International Journal of Veterinary Science

www.ijvets.com P-ISSN: 2304-3075 E-ISSN: 2305-4360 editor@ijvets.com

SHORT COMMUNICATION

Effect of Feeding Crop Residue based Complete Rations on Rumen Fermentation Pattern in Graded Murrah Bulls

S. Venkateswarlu[1], D. Srinivas Kumar* and E. Raghava Rao[2]

[1]Veterinary Assistant Surgeon, Veterinary Dispensary, Durgi, Andhra Pradesh, India; *Department of Animal Nutrition and [2]Associate Dean, NTR College of Veterinary science, Gannavaram, Andhra Pradesh, India-521 102, India

ARTICLE INFO

Received: January 12, 2013
Revised: March 05, 2013
Accepted: March 09, 2013

Key words:
Complete rations
N fractions
pH
Straws
Stovers
TVFA

***Corresponding Author**
D. Srinivas Kumar
kumardhulipalla@rediffmail.com

ABSTRACT

In 4 x 4 LSD, four rumen fistulated Murrah bulls (6 yrs; 353 ± 8.26 kg) were fed four iso-nitrogenous complete rations comprising of jowar stover (T_1), maize stover (T_2), red gram straw (T_3) and black gram straw (T_4) and concentrate mixture in 60:40 proportion, to study the effect on rumen fermentation pattern. The mean pH values were lower ($P<0.01$) in T_1 and T_2 when compared to T_3 and T_4 while mean TVFA concentration was significantly ($p<0.01$) higher in T_2 and T_4 compared to T_1 and T_3. The ammonia N concentration was significantly ($P<0.01$) higher in T_3 while residual N concentration was significantly ($P<0.01$) higher in T_1 compared to other treatments. Time of sampling had a significant ($P<0.01$) effect on rumen fermentation. Peak concentration of TVFA was recorded 4 h post feeding while for N fractions it is 2 h post feeding irrespective of the treatments. Thus, it was concluded that feeding of crop residue based complete rations provided an optimum rumen environment in graded Murrah bulls for effective nitrogen utilization and total volatile fatty acid production

Cite This Article as: Venkateswarlu S, DS Kumar and E Raghava Rao, 2013. Effect of feeding crop residue based complete rations on rumen fermentation pattern in graded murrah bulls. Inter J Vet Sci, 2(1): 35-38. www.ijvets.com

INTRODUCTION

In India, crop residues form a major portion of roughages and thus play an important role in feeding ruminants. High levels of structural carbohydrates and low nitrogen content of these roughages result in low palatability and poor nutrient utilization. The palatability and nutrient utilization of these crop residues can be improved by incorporation in complete diets. Rumen fermentation pattern is the key to the productive performance of dairy animals (Wadhwa and Bakshi, 2006). Complete feed provides a stable environment for rumen fermentation and enhancement in utilization of low grade roughages (Venkanna *et al.*, 1997). The level and type of roughage in the diet changes the pattern of microbial population in the rumen which in turn may affect their capacity to colonize feed particles and influences the supply of nutrients (Bakshi *et al.*, 2004). Hence, an attempt was made to study the effect of feeding different crop residue based complete rations on rumen fermentation pattern in graded Murrah bulls.

MATERIALS AND METHODS

The experiment was carried out at the Department of Animal Nutrition, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh, India, to study the effect of feeding crop residue based complete rations on rumen fermentation pattern in graded Murrah bulls.

In 4 x 4 LSD, four graded Murrah bulls (6 yrs; 353 ± 8.26 kg) each fitted with a permanent rumen fistula were fed four iso-nitrogenous complete rations comprising of roughage *viz.* Jowar stover (T_1), Maize stover (T_2), Red gram straw (T_3) and Black gram straw (T_4) and concentrate in 60:40 ration. All the bulls were offered 6.5 kg each of respective complete ration to meet the nutrient requirements as per ICAR, 1998. The ingredient composition of these complete rations is furnished in Table1.

The bulls were housed in well ventilated conventional stalls maintained in good hygienic condition, and were fed individually for 112 days. All the animals were provided with *ad libitum* clean, fresh drinking water. After 26 days of feeding, rumen liquor was collected from the fistulated buffaloes at 0, 1, 2, 4, 6 and 8 h post-feeding. The animals were offered water 1 h before first collection, and after last collection, to eliminate dilution with water on nitrogen concentration. The collected rumen liquor was strained through four layers of muslin cloth, and the resultant liquid was designated as strained rumen liquor (SRL). On the 29th day, animals were switched over to the other group and feeding continued for another 28 days.

