Growth and Nutrient Utilization in Buffalo Calves Fed Ammoniated Wheat Straw Supplemented with Sodium Sulphate

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ABSTRACT : Ten male buffalo calves (aged 6-8 months, average body wt. 88.5±0.5 kg) were divided into two groups of five animals in each. All the animals were fed on urea-ammoniated wheat straw (4% urea, 50% moisture) along with concentrate mixture (50:50 on DM basis). In addition animals in group II were given sodium sulphate to see the effect of sulphur on the utilization of nitrogen added through urea-ammoniation. This feeding practice continued for a period of 120 d, during which fortnightly body weights were taken to assess their growth rate. A metabolism trial was conducted after 90 days of feeding to know the digestibility of nutrients and their balance. Results revealed no significant difference in the intake of DM and other nutrients in two groups. The digestibility of DM, OM, EE, NDF, ADF and cellulose was alike in animals fed ammoniated straw and ammoniated straw+sodium sulphate supplemented group, whereas the digestibilities of CP and hemicellulose was significantly ($p<0.01$) more in group I and II respectively. There was no significant difference in intake of nitrogen, calcium and phosphorus in 2 groups. Similarly, the balance of these 3 nutrients was positive and statistically alike in two groups. Intake and excretion of sulphur through faeces and urine was significantly ($p<0.01$) more in group II than in group I. Inspite of higher excretion of sulphur through faeces and urine in group II, the sulphur balance was significantly ($p<0.05$) more in group II than in group I, probably due to significantly ($p<0.01$) higher intake of sulphur in this group. There was no significant difference in total body weight gain or average daily gain between two groups, indicating that addition of sodium sulphate did not have any positive effect on these parameters. Similarly the intake of DM, DCP and TDN were also alike in two groups. The DCP and TDN values of the two diets were 8.0, 60.4 and 6.8, 56.6% respectively. Feeding cost/unit gain was alike in both the groups. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 3 : 325-329)***

Key Words : Buffalo Calves, Growth, Urea Ammoniated Wheat Straw, Sodium Sulphate

INTRODUCTION

Non-protein nitrogen like urea can be effectively utilized by the ruminants to fulfill their protein requirement (NRC, 1989) and are better utilized when there is a readymade source of energy and sulphur in the diet (McDonald et al., 1977), as these enhance microbial protein synthesis in the rumen (Ernest, 1979). Crop residues are the major feeds on which the livestock population thrive in the third world countries including India. These crop residues are not only deficient in some of the essential nutrients like nitrogen, minerals and vitamins, but also have low digestibility. Urea-ammoniation of the crop residues has been found beneficial as it enhances the palatability, digestibility and also adds a significant amount of non-protein nitrogen in the crop residues (Jai Kishan et al., 1986,1987; Dass et al., 1993a,b; Badrudeen et al., 1994; Dass et al., 2000; Rath et al., 2001). The additional nitrogen added to the crop residues demands an additional supply of sulphur while feeding to animals, as nitrogen is utilized efficiently when the N:S ratio is maintained properly (Bouchard and Conrad, 1973).

The objective of the present study was to compare the growth rate, nutrient utilization and relative cost of feeding in buffalo calves fed urea-ammoniated wheat straw (UAWS) with or without additional sulphur through sodium sulphate.

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MATERIALS AND METHODS

Preparation of ammoniated wheat straw

Urea-ammoniated wheat straw (UAWS) was prepared following the procedure suggested by Dass et al. 1984). After 4 weeks of incubation, the required amount of UAWS was aerated everyday, prior to feeding to the experimental buffalo calves, to make it free from ammonia.

Animals and feeding

Ten growing male buffalo calves (6-8 months old, 88.5+0.5 kg average body weight) purchased from the local market were assigned to two equal groups in a completely randomised design after deworming, vaccination and acclimatization to the new environmental conditions for a period of 20 days. The buffalo calves were housed individually in well ventillated cement floored shed having individual feeding facilities and reared under proper hygenic and uniform managemental conditions. All the buffalo calves were offered concentrate mixture and UAWS in the ratio of 1:1 on DM basis to fulfill their nutrient requirement as per Kearl (1982). The concentrate mixture was offered at 9.0 AM throughout the experimental period

Table 1. Physical and chemical composition of feeds offered to experimental buffalo calves

