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Growth performance and nutrient utilization in growing buffalo calves as affected by replacing groundnut cake with roasted guar (*Cyamopsis tetragonoloba*) korma

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Abstract
This study was conducted to evaluate the effect of feeding roasted guar korma by replacing groundnut cake (C) at 50 per cent level (T1) and 100 per cent level (T2) on protein basis, on growth performance in female buffalo calves. Roasted guar korma is a by-product of guar gum manufacturing and is a high vegetable protein feed. 18 female buffalo calves were grouped randomly in all three treatments and a growth trial of 150 days was conducted. The intakes of wheat straw, concentrate and total DM were similar in all the groups. A digestibility trial was conducted at the end of the experiment and the difference in digestibility of proximate nutrients and cell wall constituents between various treatment groups and the nutritive value of the ration was found to be statistically non-significant ($P< 0.05$). Total live weight gain in 150 days and average daily gain were found to be significantly higher in T_2 than C, but were comparable to T_1 for both the groups. There was no significant difference in FCR and FCE among calves in three treatment groups, but FCR of calves in T_2 group was less than the other two groups, indicating high FCE in T_2. The cost of ration consumed daily and the cost of dry matter required per kg body weight gain were also lower in T_2 as compared to the other two groups. Hence, roasted guar korma can be added at 50 or 100 per cent level in diet, as a protein source, of growing buffalo calves, without affecting the DM intake, nutrient utilization, growth and cost of feeding.

Keywords: Roasted guar korma, groundnut cake, female buffalo calves, growth performance, nutrient utilization

Introduction
Livestock rearing is one of the most important economic activities in the rural areas of the country contributing significantly to the national economy. It provides supplementary income to most of the family dependent on agriculture and for many landless families, the income generated through the livestock rearing activities has been the mainstay (DADH). Price ratio of concentrate feeds to animal products has narrowed down and thus in order to economize the cost of production of animal products, there is a need for substitution of traditional concentrates by some cheap but nutrient rich agro industrial by-products.

Guar (*Cyamopsis tetragonoloba*) is an important cash crop in rain fed, especially in semi-arid and arid regions of India. It is a drought-tolerant annual legume mostly grown in India and Pakistan (Mishra *et al*., 2013) [14]. It is an industrially important legume, as guar gum of high export value is extracted from it. The average production of guar seed in India is 7-8 lakh tones and it fluctuates largely based on rainfall pattern (APEDA) Guar seed has three parts: the seed coat (14–17%), the endosperm (35-42%) and the germ (43–47%) (Lee *et al*., 2004) [13]. Guar gum extraction results in the production of protein-rich by products, Churi Korma (guar meal), which are the germ and hull portions of the seed (Sharma & Gummagolmath, 2012). Extracts from Guar seed include Guar Split/Gum (29%), Korma (30-35%) and Churi (35-40%) (APEDA, 2014) [2]. The processed guar korma is usually rich in proteins and carbohydrates and thus forms a high protein feed for ruminants and other animals. It is used mainly to feed the milking animals to increase the milk and milk fat percentage, besides being a good feed for beef animals (Etman *et al*., 2014a) [5]. The CP content of guar korma is 56-58 per cent, Saeed *et al*., (2017); 55.8 per cent, Soliman *et al.*, (2014) [18]; 52.7 per cent, Nidhina and Muthukumar (2015) [15]; 50 per cent, Etman *et al*., (2014a) [5] and 46.9 per cent, Grewal *et al*., (2014) [9].

The CP content of guar korma varies according to the type of germ fraction and heat treatment in the final product. Guar korma is generally cheaper feed ingredient than soyabean meal, dried distiller grains, cotton seed cake and groundnut cake and therefore used as a substitute for those traditional meals in feeding animals (Etman *et al.*, 2014a) [5].

Beta-galactomannan gum residue and trypsin inhibitor are the major antinutritional factors present in guar meal. Beta-galactomannan gum residue acts as a growth depressing agent in poultry, but this effect can be overcome by the inclusion of certain enzymes, such as pectinase and cellulase as they are capable of hydrolysing the galactomannan gum (Gheisari *et al.*, 2011) [7]. Several researchers were of the opinion that trypsin inhibitor is the primary antinutritional factor that limits the use of guar meal in feed (Couch *et al.*, 1967) [3] but, according to the reports of Lee *et al*., 2003 [12], guar meal contains negligible amounts of trypsin inhibitor. Saponins decrease the palatability of the feed and impair the digestion of proteins and absorption of minerals and vitamins in the gut (Fransis *et al.*, 2013). Effects of different heat treatment on the antinutritional factors of industrial guar meal showed a significant reduction of trypsin inhibitor and Phytate level (Nidhina & Muthukumar, 2015) [15]. Etman *et al*., (2014a) [5] concluded that total and daily gains increased with increasing guar korma levels in experimental rations of growing buffalo calves. When groundnut cake was replaced by guar meal in crossbred calves ration at 0, 50 and 100% levels, daily gains, feed efficiency and digestibility of DM improved as level of guar meal increased in ration (Sagar and Pradhan, 1977).

