Comparative Evaluation of Cotton Seed Meal and Sunflower Seed Meal in Urea Molasses Blocks Versus Commercial Concentrate as Supplement to Basal Ration of Wheat Straw with Stall-fed Buffalo Calves

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ABSTRACT : Eighteen water buffalo calves of Nili-Ravi breed (about 15 months age and of 147±12 kg average body weight and mixed sex) were used with six animals on each treatment. All the animals were fed long wheat straw for *ad libitum* intake as the basal ration. Animals in group-I were supplemented with *ad libitum* amount of urea molasses block having cotton seed meal (CSMB) while the animals in group-II were supplemented with *ad libitum* urea molasses block containing sunflower seed meal (SFMB) and group III animals were supplemented with a fixed amount of commercial concentrate feed (CCF). The experiment lasted for a period of 80 days (April to June). Results revealed a significantly decreased total feed intake (wheat straw+supplements) in group-III (1,666±52 g/h/d) as compared to group I (2,299±194 g/h/d) and group-II (2,193±230 g/h/d). Average daily supplement intakes were 891±87; 666±104 and 593±0 grams per head in group I, II and III, respectively. Supplement intakes among groups were different ($p<0.05$). Average daily body weight gains (g/h) were 214±25, 174±23 and 183±24 for group I, II and III, respectively. Feed conversion ratio (FCR) was found to be 10.74±1.12, 12.60±0.88 and 9.90±1.33 grams for group No. I, II and III, respectively. The economic net benefit of live weight gain of calves were 7.63, 6.11 and 7.33 rupees/h/d for group No. I, II and III, respectively. Thus SFM can replace CSM and urea molasses blocks can replace commercial concentrates as supplement to basal ration of wheat straw. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 2 : 193-198)***

Key Words : Buffalo Calves, Urea-molasses Blocks, Cotton Seed Meal, Sunflower Seed Meal, Commercial Concentrate, Wheat Straw

INTRODUCTION

A major constraint to the production of ruminants on small holder farms throughout the tropics, especially during the dry season, is that the roughage feeds provided are unbalanced in terms of energy, protein and minerals. Also they are lignified, bulky and their digestibility is low (Preston and Leng, 1987). This limits feed intake, rumen fermentation, and productivity. Their use can be improved by providing a supplement of fermentable carbohydrates, nitrogen and minerals combined with a small amount of nutrients that by-pass the rumen (Preston and Leng, 1987; Sansoucy et al., 1992). Mixtures of molasses, urea, carbohydrates and minerals can be used as supplements which can increase intake of poor quality forages by up to 40% (Sansoucy et al., 1992; Badurdeen et al., 1994; Rafiq et al., 1996) and may be economical compared to conventional concentrates as well. Supplementation of cows, buffaloes, sheep and goats fed a basal feed of cereal straw, lignified grass and/or maize stover with urea-molasses blocks (UMB) has been shown to increase milk yield and reduce feed costs of cows and buffaloes in India (Leng and Kunju, 1990; Srinivas and Gupta, 1997), in Indonesia (Hendratno et al., 1991), economical weight gain in lambs, cows and buffaloes in Pakistan (Mirza et al., 1988; Habbib et al., 1991) and in Bangladesh (Saadullah, 1991). If good quality forages are available to animals, then the benefit due to the supplementation with UMB is limited (Hendratno et al., 1991; Sansoucy et al., 1992).

Cotton seed meal (CSM) is abundantly available in Pakistan. Production of sunflower is also gaining popularity and as a result sunflower seed meal (SFM) is available. However, price of CSM is much higher than SFM mainly because of higher levels of crude fibre in SFM making it less suitable for use in poultry feeds. However, this higher fiber of SFM can be efficiently used in ruminant feeds. Therefore, aim of the study was to test the bio-economic efficiency of CSM vs. SFM as vegetable protein supplements in UMB and compare them with commercial concentrate as a supplement to basal ration of wheat straw fed to growing water buffaloes.

