucose (mg/dl)	58.94±2.54	56.50±2.74	54.44±2.66
Protein (g/dl)	7.25±0.33	7.30±0.26	7.08±0.29
Albumin (g/dl)	3.94±0.22	4.38±0.30	4.12±0.18
Globulin (g/dl)	3.31±0.28	2.92±0.26	2.96±0.32
Urea (mg/dl)	28.86^{b}±0.36	24.64^{a}±0.16	$25.58^{a\pm}$0.18

[ab]Means with different superscripts in a row differ significantly (P<0.05).

et al. (2008) also recorded optimum growth performance with 60% replacement of concentrate with mixed leguminous forages in the diet of crossbred cattle. Protein in T_2 diet might have not only provided readily available fermentable nitrogen, amino acids and peptides for microbial growth in the rumen but also supplied valuable amino acids for absorption in the lower gut leading to better growth performance of animals. The feed conversion efficiency (FCR, %) was comparable among the groups. Similar FCR values were observed in buffalo calves when groundnut nitrogen was replaced with Azolla N (Indira *et al*. 2009). Present results were in close agreement with the findings of Mahanta *et al*. (2005) who did not observe significant difference in feed conversion efficiency in crossbred heifers fed with different levels of berseem hay and sorghum silage *ad lib.* as basal roughage in the diets. On the contrary, Thang *et al.* (2008) recorded improved FCR in crossbred heifers which might be due to partial replacement of nitrogen of cereals portion of the concentrate with mixed legume foliages.

Replacement of concentrate with stylo meal at different levels in the diet of crossbred heifers did not influence the concentration of plasma glucose, protein and its fractions except urea (Table 4). In the present experiment, replacement of concentrate with stylo meal in T_2 and T_3 resulted in lower plasma urea N, which might be due to slower rate of degradation of stylo meal as compared to concentrate (Ash 1990). Higher degradability of concentrate protein in T_1 coupled with slower rate of release of energy from wheat straw might have lead to excess ammonia absorption from the rumen and ultimately resulting in increased plasma urea level. Replacement of protein of concentrate with stylo meal in crossbred heifers did not alter the blood glucose or protein contents (Samanta *et al*. 2003). All the values of blood metabolites were within the normal physiological range as reported by Das and Singh (2005).

It can be inferred from the results that DM intake was not affected with the replacement of concentrate with stylo meal in crossbred heifers. But DOM, DCP and TDN intakes were significantly (P<0.05) improved in T_2 as a result of 50% replacement of concentrate CP with stylo meal. Similarly

digestibility of DM, OM and CP were also improved (P<0.05) in T_2 group, however, nutrient utilization was not affected with 100% replacement of concentrate CP with stylo meal in T_3 group. Plasma glucose, urea and total protein fractions were within the normal physiological range. Thus, stylo meal can be incorporated by replacing concentrate CP (100%) safely and inexpensively, however, for achievement of optimum nutrient utilization and animal performance, 50% CP of concentrate mixture should be replaced with stylo meal in the diet of crossbred heifers.

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