Materials and Methods

Location of experiment: The experiment was conducted at the animal farm of Animal Nutrition & Feed Technology Division, Central Institute of Research on Buffaloes, Hisar. Hisar city is situated in semi –arid region and climatic conditions are subtropical in nature.

Experimental diets

The different concentrate mixtures offered to animals of control and different treatment groups and their chemical composition are presented in Table 1 and 2. The concentrate mixture for control group (C) was formulated by mixing groundnut cake, wheat, maize, barley and wheat bran; in T1 the 50% and in T2 group the 100% protein from groundnut cake in C was replaced by roasted guar korma. Mineral mixture and common salt were added @ 2% and 1% of concentrate mixture. Wheat bran was added as a filler to make the total weight to 100 kg. Representative samples of feeds (concentrate mixture and wheat straw) were analysed for proximate principles *viz*., dry matter, organic matter, crude protein, ether extract, and crude fibre, total ash as per the procedure of AOAC (2005) [1] and neutral and acid detergent fibre as per the procedure of Van Soest *et al*. (1994).

Table 1: Ingredient composition of concentrate mixture (kg /100kg)

Ingredients	Treatment		
	C	T_1	T_2
Groundnut Cake	33	16.5	---
Roasted Guar Korma	---	12.5	25
Wheat	9	9	9
Maize	12	12	12
Barley	12	12	12
Wheat Bran	31	35	39
Mineral Mixture	2	2	2
Salt	1	1	1
Total	100	100	100

Table 2: Chemical composition of concentrate mixture % DM basis

Attributes	Treatments		
	C	T_1	T_2
DM	90.30	90.35	90.64
OM	90.15	89.82	89.50
CP	22.96	23.46	23.88
EE	4.65	4.35	3.95
CF	12.30	12.05	11.50
Total Ash	9.85	10.18	10.50
NFE	50.24	49.96	50.17
NDF	42.00	42.80	43.40
ADF	18.80	18.50	18.00

Distribution and feeding of animals

18 calves were selected on the basis of their body weight, age and average weight gain during the previous 34 days and were distributed in three groups of six each in completely randomised block design. The growing buffalo calves were offered a ration containing weighed quantity of concentrate and wheat straw was fed ad.lib. as a basal diet. Concentrate mixture was fed individually while wheat straw and drinking water were made available to animals free choice. Total quantity of concentrate mixture fed to all the groups was same. Green fodder was also offered once a week to meet out the vitamin A requirements. The animals were fed according to ICAR (2012).

Digestion trial

A digestion trial of 7 days was conducted during experimental period with 6 days collection period, during which quantitative collection of total faeces voided on 24 hourly basis was made to determine the nutrients digestibility. Animals were weighed before and after trial consecutively for two days.

Results and Discussions

Dry matter and crude protein intake

The values of daily dry matter and crude protein intake in growing buffalo calves on different rations are presented in Table 3. The intakes of wheat straw, concentrate and total DM were similar in all the groups. Similarly, the difference between dry matter intake expressed as per 100 kg body weight and crude protein intake between different treatments was insignificant. These results were in agreement with those reported by Goswami *et al*., (2012) [8] and Sharif *et al*., (2014) [16] in Sahiwal calves and Grewal *et al*., (2014) [9] in growing male buffalo calves.

Table 3: Mean values of daily dry matter and crude protein intake (kg) in growing buffalo calves under different dietary treatments

Parameters	Treatments		
	C	T_1	T_2
Intake			
Wheat straw	2.08±0.21	2.19±0.18	2.16±0.23
Concentrate	2.88±0.29	2.88±0.30	2.88±0.26
Total DM	4.97±0.32	5.08±0.29	5.05±0.20
DM intake per 100 kg body weight	2.25±0.02	2.29±0.05	2.22±0.05
Crude protein intake	0.80 ±0.06	0.84±0.06	0.87±0.07

Digestibility coefficients and nutritive value of rations

Digestibility coefficients (per cent) and nutritive value of different rations in growing buffalo calves under different dietary treatments is given in Table 4. The difference in digestibility of proximate nutrients and cell wall constituents between various treatment groups was statistically non-

significant ($P< 0.05$). However, digestibility of dry matter, organic matter and crude protein were similar between groups C and T_2, the values were lower for the T_1 group. Digestibility of nitrogen free extract was similar for all three groups. Ether extract digestibility was similar in C and T_1 but slightly lower in T_2. The digestibility of crude fibre was highest in T_2 and was lowest in T_1 whereas for neutral detergent fibre and acid detergent fibre digestibility, the values were highest in T_2 and lowest in C. Statistical analysis of the results revealed that there was no significant difference in nutritive value of different rations among different dietary treatments. These results were in agreement to those of Sharif *et al*., (2014) [16], Grewal *et al*., (2014) [9] and Goswami *et al*., (2012) [8] but, Goswami *et al* observed higher nitrogen retention at 50% guar meal supplementation level.