About 100 ml of the SRL was drawn at each collection into a clean sterile polythene bottle. The pH of rumen liquor was measured immediately after the collection of rumen liquor using digital pH meter. Ammonia nitrogen was estimated by micro-diffusion method (Conway, 1957) using mixed indicator (Livingston *et al*., 1964). The TVFA concentration was estimated using the procedure of Barnett and Reid (1957). The total nitrogen (Micro-Kjeldahl), TCA-insoluble protein nitrogen (Cline *et al*., 1958), residual nitrogen, and food and protozoal nitrogen were ascertained (Singh *et al*., 1968).

Statistical analysis of the data was carried out as per the procedures suggested (Snedecor and Cochran, 1989) using SPSS version 17.0.

Table 1: Ingredient composition of complete rations fed to graded Murrah bulls

	Complete rations			
Ingredient	T_1	T_2	T_3	T_4
Jowar stover	60	--	--	--
Maize stover	--	60	--	--
Red gram straw	--	--	60	--
Black gram straw	--	--	--	60
Maize grain	6.0	7.2	8.0	9.6
DORB	7.7	8.1	10.5	12.5
Cotton seed cake	15.6	12.4	11.6	8.8
Gingelly cake	9.2	10.8	8.4	7.6
Mineral mixture	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

RESULTS AND DISCUSSION

The particulars of rumen pH, TVFA (meq/ litre of SRL), Ammonia nitrogen, Total N, TCA-Insoluble protein nitrogen, Residual Nitrogen, and Food and Protozoal Nitrogen (mg/ 100 ml of SRL) in graded Murrah bulls as affected by feeding complete rations containing different crop residues at 0, 1, 2, 4, 6 and 8 hours post-feeding are given in Table-2

Rumen pH

The data on rumen pH (Table 2) of buffalo bulls fed complete rations containing different crop residues indicated that the mean pH of SRL was higher ($P<0.01$) in animals fed red gram (T_3) or black gram straw (T_4) based complete rations than those fed jowar (T_1) and maize stover (T_2) based complete rations. However, no significant difference was observed between T_1 and T_2 or T_3 and T_4. Further in the present study, the pH values observed for different treatments were within the normal physiological range (6.2 to 7.2) as reported by Radostitis *et al.* (2003). Time of sampling had significant ($P<0.01$) effect on rumen pH. The pH of rumen liquor showed a decreasing trend up to 4 h post feeding in all the buffalo bulls irrespective of the treatment prior to attaining normal levels. This post prandial decline in pH values might be due to increased microbial fermentation and accumulation of organic acids in the rumen. These results are in agreement with the findings of earlier workers (Dahiya *et al*., 2011; Raja Kishore, 2012).

Total volatile fatty acids

The total volatile fatty acids (TVFA) concentration (meq/L) in SRL (Table 2) was higher ($P<0.01$) in buffalo bulls fed maize stover (T_2) and black gram straw (T_4) based complete rations compared to those fed either jowar stover (T_1) or red gram straw (T_3) based complete rations. No significant difference was observed between T_2 and T_4. The higher TVFA concentration in T_2 or T_4 compared to other treatments may be attributed to availability of synchronized energy (Satter and Slyter, 1974). Time after feeding linearly increased ($P<0.01$) the TVFA concentration up to 4 h post feeding beyond which there was a decline in its concentration and a similar trend was observed in all the treatments. The significant effect of time of sampling on the concentration of TVFA was in agreement with the earlier reports (Dahiya *et al.*, 2011 and Raja Kishore, 2012).