Attributes physical composition	Conc. mixture (Percent as fed basis)	UAWS
Ingredients		
Wheat bran	12	
Crushed maize	66	
Soyabean cake	19	
Mineral mixture	2	
Common salt	1	
Vitablend (AD_3) g/100 kg	25	
Chemical Composition (percent on DM basis)		
Organic matter	94.5	86.9
Crude protein	20.3	7.50
Ether extract	5.60	0.90
Neutral detergent fibre	28.0	85.0
Acid detergent fibre	5.80	63.7
Cellulose	3.80	44.6
Hemicellulose	22.2	21.2
Calcium	1.60	0.57
Phosphorus	0.70	0.13
Sulphur	0.20	0.17

of 120 days. The concentrate mixture of group II was added with sodium sulphate to maintain N:S ratio of 10:1. Quantity of feeds offered to the animals in both the groups were adjusted fortnightly as per their body weight. The left over residue of each animal was weighed after 24 h consumption to arrive at daily feed intake. Clean and fresh drinking water was provided *ad libitum* at 10.0 AM and 3.0 PM daily, to all the animals.

Metabolism trial

In order to study the digestibility and balance of nutrients a metabolism trial of six days duration involving daily quantitative collection of feces and urine and recording of feed offered and residue was carried out after 90 days of experimental feeding on all the animals by harnessing them in metabolic cages. Representative sample of feed offered, residue left, feces and urine voided were brought to the laboratory for further analysis.

Chemical analysis

The proximate composition of feeds and fecal samples were determined as per AOAC (1990) methods. The contents of neutral detergent fiber (NDF), acid detergent fiber (ADF) and cellulose were analysed as per Van Soest et al. (1991). Hemicellulose content was calculated by subtracting ADF from NDF. Nitrogen content in feed, feces and urine was determined by micro-kjeldhal method and CP calculated as Nx 6.25. Mineral extract of feed, feces and urine was prepared (AOAC, 1990) and analysed for calcium as per Talapatra et al. (1940) and phosphorus colorimetrically involving molybdovanadate reagent (AOAC, 1990). Sulphur in feed, feces and urine was

Table 2. Effect of sodium sulphate supplementation on ammoniated wheat straw utilization in buffalo calves

Attribute	Group	
	UAWS	UAWS+sodium sulphate
Dry matter		
Intake (g/d)	3,319.0±157.4	3,634.9±341.7
Digestibility (%)	60.3±1.3	57.2±1.5
Organic matter		
Intake (g/d)	2,981.2±143.7	3,253.1±302.7
Digestibility (%)	64.0±1.0	61.8±1.4
Crude protein		
Intake(g/d)	468.7±30.6	491.5±44.7
Digestibility (%)**	57.0±0.8	51.6±2.3
Ether extract		
Intake (g/d)	113.4±8.4	113.3±10.1
Digestibility (%)**	70.5±2.7	64.9±7.7
NDF		
Intake (g/d)	1,844.4±58.3	2,086.8±213.9
Digestibility (%)	59.7±1.7	56.7±2.5
ADF		
Intake (g/d)	1,120.3±32.0	1,331.7±134.0
Digestibility (%)	51.3±2.8	45.1±3.8
Cellulose		
Intake (g/d)	773.7±22.4	926.1±93.7
Digestibility (%)	69.2±1.6	66.3±2.7
Hemicellulose		
Intake (g/d)	724.3±34.8	790.9±73.7
Digestibility (%)**	67.3±1.3	77.4±3.8

** ($p<0.01$).

estimated as per the method of Johnson et al. (1970) with the modification as suggested by Bull and Vandersall (1973). The data were analysed statistically using student's 't' test as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The chemical composition of ration ingredients is presented in Table 1. The urea-ammoniation of wheat straw increased the CP content to 7.5 per cent, which is in agreement with the earlier observations (Jai kishan et al., 1986;1987; Mehra et al., 1989). Intake and digestibility of various nutrients are presented in Table 2. Intake (g/d) of dry matter (DMI), organic matter (OMI) ether extract (EEI), crude protein (CPI), neutral detergent fibre (NDFI), acid detergent fibre (ADFI), cellulose and hemicellulose (HCI) were similar in both the groups. Addition of sodium sulphate in the diet of animals of group II did not affect the intake of any nutrient. Similarly, Bird (1973) did not find any effect on DMI in cattle and sheep given 0.4 per cent sodium sulphate in the basal diet of wheat straw. Manwal and Sharma (1997) and Saijpal et al. (1998) also did not find any significant effect on DMI in crossbred heifers fed different types of urea treated wheat straw added with