Table 4: Digestibility coefficients (per cent) and nutritive value of different rations in growing buffalo calves under different dietary treatments

Digestibility (%)	Treatments		
	C	T_1	T_2
DM	54.27±0.37	53.24±1.16	54.2±0.63
OM	56.7±0.48	56±1.14	56.69±0.66
CP	64.58±0.32	61.08±1.35	64.12±1.54
EE	79±5.56	79.58±3.68	76.23±4.32
CF	44.44±0.85	42.65±2.58	46.37±0.6
NFE	60.37±1.03	61.1±0.91	59.76±0.82
NDF	43.49±0.41	43.69±1.87	45.03±0.64
ADF	32.61±2.37	34.86±2.57	37.24±1.57
TDN%	57.27±0.45	56.22±1.28	56.65±0.8
DCP%	10.73±0.14	10.27±0.21	10.74±0.41

Growth performance

The data showing total gain (kg), average gain (g/d) and FCR is presented in Table 5. No significant difference in initial and final body weights was recorded among the three groups. Total live weight gain in 150 days in C was 91.39, while it was 93.98 in T_1 and 104.33 kg in T_2. Though the values of live weight gain were higher in T_1 and lower in C but difference was non-significant. Similarly, difference between T_1 and T_2 was also non-significant. But, there was significant difference between C and T_2 groups. Overall average daily gain (g/d) and average body weight gain per 100 kg body weight (g/d) were 609, 626 and 695 grams and 233.3, 236.85 and 253.68 grams in C, T_1 and T_2 groups, respectively. The values were recorded to be lower in C than T_1 and T_1 than T_2 group but did not differ significantly ($p< 0.05$). But difference between C and T_2 was significant.

These results are in agreement with those reported by Etman *et al*., (2014a) [5], who concluded that total and daily gains increased with increasing guar korma levels in experimental rations of growing buffalo calves. In another study by Janampet *et al*., (2016) [11] there was significantly ($p<0.05$) higher average daily gain in kids fed on ration T2 (50% replacement of gnc with toasted guar meal) than on kids fed on T3 (100% replacement of GNC with toasted guar meal), but the values were comparable with the control (GNC as protein source) group. Goswami *et al*., (2012) [8] reported that in crossbred calves fed concentrate replacing groundnut cake with guar meal at 50% and 75% level no significant difference in weight gain was observed. Sharif *et al*. (2014) [16] also did not observe significant difference in weight gain in Sahiwal calves on replacing cottonseed cake with guar meal at 7.5% and 15% level in concentrate mixture respectively. No effect on growth rate in calves in findings of Goswami and sharif *et al*., may be because they used raw guar meal.

There was no significant difference in FCR and FCE among calves in three treatment groups. But FCR of calves in T_2 group was less than the other two groups, indicating high FCE in group T_2.

Table 5: Growth performance, feed conversion ratio and feed conversion efficiency in growing buffalo calves under different dietary treatments during experimental period

Parameters	Treatments		
	C	T_1	T_2
Initial body weight (kg)	169.64±12.83	170.32±12.23	169.63±10.54
Final body weight (kg)	261.03±14.7	264.3±13.89	273.97±12
Total Weight Gain (kg)	91.39^{a}±4.37	93.98^{ab}±3.71	104.33^{b}±3.48
Average body weight gain(g/d)	609^{a} ± 20.02	626^{ab} ± 22.14	695^{b} ± 19.08
Average body weight gain per 100 kg body weight (g/d)	233.30^{a} ±10.23	236.85^{ab}±12.27	253.68^{b}±10.17
DMI (kg in 150 days)	745.64±47.41	762.68±44.18	757.45±30.64
FCR	8.19±0.52	8.16±0.53	7.28±0.28
FCE (%)	12.43±0.73	12.51±0.78	13.85±0.57

*Mean values in a row with different superscript differ significantly ($P< 0.05$)

Cost of growth

Cost of dry matter required per kg body weight gain was Rs 115.88, 112.44 and 99.94 in treatment groups C, T_1 and T_2 respectively (Table 6.). This showed that there was daily net saving of Rs 3.77 and 16.10 per kg body weight gain in treatments T_1 and T_2, respectively. This gain can be attributed to the higher CP content of RGK. The market price of RGK fluctuates seasonally as guar is an annual crop. Thus, by incorporating guar korma in ruminant rations we can decrease cost of production. Similar findings were given by Etman *et al*., (2014a) [5] in buffalo calves, Walla *et al*., (2016) in milk production in Egyptian buffaloes and Janampet *et al*., (2016) [11] in growing kids.

Table 6: Cost of feeding in growing buffalo calves under different dietary treatments

Treatments	Average daily DM intake in kg		Cost of ration consumed (Rs/d)			Live wt gain (kg/d)	Cost/kg Live wt gain (Rs)	Net savings per kg weight gain (Rs)
	Concentrate mixture	Wheat straw	Concentrate mixture	Wheat straw	Total			
C	2.88	2.08	66.15	4.10	70.26	0.609	115.35	0
T_1	2.88	2.19	65.52	4.33	69.85	0.626	111.58	3.77
T_2	2.88	2.16	64.71	4.27	68.98	0.695	99.25	16.10

Conclusions

Roasted guar korma can successfully replace (on 100% protein basis) groundnut cake in CM as evident from better growth rate, FCR, FCE and cost of growth in growing buffalo calves.

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