Ammonia Nitrogen

The concentration of ammonia nitrogen (mg / 100 ml SRL) was higher ($P<0.01$) in red gram straw (T_3) based complete ration compared to jowar stover (T_1), maize stover (T_2) or black gram straw (T_3) based complete rations (Table 2). This is in agreement with the findings of Raja Kishore (2012), who reported higher concentration of ammonia nitrogen in red gram straw based complete ration compared to either maize stover or black gram straw based complete rations. The increase in the concentration of ammonia nitrogen in buffalo bulls fed T_3 may be attributed to higher pH values in T_3 as uptake of ammonia by bacteria is reduced for microbial protein synthesis at higher pH (Chen and Jan, 1992). Lower ammonia nitrogen concentration reported in T_1 and T_2 indicates better utilization of ammonia nitrogen (Bakshi *et al.*, 2004). Time of sampling had a significant ($P<0.01$) effect on ammonia nitrogen concentration, which peaked at 2 h post feeding. The increased ammonia nitrogen concentration at 2 h post feeding could be due to deamination of amino acids and flow of ingesta from reticulo- rumen to rumen. Similar results were reported by Reddy *et al*. (2000) in buffalo bulls, Datt *et al*. (2011) in Nellore rams and Dahiya *et al*. (2011) in adult buffaloes.

Total Nitrogen

The total nitrogen concentration (mg / 100 ml SRL) was lower ($P<0.01$) in maize stover (T_2) based complete ration as compared to jowar stover (T_1) or black gram straw (T_4) based complete rations (Table 2). In the present study, higher total N concentration recorded in SRL of graded Murrah bulls fed T_2 may be attributed to higher intakes and better degradation of protein. Time of sampling had a significant ($P<0.01$) effect on total nitrogen concentration. The total N concentration was highest ($P<0.01$) at 2 h post feeding irrespective of the diet which may be attributed to active degradation of proteins and hydrolysis of NPN substances in rumen. The

Table 2: Effect of feeding crop residue based complete rations rumen fermentation in graded Murrah bulls.

Treatment/ Parameter	Time of rumen liquor sampling (h)						Treatment Mean**
	0	1	2	4	6	8	
pH							
T_1	6.86	6.82	6.71	6.57	6.76	6.82	6.76^{A} ± 0.05
T_2	6.84	6.82	6.68	6.54	6.72	6.79	6.73^{A} ± 0.05
T_3	7.01	6.98	6.85	6.77	6.87	6.93	6.90^{B} ± 0.04
T_4	6.96	6.87	6.81	6.71	6.83	6.88	6.84^{B} ± 0.04
Overall**	6.92^{d}	6.87^{d}	6.76^{b}	6.65^{a}	6.80^{bc}	6.88^{cd}	
TVFA (meq/l of SRL)							
T_1	62.47	69.63	82.25	102.5	81.13	75.25	78.88^{B}±6.14
T_2	60.5	71.25	86.75	115.63	85.19	76.88	82.70^{C} ± 8.40
T_3	61.69	67.5	76.63	93.88	79.5	70.5	74.95^{A} ± 5.03
T_4	66.63	71.75	87.75	102.25	86.25	74.25	81.48^{C} ± 5.87
Overall **	62.83^{a}	70.03^{b}	83.35^{d}	103.5^{e}	83.02^{d}	74.22$_{c}$	
NH_3-N (mg/100ml SRL)							
T_1	6.23	6.69	10.78	10.57	9.34	6.93	8.42^{A} ± 0.92
T_2	7.92	9.08	13.38	12.46	11.73	6.79	10.23^{B} ±1.19
T_3	10.26	12.25	15.68	18.17	11.83	8.89	12.85^{D}±1.55
T_4	9.52	11.87	15.12	12.92	10.47	8.47	11.40^{C} ±1.08
Overall **	8.48^{b}	9.97^{c}	13.74^{e}	13.53^{e}	10.84^{d}	7.77^{a}	
Total N (mg/100ml SRL)							
T_1	64.00	77.00	100.75	89.50	77.75	69.00	79.67^{B}±6.04
T_2	60.25	71.63	97.50	86.75	73.75	66.50	76.06^{A}±6.13
T_3	61.25	76.25	101.25	85.75	75.50	68.75	78.13^{AB}±6.25
T_4	64.5	74.25	99.00	92.25	77.00	69.00	79.33^{B}±6.04
Overall **	62.50^{a}	74.78^{c}	99.63^{e}	88.56^{d}	76.00^{c}	68.31^{b}	
TCA precipitable N (mg/100ml SRL)							
T_1	18.70	22.18	28.11	25.84	21.47	19.20	22.58^{A}±1.66
T_2	18.84	22.93	28.63	24.58	22.12	20.55	22.94^{AB}±1.53
T_3	19.66	23.25	29.24	24.10	21.88	19.75	22.98^{AB}±1.59
T_4	19.97	23.71	28.41	25.69	23.25	20.00	23.51^{B}±1.47
Overall **	19.29^{a}	23.02^{b}	28.60^{d}	25.05^{c}	22.18^{b}	19.88^{a}	
Residual nitrogen (mg/100ml SRL)							
T_1	25.04	28.47	33.79	28.76	23.67	21.74	26.91^{C} ± 1.94
T_2	22.89	25.39	29.12	26.47	21.12	21.38	24.40^{B} ± 1.41
T_3	20.51	22.83	26.11	19.82	19.51	18.04	21.40^{A} ± 1.41
T_4	23.04	24.66	27.61	27.08	23.09	20.76	24.37^{B} ± 1.17
Overall **	22.87^{b}	25.34^{c}	29.16^{d}	27.44^{c}	21.85^{b}	20.48^{a}	
Food and protozoal nitrogen(mg/100ml SRL)							
T_1	14.03	19.67	28.07	24.34	23.27	21.14	21.75^{B} ± 2.13
T_2	10.60	14.23	26.37	23.24	18.79	17.78	18.50^{A} ± 2.57
T_3	10.83	17.92	30.23	23.66	22.29	22.07	21.17^{B} ± 2.88
T_4	11.97	14.02	27.87	26.57	20.20	19.78	20.07^{AB} ±2.87
Overall **	11.86^{a}	16.46^{b}	28.14^{e}	24.45^{d}	21.14^{c}	20.19^{c}	