Table 3. Intake, excretion and balance of nitrogen, calcium, phosphorus and sulphur in experimental buffalo calves

Attribute	Group	
	UAWS	UAWS+sodium sulphate
N intake (g/d)	74.9±4.9	78.5±7.2
N out go through		
Feces (g/d)	32.20±2.0	37.36±1.6
Urine (g/d)	18.82±1.8	20.93±2.7
N balance (g/d)	23.97±3.0	20.16±3.5
Ca intake (g/d)	38.6±2.4	41.0±3.8
Ca out go through		
Feces (g/d)	28.2±2.0	31.3±2.2
Urine (g/d)**	3.20±0.3	6.00±0.7
Ca balance (g/d)	7.25±1.9	3.76±1.8
Phosphorus intake (g/d)	14.47±1.0	14.81±1.3
P out go through		
Feces (g/d)	6.70±0.6	7.36±0.9
Urine (g/d)	3.34±0.2	4.20±0.7
P Balance (g/d)	4.36±0.7	3.21±0.90
Sulphur intake (g/d)**	6.08±0.5	11.78±0.8
S outgo through		
Feces (g/d)**	1.10±0.2	2.54±0.3
Urine (g/d)**	3.37±0.5	5.95±0.8
S balance (g/d)*	1.61±0.05	3.29±0.7

* $p<0.05$, ** $p<0.01$.

Table 4. Effect of sodium sulphate supplementation on nutrient intake in experimental buffalo calves

Attribute	Group	
	UAWS	UAWS+sodium sulphate
Average body weight (kg)	125.1±11.4	132.2±10.9
Metabolic body size ($W^{0.75kg}$)	37.28±2.6	38.89±2.4
Dry matter		
Intake (g/d)	3,319.0±157.1	3,724.4±341.7
Intake (g/100 kg BW)	2,701.1±134.3	2,763.80±165.6
Intake (g/kg $W^{0.75}$)	89.59±2.3	93.35±5.3
Crude protein		
Intake (g/day)	468.7±30.6	491.5±44.7
Intake (g/100 kg BW)	378.6±10.68	373.8±21.8
Intake (g/kg $W^{0.75}$)	12.58±0.1	12.62±0.7
DCP		
Intake (g/day)	267.5±18.7	256.7±36.0
Intake (g/100kg BW)	215.7±5.9	193.3±16.5
Intake (g/kg $W^{0.75}$)	7.2±0.1	6.6±0.6
TDN		
Intake (g/d)	2,005.3±88.3	2,115.0±244.0
Intake (g/100 kg BW)	1,634.2±87.0	1,663.5±276.2
Intake (g/kg $W^{0.75}$)	54.20±1.6	54.12±3.8
Nutritive value of diets		
DCP (%)	8.0	6.8
TDN (%)	60.4	56.6
Nutrient requirement (g/d) as per Kearl (1982)		
DM	2,800	2,800
CP	373	373
TDN	2,470	2,470
Nutrient intake as percentage of requirement		
DM	118.5	140.2
CP	125.7	131.8
TDN	81.2	85.6

sodium sulphate. The digestibility (%) of DM, EE, NDF, ADF and cellulose were alike in 2 groups, whereas the digestibilities of CP and hemicellulose were significantly ($p<0.01$) more in group I and II respectively. The results were similar to the observation of Teller et al. (1977) who did not find any significant effect of sulphur supplementation on the digestibility of organic nutrients. Contrary to this Verma et al. (1981) observed a greater DM and OM digestibility in buffalo calves where N was provided along with sulphur as ammonium sulphate. Optimum levels of sulphur with nitrogen from NPN had a beneficial effect upon the digestibility of cellulose (Bull and Vandersall, 1973). Graham et al. (1976) reported that sodium sulphate added to urea containing diet significantly increased the digestion of cellulose in sheep.