MATERIALS AND METHODS

Eighteen water buffalo calves of Nili-Ravi breed (about 15 months age and 147±12 kg average body weight and mixed sex) were used as experimental animals at Animal Sciences Institute (ASI), National Agricultural Research Centre (NARC), Islamabad. Animals were randomly divided into three groups with six animals on each treatment. All the calves were fed individually in a well ventilated, clean, cement floored shed with Asbestas sheet roof and reared under uniform management conditions. All

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Table 1. Ingredient composition (%) of feed supplements offered to experimental buffalo calves

Ingredients	CSMB[a] (Group-I)	SFMB[b] (Group-II)	CCF[c] (Group-III)
Cotton seed meal	8.5	-	10
Sunflower seed meal	-	8.5	10
Maize oil cake	-	-	10
Corn gluten feed (20% CP)	-	-	18
Rice polishings	-	-	32
Rice bran	21	21	-
Wheat bran	8.5	8.5	-
Molasses	42	42	17.5
Urea	5.3	5.3	1.0
Dicalcium phosphate	1.0	1.0	0.5
NaCl	4.2	4.2	0.5
Calcium oxide	8.5	8.5	0.5
Vit. mineral mixture	1.0	1.0	-

[a] Cotton seed meal block. [b] Sunflower seed meal block. [c] Commercial concentrate feed.

Table 1-a. Chemical composition (%DM basis) of feed ingredients used in urea-molasses blocks and commercial concentrate feed

Ingredients	DM	CP	CF	TA	EE
Cotton seed meal	90	41.74	9.77	6.26	3.60
Sunflower seed meal	91	35.62	19.10	9.33	7.60
Maize oil cake	89	14.10	10.19	8.00	3.88
Corn gluten feed (20% CP)	91	20.10	10.94	9.00	4.22
Rice polishings	90	12.49	9.75	7.60	6.93
Rice bran	90	9.10	14.25	9.10	4.13
Wheat bran	89	14.10	13.53	6.20	3.79
Sugar cane molasses	75	3.9	-	7.70	0.10
Urea (fertilizer grade)	98	280	-	-	-

the animals were fed long wheat straw *ad libitum* as a basal ration. Buffalo calves in group I were supplemented with *ad libitum* amount of urea molasses block having cotton seed meal as protein supplement (CSMB), while the animals in group II were supplemented with *ad libitum* urea molasses block containing sunflower seed meal as protein supplement (SFMB), and the group III animals were supplemented with a fixed amount of commercial concentrate feed (CCF). The experiment lasted for a period of 80 days (April to June). All the animals were weighed at the start of experiment and then after every 15 days. These were the fasting body weights i.e. after about 16 h without feed and water. Wheat straw and supplemental feeds were offered using half metal drums and every morning leftover straw and blocks were weighed to calculate their previous day intake. All the offered CCF was consumed by all the animals of that group. *Ad libitum* water was offered twice daily i.e. morning and evening. Wheat straw and urea molasses blocks (UMB) were fed together in the same drums; while CCF was offered every morning after cleaning the drums from refused wheat straw. All the CCF was finished by all animals in about half an hour and after that new wheat straw was fed every morning. Before the start of this experiment these animals had been fed oats green fodder mixed with wheat straw (50:50 ratio) free choice with supplements of commercial concentrate (1 kg per head per day) along with free choice of UMB, as a routine feeding practice.

Ingredient composition of UMB and CCF is given in Table 1, while chemical composition of feed ingredients used in the preparation of urea-molasses blocks and commercial concentrate is given in Table 1-a. All the UMB and CCF were prepared at the Feed Technology Unit (FTU) of the Animal Nutrition Programme (ANP), ASI, NARC. The ingredients of UMB were mixed in the mechanical mixer and then converted into blocks of 5 kg each in hydraulic press and wrapped in plastic sheets to increase their shelf life. Four samples of each CSM and SFM used in the UMB and CCF were analysed using AOAC (1995) methods. Average chemical composition (percent) of CSM was found to be 89.57, 41.74, 9.77 and 6.26 for DM, CP, CF and TA, respectively. The average chemical composition of SFM (percent) was found to be 90.59, 35.62, 19.1 and 9.33 for DM, CP, CF and TA, respectively. Average CP of the CCF was found to be 19.5 percent.

