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INFLUENCE OF SUBSTITUTION OF CONCENTRATE WITH MOLASSES AND CORN STEEP LIQUOR ON NUTRIENT INTAKE, WEIGHT GAIN AND FEED CONVERSION EFFICIENCY OF BUFFALO CALVES

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ABSTRACT

The objective of the present research study was to explore the effects of substitution of molasses and corn steep liquor with concentrate on nutrient intake and growth performance of buffalo calves. The null hypothesis was that molasses and corn steep liquor can replace a considerable amount of concentrate without adversely affecting intake and growth of buffalo calves. Thirty two (32) male buffalo calves at 12 to 18 month of age and weight (average 150kg) were divided into 4 groups according to Completely Randomized Design for this study. Four iso-nitrogenous and iso-caloric experimental diets were formulated. Control diet contained 37% maize fodder, 28% wheat straw and 35% concentrate on dry matter (DM) basis. Other two rations A and B were formulated to replace 42% of concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL in the ratio of 50:50. The animals were fed individually at *ad libitum* intakes for 90 days. Feed offered and refusals were recorded daily and composited for analysis. During last week of the study, a digestibility trial was conducted; acid insoluble ash was used as digestibility marker. Intake of DM (kg/day) was higher ($p<0.05$) in buffalo calves fed control (5.93) followed by B, C and A (5.65, 5.59 and 5.34) diets However, non-significant differences in nutrient intake were observed in buffalo calves fed B and C diets. Digestible DM and CP intakes were similar in all treatments while NDF intakes were significantly ($p<0.05$) higher in buffalo calves fed control diet than those fed A, B and C diets. Daily gain in weight was higher ($p<0.05$) in buffalo calves fed B and C (770 and 750 g/day) diets than those fed control (620 g/day) and A (560 g/day) diets (Table 5). Daily weight gain remained unaltered statistically between animals fed B and C diets. The improved body weight gain of buffalo calves fed CSL and molasses plus CSL diets could be attributed to intake of more digestible nutrients. It is, therefore, concluded that CSL and molasses plus CSL could successfully replace concentrate portion of the ruminant's feed thereby reducing cost of production.

Key words: Concentrate, molasses, corn steep liquor, nutrient intake, digestion, buffalo calves

INTRODUCTION

In developing countries feed resources such as cereal grains and concentrates are not feasible to feed the animals due to their high price and competitive supply for human consumption. Replacement of concentrates with cheaper agro industrial by-products can increase profitability and reduce demand for cereal grains. So it is imperative to explore new livestock feed resources like corn by-products, which could be utilized efficiently for animals feeding. The quality of crop residues is considered inadequate to provide for a gigantic weight gain in young calves, because they do not have enough available energy and protein. Thus supplementation with protein and energy source is recommended by various scientists in order to ensure their adequate performance (Sarwar *et al*., 2004). The direct supplementation of fermentable carbohydrates and crude protein can enhance the ruminal functions (Jakhmola *et al*., 1988). Supplementation is the quick and cost effective method of enhancing nutritional worth of low quality crop residues.

Molasses and Corn Steep Liquor (CSL) are the by products of corn and sugar cane industry. Both the materials are slurry liquid could be used as binding martial in mash feed. Molasses is the rich source of energy while the CSL is protein source too. Corn steeping liquor contains carbohydrates, amino acids, peptides and essential minerals (Nisa et al., 2004). Increased dietary energy via molasses supplementation has improved feed use efficiency in mature ruminants (Brown et al., 1987; Morales et al., 1989).

Feeding molasses in combination with CSL may supply both energy and protein in a cost-effective manner to the ruminants. However, the scientific evidence regarding the influence of feeding molasses and CSL separately and in combination on animal performance is limited. Therefore, the project in question is designed to examine the influence of feeding molasses and CSL separately and in combination on feed intake, weight gain and other body measurements in male buffalo calves.

MATERIALS AND METHODS

Thirty two buffalo male calves of 12 to 18 month of age and weight (Av, 150 kg) were divided in to four groups (eight animals in each group) according to Completely Randomized Design (CRD, uneven treatment groups) to examine the influence of replacement of concentrate with molasses, CSL or their combination on nutrient intake, growth performance and feed efficiency. The treatments (four experimental rations) to animals and the animals to groups were allotted at random. The animals were weighted initially and fortnightly thereafter for three proceeding months. Animals were housed on a concrete floor in separated pens. Fresh and clean water was made available round the clock in the sheds for whole experimental period. Four iso-nitrogenous and iso-energetic experimental diets were formulated using NRC (2001) values for energy and protein (Table 1). The control diet contained 37% maize fodder 28% wheat straw and 35% concentrate on DM basis. Other two rations A and B were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL in the ratio of 50:50. The animals were fed individually at *ad libitum* intakes. Experimental period lasted for 90 days. First 10 days were given for dietary adaptation and 80 days for sample collection. Feed offered and refusal were recorded daily and composited for analysis.