Results on nitrogen (N), calcium (Ca), phosphorus (P) and sulphur (S) intake, their excretion and retention are presented in Table 3. Results revealed no significant difference in intake and retention of N, Ca and P in two groups. Animals in both the groups were in positive N, Ca, P and S balances. Contrary to this higher nitrogen retention was reported by Verma et al. (1981) in buffalo calves fed on wheat straw along with ammonium sulphate as a source of N and S. Bird (1973) reported that sulphate supplements slightly increased the output of fecal nitrogen and decreased the N balance ($p<0.01$) in cattle fed on wheat straw diet. Similar were the observation of Saijpal et al. (1998) in crossbred heifers fed on urea treated wheat straw supplemented with inorganic sulphur as sodium sulphate. Sulphur intake, its excretion through feces and urine was significantly ($p<0.01$) more in group II than group I. Similar higher excretion of sulphur through feces and urine was reported earlier by Morrison et al. (1990) in sheep fed poor quality tropical grass hay supplemented with sulphate. Retention of S (g/d) was significantly ($p<0.05$) more in group II than group I. These findings are similar to the observations of Morrison et al. (1990) in sheep fed poor quality tropical grass hay supplemented with sulphate, who reported that S supplementation restored sheep from a severely negative N and S balance to approximately zero balance.

Body weight gain and plane of nutrition in two groups of animals are presented in Table 4 and change in body weight during the experimental period is depicted in Figure 1. The total body weight gain in group I and II were 68.0 and 76.2 kg respectively in 120 days of experimental feeding, which were alike statistically. The average daily gain (g/d) was 565.0 and 635.0 in group I and II respectively indicating no significant difference in body

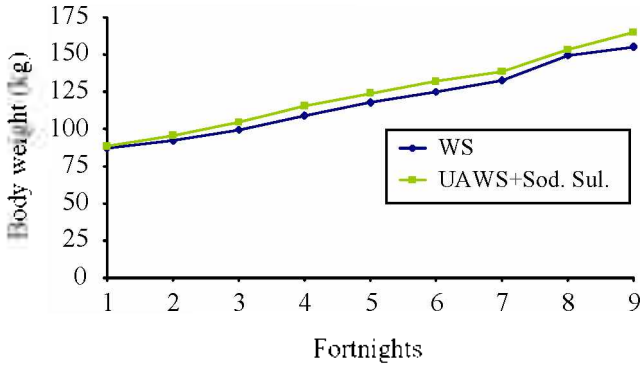

Figure 1. Fortnightly body weight change in growing buffalo calves.

Table 5. Feed cost of live weight gain in growing buffalo calves

Attribute	Group	
	UAWS	UAWS+sodium sulphate
Dry matter intake (kg) through		
Concentrate mixture	191.5	197.9
UAWS	226.2	260.9
Total	417.7	458.8
Cost of feed (Rs.)		
Concentrate mixture	1,359.6	1,405.3
UAWS	284.9	328.7
Total cost (Rs.)	1,644.5	1,734.0
Total live weight gain (kg)	68.0	76.2
Cost/kg gain (Rs.)	24.29	23.12

Cost of feeds in the year 2000-2001 in India were (Rs. Per kg): Maize-6.22, Wheat bran-5.38, Soyabean cake-9.28, Mineral mixture-12.98, Salt-0.95, Wheat straw-1.00, Na_2SO_4-156.00, Urea-4.00.

weight gain due to the supplementation of sulphur. These results were contrary to the findings of Manwal and Sharma (1997), who observed significant higher growth rate in crossbred heifers fed on urea ammoniated wheat straw supplemented with sodium sulphate. In the present study, also, the addition of sulphur enhanced the average daily gain by 70g/d, but the values were alike statistically in 2 groups. The intake of DM, digestible crude protein (DCP) and total digestible nutrients (TDN) were alike in two groups indicating that addition of sulphur did not have any significant effect on nutrient intake. The DCP and TDN (%) values of the two diets were 8.0, 60.4 and 6.8, 56.6 in two groups respectively. The intake of DM and crude protein (CP) was higher in both the groups in comparison to the values recommended by Kearl (1982), whereas the intake of TDN in both the groups was less than the requirement specified by Kearl (1982), indicating that the diets were deficient in energy.

The feed cost of live weight gain (FCWG) is largely dependent on cost of feed and efficiency of feed utilization. The total cost of feed in group I was Rs. 1,644.5 as compared to 1,734.0 in group II, which were alike statistically (Table 5). The feed cost/Kg gain was not different statistically in group I (Rs. 24.29) and II (Rs. 23.92).

CONCLUSION

In the current study it was observed that supplementation of sodium sulphate in the diet of buffalo calves fed on ammoniated wheat straw and concentrate mixture in the ratio of 1:1 had no beneficial effect.

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