Economic analysis of the data was done using the technique of Perrin et al. (1979). In calculating economical values, ingredient cost of CCF was used as Rs.3.40 /kg; that of CSMB as Rs.3.45 /kg; that of SFMB as Rs.3.04 /kg, and of wheat straw as Rs.1.5 /kg. One US$ was equal to about 60 rupees (Rs). Value of liveweight was used as Rs.60 /kg. The data of feed intake, weight gain and feed conversion ratio were analysed using analysis of variance (ANOVA) of Steel and Torrie (1986) and Duncan's Multiple Range Test as described by (Duncan, 1955).

Table 2. Feed intake, live weight gain and feed conversion ratio (grams±SE) of experimental buffalo calves

Parameters	Treatments		
	I (CSMB)*	II (SFMB)*	III (CCF)*
Number of buffaloes	6	6	6
Average daily weight gain (g)	214±25	174±23	183±24
Average daily block or concentrate intake (g/h/day)	891^{a} ±87	666^{b}±104	593^{b}±0
Average daily wheat straw intake (g/h/day)	$1,408^{a}$±150	$1,527^{a}$±172	$1,073^{b}$±52
Total feed intake (wheat straw+supplement),	$2,299^{a}$±194	$2,193^{a}$±230	$1,666^{b}$±52
FCR (g feed/g gain)	10.74±1.12	12.60±0.88	9.90±1.33

Values in rows with different superscripts differ ($p<0.05$).
(CSMB)* Cotton seed meal block. (SFMB)* Sunflower seed meal block. (CCF)* Commercial concentrate feed.

Table 3. Intake (g±SE) of different feed ingredients by experimental animals

Parameters	Treatments		
	I (CSMB)*	II (SFMB)*	III (CCF)*
Supplement intake(g)/100 kg body weight	578^{a}±78	436^{ab}±59	402^{b}±36
Wheat straw intake (g)/100 kg body weight	914±176	818±122	719±62
Total feed (wheat straw+supplement) intake /100 kg body weight (g)	1,492	1,254	1,121
Molasses intake (g/h/d)	374^{a} ±37	280^{b}±44	104^{c}±0
Percent of molasses intake to total feed intake	16.27^{a}±1.21	12.75^{b}±1.47	6.26^{c}±0.22
Urea intake (g/h/d)	47^{a}±5	35^{b}±5	6^{c}±0
Percent of urea intake to total feed intake	2.05^{a}±0.15.	1.61^{b}±0.18	0.36^{c}±0.01

Values in rows with different superscripts differ ($p<0.05$).
(CSMB)* Cotton seed meal block. (SFMB)* Sunflower seed meal block. (CCF)* Commercial concentrate feed.

RESULTS

Performance of buffalo calves fed a basal ration of wheat straw and supplemented with urea molasses blocks having cotton seed meal as vegetable protein source (CSMB); urea molasses blocks having sunflower seed meal as vegetable protein source (SFMB) and commercial concentrate feed (CCF) is summarised in Table 2. Calves supplemented with CSMB (Group 1) consumed 1,408±150 grams of wheat straw per head per day. Calves supplemented with SFMB (Group II) consumed 1,527±172 grams of wheat straw per head daily, while calves supplemented with CCF (Group III) consumed significantly lower amount of wheat straw i.e., 1,073±52 grams per head daily, which was significantly lower than first two groups. Intakes of supplements (g/h/d) were found to be 891±87; 666±104 and 593±0 for group I, II and III, respectively. Supplement intake of group 1 (CSMB) was significantly higher than the other two groups. Total feed intake (straw+supplement) was, however, statistically similar in the two groups supplemented with blocks, while it was significantly lower in animals supplemented with CCF. Average daily body weight gains (ADG) were 214±25, 174±23 and 183±24 for group I, II and III, respectively, and the differences in ADG were statistically non-significant ($p>0.05$).