Digestion Study: During last week of the study, a digestibility trial was conducted. Fecal grab samples were taken twice daily such that a sample was obtained for every 3-hour interval of 24 hours period (Sarwar *et al.*, 1991). The acid insoluble ash was used as digestibility marker (Van Keulen and Young, 1977).

Sample collection and chemical analyses: The samples of experimental diets, orts and feces were dried at 55^0C in a forced air oven and ground to 2 mm particle size through a Wiley mill. These samples were analyzed for DM, N content and ash by the methods of AOAC (1990), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) by the methods described by Van Soest *et al.* (1991), for estimation of net energy of lactation ($NE_{L,}$ NRC, 2001).

Statistical analysis: The data obtained for each parameter (Nutrient intake, digestibility, weight gain and feed efficiency) were analyzed according to Randomized Complete Block Design. The statistical model used for all parameters was;

$$Y_{ij} = \mu + \tau i + \varepsilon_{ij.}$$

Where, μ was overall mean,

τ_j was the effect of treatments (3 treatments) and

ε_{ij} was difference within treatment means (error term).

In case of significant ($p<0.05$) difference among treatment means, the Duncan's Multiple Range test was applied (Steel *et al*, 1997).

RESULTS AND DISCUSSION

Nutrient Intake: Intake of DM were higher ($p<0.05$) in buffalo calves fed control (5.93 kg/day) followed by B and C (5.65 and 5.59 kg/day) diets than those fed A (5.34 kg/day) (Table 3). However, non-significant differences in nutrient intake were observed in buffalo calves fed B and C diets having 35% CSL or 35% molasses+CSL. Crude protein intake in buffalo calves fed all the experimental diets did not show any treatment effect (Table 3). Digestible DM and CP intakes were similar in all treatments while NDF intakes were significantly ($p<0.05$) higher in buffalo calves fed control diet than those fed A, B and C diets. Increased NDF intake with control diet was because of higher NDF of control diet as compared to other three diets. Leng *et al.* (1993) reported that supplementation of low quality fibrous feeds with non-protein N increased the digestibility of the feed thereby improved voluntary feed intake (Hogan, 1996). A faster digestion rate of the potentially digestible fiber promoted greater DM intake (Sarwar *et al.*, 1991).

Digestibility: Dry matter and NDF digestibilities were higher ($p<0.05$) in buffalo calves fed A, B and C diet than those fed control diet (Table 4). However, DM and NDF digestibilities were similar in buffalo calves fed A, B and C diets. Crude protein digestibilities were higher in B and C diets followed by A and control diets (Table 4). The probable reason for higher nutrient digestibilities of A, B and C diets was that these diets contained 35% DM from highly digestible feed ingredients molasses and CSL. This effect might have resulted from increased total tract digestibility in buffalo calves fed A, B and C (molasses, CSL and molasses plus CSL) diets. The supplementation of diets with fermentable energy not only improved feed intake but could also enhance nutrient digestibility (Sarwar et al., 2004). In the current study the diets were supplanted with molasses or molasses plus CSL which enhanced nutrient digestibility in buffaloes.

Growth performance: Daily weight gain was higher ($p<0.05$) in buffalo calves fed B and C (770 and 750 g/day) diets than those fed control (620 g/day) and A (560 g/day) diet (Table 5). Daily weight gain remained unaltered statistically between animals fed B and C diets. Higher digestible nutrient intake (Table 3) might have resulted in better weight gain of buffalo calves fed B and C diets than those fed control and A diets. In the present study the improved body weight gain of buffalo calves fed CSL and molasses+CSl diets could be attributed to intake of more digestible nutrients. Earlier studies illustrated that supplementation of low quality forages with molasses based mixture increased animal weight

gain in free grazing cattle and buffalo calves (Wadsworth, 1988). Supplementation of low quality crop residues with fermentable carbohydrates improved animal performance (Brown, 1993) and forge intake (Mclennan *et al*., 1981). Supplementation of fermentable carbohydrates and N probably increased the intake of poor-quality roughages (Bond and Rumsey, 1973).

It is therefore, concluded that CSL and molasses+CSL could successfully replace concentrate portion of the ruminant's feed thereby reducing cost of production.

The control diet contained 65% wheat straw and 35% concentrate on DM basis. The other two diets (A and B) were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL (50:50).