Values bearing different superscripts in a column or in a row differ significantly (P<0.01)

subsequent decline in the total N concentration might be due to changes in the rumen volume through inflow of saliva as well as out flow of digesta (Grubb and Dehority, 1975). The differences in total N concentration due to time of sampling were in agreement with earlier reports (Reddy *et al*., 1993; Datt *et al*., 2011 and Dahiya *et al*., 2011).

TCA insoluble protein nitrogen

The TCA insoluble protein nitrogen (Table 2) was higher (P<0.01) in black gram straw (T_4) based complete ration compared to jowar stover (T_1) based complete ration. However, no significant differences (P>0.05) were observed between T_1, T_2 and T_3 or between T_2, T_3 and T_4. These results corroborated with the findings of Raja Kishore (2012). Time of sampling had a significant (P<0.01) effect on TCA insoluble protein nitrogen concentration and it reached peak at 2 h post feeding. This was in agreement with the findings of Reddy *et al.* (2001), Dahiya *et al.* (2011) and Datt *et al.* (2011) in animals fed complete diets. The TCA insoluble protein nitrogen reached peak concentration at 2 h post feeding beyond which there was a decline. Peak concentration of TCA insoluble protein nitrogen at 2 h post feeding might be due to active degradation of protein, synthesis of microbial protein in the rumen and subsequent decline in its concentration due to change in the rumen volume through inflow of saliva.

Residual nitrogen

The concentration of residual nitrogen (Table 2) was higher (P<0.01) in jowar stover (T_1) based complete ration as compared to complete rations containing either maize stover (T_2), red gram straw (T_3) or black gram straw (T_4). Higher concentration of total nitrogen in the rumen fluid of buffalo bulls fed T_1 might have influenced residual nitrogen. Time of sampling had a significant (P<0.01) effect on residual nitrogen. Peak concentration of residual nitrogen was recorded at 2 h post feeding and declined slowly thereafter in buffalo bulls fed complete diets containing different crop residues, following the trend similar to total N and TCA insoluble nitrogen. The gradual decrease in residual nitrogen concentration in the present study at 4 h post feeding may probably be due to variation in the microbial activity and optimal utilization of dietary nitrogen by 4 h after feeding. Similar observations were reported by Reddy *et al.* (2001) and Raja Kishore (2012) in animals fed complete diets.

Food and Protozoal nitrogen

The concentration of food and protozoal nitrogen (Table 2) was lower (P<0.01) in maize stover (T_2) based complete ration as compared to complete rations containing either jowar stover (T_1) or red gram straw (T_3). Time of sampling had a significant (P<0.01) effect on the concentration of food and protozoal nitrogen. The concentration of food and protozoal nitrogen was the highest at 2h post-feeding. It increased (P<0.01) from 0h to 2h post-feeding and then declined. Reddy *et al.* (2001) reported similar findings in buffalo bulls fed sugarcane bagasse based complete diets.