Feed conversion ratio (FCR), which is the grams of feed eaen for each gram of body weight gain were 10.74±1.12; 12.60±0.88 and 9.90±1.33 for animals of group I, II and III, respectively. Statistically FCR did not differ among groups. Consumption of different feed ingredients of each supplement and basal feed is given in Table 3. On per 100 kilogram body weight basis daily intakes (g) of wheat straw were 914±176; 818±122 and 719±62 for group I, II and III, respectively, and these differences were statistically non-significant ($p>0.05$). Daily intakes (g) of supplements on per 100 kilogram bodyweight basis were 578±78, 436±59 and 402±36 for groups I, II and III, respectively. Animals in group III had significantly ($p<0.05$) lower supplement intake on per 100 kg BW basis compared to group I. Daily intakes of molasses (g) were 374±37, 280±44 and 104±0 in groups I, II and III, respectively. Molasses intake differed ($p<0.05$) among all treatments. Daily intakes of urea (grams) were 47±5; 35±5 and 6±0 in groups I, II and III, respectively. Intake of urea also differed ($p<0.05$) among the treatments.

Economic analysis has been shown in Table 4. Net benefit has been calculated by calculating the benefit of body weight gain by giving value of Rs.60 per kilogram of body weight gain and deducting the expenditure of feed from that value. Net benefit was found to be best in animals of group 1 fed CSMB (Rs.7.63/day), followed by group III fed CCF (Rs.7.33/day) and group II fed SFMB (Rs.6.11/day).

DISCUSSION

Intake of the basal ration i.e. wheat straw in our study was in agreement with the results of Sansoucy et al. (1992).

Table 4. Economic analysis of live weight gain by buffalo calves

Parameters	Treatments		
	I (CSMB)*	II (SFMB)*	III (CCF)*
Feed intake			
Supplement intake (g/h/d)	891[a]	666[b]	593[b]
Wheat straw intake (g/h/day)	1,408[a]	1,527[a]	1,073[b]
Total feed intake (supplement+wheat straw) (g/h/day)	2,299[a]	2,193[a]	1,666[b]
Cost of feed eaten* (Rs/h/d)			
Supplement feed	3.07	2.02	2.02
Wheat straw	2.11	2.29	1.61
Total cost	5.18	4.31	3.62
Average liveweight gain (g/h/d)	214	174	183
Total benefit of liveweight gain at Rs.60/kg (Rs/h/d)	12.82	10.42	10.98
Net benefit (Rs/h/d)	7.63	6.11	7.33

Values in rows with different superscripts differ ($p<0.05$).

* Ingredient cost of commercial concentrate feed (CCF)=Rs.3.40/kg; CSMB=Rs.3.45/kg; SFMB=Rs.3.04/kg and wheat straw=Rs.1.5/kg. One US$=Rs.60/-. * CSMB Cotton seed meal block. * SFMB Sunflower seed meal block. *CCF Commercial concentrate feed.

Badurdeen et al. (1994) and Rafiq et al. (1996) who have reported increased intake of low quality roughages as a result of their supplementation with molasses-urea blocks (UMB). This improved intake of basal ration may be due to supplementation satisfying the requirements of rumen micro-organisms, thereby resulting in efficient fermentation of fibre which in turn will increase fermentative outputs (Tiwari et al., 1990; Garg and Gupta, 1992). Preston and Leng (1987) reported that intake of low quality roughages can be increased by supplementation with fermentable carbohydrates, nitrogen and minerals with small amounts of protein that by-pass the rumen fermentation. It has also been reported that supplementation of poor quality roughages with molasses increased their intake (Khalili et al., 1993) and growth of cattle (Barnah et al., 1992). The results of our study are also in agreement with Mehrez and Orskov (1978), Krebs and Leng (1984) and Boniface et al. (1986) who reported that higher rumen ammonia concentration may be required to maximize forage digestion and thereby allow higher hay intake. Krebs and Leng (1984) also reported that slow and continuous supply of fermentable nitrogen and carbohydrates in rumen increases the digestion rate of roughages and this can be effectively done by supplementation with UMB. Leng (1984) reported that availability of fermentable N and readily available carbohydrates supplied through UMB facilitates the growth of cellulolytic microbes, which might result in better utilization of wheat straw. Similarly digestibility coefficients of DM, OM, N, EE, ADF and NDF were significantly increased in buffalo calves supplemented with UMB and fishmeal (Tiwari et al., 1990). Low intake of straw in group-III is in agreement with the findings of Menson (1981) and Habbib at al. (1991). In case of CCF group all the concentrate was consumed in less than one hour, therefore, might have not maintained sufficient rumen ammonia level throughout the day, which might have reduced the wheat straw intake (Johnson, 1976). Higher intake of crude fibre from the CCF vs. UMB might have also caused reduced straw intake (Mosi and Butterworth, 1985).