Table 1. Ingredients and chemical composition (%) of experimental diets

Ingredients	Diets*			
	Control	A	B	C
Maize fodder	37.0	37.0	37.0	37.0
Wheat Straw	28.0	28.0	28.0	28.0
Wheat bran	4.00	0.00	0.00	0.00
Cotton seed cake	25.0	15.0	18.0	17.0
Sunflower meal	3.00	1.00	0.00	0.00
Cane Molasses	0.00	15.0	0.00	7.50
Corn steep liquor	0.00	0.00	15.0	7.50
Di-calcium phosphate	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Urea	1.00	2.00	0.00	1.00
Total	100.0	100.0	100.0	100.0
Chemical composition				
Dry matter	65.95	63.68	59.81	61.74
Crude protein	11.36	11.27	11.42	11.31
ME, Mcal/ kg	1.19	1.23	1.13	1.18
Neutral detergent fiber	35.93	28.46	29.50	29.03
Acid detergent fiber	17.88	15.68	15.65	15.57
Acid detergent lignin	5.87	4.36	4.62	4.50
Cellulose	14.48	12.80	12.81	12.74
Hemicellulose	18.05	12.77	13.84	13.46
Total ash	4.66	5.83	5.38	5.59
Price/kg, (Rs.)	9.55	8.12	8.11	8.09

*The control diet contained 37% maize fodder, 28% wheat straw and 35% concentrate on DM basis. The other two diets (A and B) were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL (50:50).

Table 2. Chemical composition (%) of corn steep liquor and molasses

Parameters	Corn steep liquor	Molasses
Dry matter	50.0	67.0
Protein	40.0	4.50
Ash	10.0	10.7
Nitrogen free extract	16.0	0.00
pH	3.70	7.00
Dextrose	---	1.35
Sucrose	----	37.0
Fructose	----	4.11
Lactic acid	21.0	----
Specific gravity	1.25	2.00

Table 3. **Nutrient intakes by buffalo calves fed experimental diets***

Parameters	Diets*				SE
	Control	A	B	C	
Nutrient Intake, kg/day					
Dry matter	5.93	5.34	5.65	5.59	0.23
DMI, % Body weight	3.39	3.03	3.00	2.56	0.20
Crude Protein	0.68	0.60	0.65	0.63	0.03
Neutral Detergent Fiber	2.13[a]	1.52[b]	1.67[b]	1.62[b]	0.07
Acid detergent fiber	1.06[a]	0.84[b]	0.88[b]	0.87[b]	0.04
Acid detergent lignin	0.35[a]	0.23[b]	0.26[b]	0.25[b]	0.01
Metabolizable energy	0.07	0.06	0.06	0.06	0.01
Digestible Nutrient Intake, kg/day					
Dry matter	2.49	2.40	2.54	2.51	0.03
Crude Protein	0.47	0.44	0.48	0.47	0.01
Neutral Detergent Fiber	0.75	0.55	0.60	0.58	0.01

Means within row bearing different superscripts differ significantly ($p<0.05$)
*The control diet contained 65% wheat straw plus fodder and 35% concentrate on DM basis. The other two diets (A and B) were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL (50:50).

Table 4. Nutrient Digestion by buffalo calves fed experimental diets

Nutrient Digestibilities, %	Diets*				SE
	Control	A	B	C	
Dry matter	65.48	63.50	59.64	61.54	0.41
Crude Protein	70.0	73.2	75.2	75.5	1.57
Neutral Detergent Fiber	35.4	36.0	362	36.1	0.98

Means within row bearing different superscripts differ significantly ($p<0.05$)
*The control diet contained 65% wheat straw plus fodder and 35% concentrate on DM basis. The other two diets (A and B) were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL (50:50).

Table 5. Growth (Kg) in buffalo calves fed experimental diets

Parameters	Control	A	B	C	SE
Initial body weight	169.12	170.75	172.12	204.37	1.64
Final body weight	207.88	206	221	252	3.79
Weight gain	38.76[bc]	35.25[c]	48.88[a]	47.63[ab]	3.09
Daily weight gain	0.62[bc]	0.56[c]	0.77[a]	0.75[ab]	0.05
Feed Conversion Efficiency	11.26[ab]	11.91[a]	9.08[b]	8.59[b]	0.92

Means within row bearing different superscripts differ significantly ($p<0.05$)

It is therefore, concluded that CSL and molasses+CSL could successfully replace concentrate portion of the ruminant's feed thereby reducing cost of production.

The control diet contained 65% wheat straw and 35% concentrate on DM basis. The other two diets (A and B) were formulated to replace 42% concentrate with molasses or CSL on energy equivalent basis. In the fourth diet (C) 42% of concentrate was replaced by molasses and CSL (50:50).

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