Conclusion

It is concluded that feeding of crop residue based complete rations provided an optimum rumen environment in graded Murrah bulls for effective nitrogen utilization and total volatile fatty acid production, thus leading to improved animal performance.

REFERENCES

Bakshi MPS, M Wadhwa, KK Rana and S Kaushal, 2004. Effect of roughage level in complete feed on the rumen environment in crossbred cows. Indian J Anim Nutr, 21: 158-163.

Barnett JGA and RL Reid, 1957. Studies on the production of volatile fatty acids from the grass by rumen liquor in an artificial rumen 1.Volatile acid production from grass. J Agric Sci, 48: 315-321.

Chen KJ and DF Jan, 1992. Effect of ensiled dry poultry waste in native goat ration on the rumen as evaluated by in vitro method. J Taiwan Livestock Res, 25: 65-73.

Cline H, TN Hershberger and Bensely, 1958. Utilization and or synthesis of valeric acid during the digestion of glucose, starch and cellulose by rumen microorganism *in vitro*. J Anim Sci, 17: 284-291.

Conway EJ, 1957. Micro diffusion analysis and volumetric error: (4^{th} edn.) Crossby Lockwood and son, London, England.

Dahiya SS, PC Lailer, D Lal and TR Chauhan, 2011. Rumen fermentation pattern in buffaloes fed complete feed blocks. Indian J Anim Nutr, 28: 177-180.

Datt C, GVN Reddy and SS Kundu, 2011 Effect of feeding differently processed paddy straw based complete diets on feed intake and nutrient utilization in Nellore rams. Indian J Anim Nutr, 28: 160-165.

Grubb JA and BA Dehority, 1975. Effect of an abrupt change in ration from all roughage to high concentrate diet upon rumen microbial number in sheep. Applied Microbiology 30: 404-415.

ICAR, 1998. Nutrient requirements of livestock and Poultry, New Delhi.

Livingston HG, WJA Payne and MT Friend, 1964. Nitrogen metabolism of cattle in East Africa. 1. The problem and experimental procedures. J Agric Sci, 62: 313-319.

Radistitis OM, DC Blood, GC Gay and KW Hinchcliff, 2003. Veterinary medicine, 9^{th} ed. Book Power Formerly ELST, Bitish Council, London, UK.

Reddy CN, GVN Reddy and MR Reddy, 1993. Effect of fodder based complete diets on the rumen fermentation pattern in crossbred bulls. Indian J Anim Nutr, 10: 7-12.

Raja Kishore K, 2012. Evaluation of crop residue based complete rations for augmenting milk and meat production in buffaloes and sheep. PhD thesis submitted to Sri Venkateswara Veterinary University, Tirupati.

Reddy GVN and KJ Reddy, 2000. Effect of expander extruder processing on nutritive value of maize cobs based complete diets of buffaloes. Indian J Anim Sci, 70: 2, pp: 188.

Reddy GVN, KJ Reddy and D Nagalakshmi, 2001. Nutrient utilization and rumen fermentation pattern of sugarcane bagasse based complete diets in buffalo bulls. Indian J Anim Nutr, 18: 138-145.

Satter LD and LL Slyter, 1974. Effect of ammonia concentration on rumen microbial protein production in vitro. British J Nutr, 32: 199-208

Singh AK, PN Sudarshan, GS Langer, AS Sidhu, Kochar and Bhatia, 1968. Study of rumen biochemical activity in the buffaloes and Zebu cattle under non urea feeding regimens. Indian J Vet Sci Anim Husb, 38: 674-681.

Snedecor CW and WG Cochran, 1989. Statistical methods (8^{th} edition), Iowa State University Press, Ames, Iowa, USA.

SPSS, 2008. Statistical packages for Social Sciences, version 17.0, SPSS Inc, Illinois, USA.

Venkanna P, MR Reddy and GVN Reddy, 1997. Rumen fermentation pattern on complete diets based on dry mixed grass or cotton seed hulls in crossbred bulls. Indian J Anim Nutr, 14: 245-249.

Wadhwa M and MPS Bakshi, 2006 Effect of total mixed rations on the performance of buffalo calves. Indian J Anim Nutr, 23: 159-164.