Intake (g/h/d) of UMB having cotton seed meal (CSM) as vegetable protein source was significantly higher (891±87) compared with UMB having sunflower seed meal (SFM) as vegetable protein source (666±104), while total feed intake (straw+UMB) was statistically similar in both the UMB supplemented groups but significantly low in CCF group. However, on per 100 kilogram body weight basis total feed intake was statistically similar. These results are in line with Garg and Gupta (1992). This may be due to about four times more protein degradability in SFM vs. CSM (Wohlt et al., 1973), which might increase ammonia level in the rumen so high that it reduced the intake of SFMB. Trend of body weight gain in our experiment was similar to that as reported by Elias et al. (1968) who indicated that increasing the dietary molasses upto 700 grams per kilogram of diet had no negative effect on weight gain. However, in CCF group despite of low levels of concentrate and wheat straw intakes, the comparable weight gain may be due to blending of different vegetable protein sources together, which results in increased biological value of protein and hence better production (Mc Donald et al., 1995).

Our results are also in agreement with the findings of Haque and Talukdar (1985) who concluded that molasses may be best utilized as supplement to straw at 150 grams per kilogram of diet for profitable beef production.

Comparable performance of our animals fed SFMB vs. CSMB despite of low consumption may be due to higher level of sulphur containing amino acid methionine in SFM compared to CSM (Anon, 1993). Preston and Leng (1987) reported that oil seed meals diets would be expected to supply more amino acids to the animal than iso-nitrogenous urea molasses diets since urea can only contribute to microbial protein formation via rumen ammonia while a large proportion of oil seed meal diets can escape ruminal degradation and yield amino acids directly to the small intestine. Comparable performance of blocks versus concentrate may be due to the fact that higher dry matter intake is usually associated with reduction in digestibility (Van Soest, 1982).

The results of our study are also consistent with the findings of Ullery (1978) and Nishino et al. (1980) who stated that SFM could be used in dairy cattle feeds and can efficiently replace CSM and SBM. Similar results were reported by Dutta et al. (2002) who replaced groundnut cake with sunflower cake. Feed conversion ratio (FCR) found in our study is close to the one reported by Hennessy and Williamson (1988). Our results are also corroborated by Nishino et al. (1980), Kuldip et al. (1995) and Sihag et al. (1997) who reported almost similar feed intake in case of sunflower meal or cake compared to other vegetable protein supplements.

Difficulties in estimating the cost of operating a supplemental system and benefits that may emerge later, such as earlier maturity, increased frequency of calving, less maintenance requirements, less labour cost, etc. preclude an accurate economic assessment of the benefits of supplementation. Indication of economic returns can be obtained by comparing the cost of the supplements and basal feed with the value of the liveweight produced. Economic trends were similar to that reported earlier by many workers (Sansoucy, 1986; Kunju, 1986; Ali and Mirza, 1986; Mirza et al., 1990; Mirza et al., 2002).

In conclusion SFM can quite effectively replace CSM in UMB up to 9% level and UMB can also be used as a substitute of commercial concentrates when growing water buffaloes are fed basal ration of wheat straw.

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