EFFECT OF PRESENCE OR ABSENCE OF PROTOZOA ON RUMEN DIGESTIVE FUNCTIONS IN BUFFALOES ON STRAW-BASED DIETS

O.P. Nangia and P.N. Shrivastava

Haryana Agricultural University, Hisar, India

Introduction

Low quality roughages have both physical and chemical constraints which preclude optimum animal production. Balancing critical nutrients in a straw-based diet (upgrading to improve digestibility and supplementation to meet essential requirements) and ensuring an efficient rumen system can lead to moderate levels of production. Interactions of micro-organisms within the rumen are complex and not always to the advantage of the ruminant, large protozoal population in the rumen have been shown to reduce the biomass of bacteria and fungi in the rumen of animals on diets high in fibre and may reduce the digestibility of fibrous feeds (Leng, 1984). The objective of the present study was to evaluate digestion kinetics in normally faunated and "experimentally defaunated" buffaloes maintained on straw-based diets.

Materials and Methods

The studies included 4 appearantly healthy faunated Murrah buffalo calves of 2-3 years of age. They were fed four different rations, one at a time, in four separate trials in a randomized block design. The diets offered to the animals included (i) chopped wheat straw fed *ad lib.* with 2 kg standard concentrate mixture/animal/day(WSC), (ii) freshly urea (2%) treated wheat straw fed *ad lib.* no concentrate mixture (UWS), (iii) ammonia (generated from 4% urea) treated wheat straw fed *ad lib* with 2 kg concentrate mixture/ animal/day (AWSC), (iv) ammonia treated wheat straw fed *ad lib.* with non concentrate mixture (AWS). Urea treated wheat straw was prepared by dissolving 20 gm urea in 1 litre of water sprayed over 1 kg wheat straw and uniformally mixed. Ammonia treated wheat straw was prepared by dissolving 40 gm urea in 1 litre and sprayed uniformally over 1 kg and was stacked in air tight polythene bags for a period of 21 days for ammoniation at ambient temperature of 20-40 °C straw was fed after 2-3 hours of aeration to remove excess of ammonia.

After completion of this experiment the same animals were defaunated by intra-ruminal administration of Dioctyl sodium sulfosuccinate as followed by Demeyer and Nevel (1979). The schedule of feeding, obtaining rumen samples and estimating various parameters were similar to that as in experiment I. Statistical analysis was conducted on the overall average values of the parameters estimated in the two groups by 't' test.

The feeding period in each trial was comprised of an adaptation period of 21 days to a particular dietary regimen. Thereafter the rumen fluid samples were collected before feeding (0 hr) and at 3, 6, 9 and 12 hours post feeding for three consecutive days from each animal. The various rumen parameters analysed from individual rumen sample by standard method included, (i) Total nitrogen ammonia nitrogen and microbial protein nitrogen (MPN), (ii) Total and individual volatile fatty acids, (iii) Fermentation rate, maximum fermentation rate and net growth of rumen microbes.

Results and Discussion

Nitrogen fractions

The data and statistical analysis on various ruminal nitrogen fractions (Table 1) showed that ruminal total nitrogen did not differ significantly in defaunated animals on diets of WSC, UWS and AWS, whereas under AWSC regimen, the total nitrogen was significantly higher in defaunated animals as compared to faunated counterparts.

The ruminal ammonia-N was significantly lower in animals maintained defaunated in the three feeding schedule (WSC, AWSC, AWS) except in animals fed freshly treated urea straw (UWS) where ammonia-N level did not differ significantly

TABLE 1. COMPARISON OF TOTAL NITROGEN, AMMONIA NITROGEN AND MICROBIAL PROTEIN NITROGEN IN STRAINED RUMEN LIQUOR, BETWEEN FAUNATED AND DEFAUNATED BUFFALOES

Parameters	Diets	Overall mean ± S.E.		Significance of difference
		F	DF	
Total nitrogen	WSC	111.08 ± 3.91	117.74 ± 5.76	NS
	UWS	69.63 ± 4.61	70.74 ± 1.42	NS
	AWSC	157.74 ± 4.39	209.68 ± 7.75	*
	AWS	61.91 ± 2.44	72.03 ± 2.28	NS
Ammonia-N	WSC	9.22 ± 0.46	7.32 ± 0.34	*
	UWS	18.53 ± 1.11	22.90 ± 1.02	NS
	ASWC	21.28 ± 1.26	10.66 ± 0.59	*
	AWS	13.04 ± 0.82	8.39 ± 0.27	*
Microbial protein-N	WSC	61.01 ± 1.15	55.83 ± 2.11	NS
	UWS	27.88 ± 1.28	43.28 ± 1.91	*
	AWSC	92.23 ± 2.66	127.21 ± 4.94	*
	AWS	33.28 ± 2.83	54.07 ± 2.23	*

* Indicates significant difference in a row at $p < 0.05$
NS; Nonsignificant F; Faunated DF; Defaunated

TABLE 2. COMPARISON OF VOLATILE FATTY ACIDS IN STRAINED RUMEN LIQUOR BETWEEN FAUNATED AND DEFAUNATED BUFFALOES

Parameters	Diets	Overall mean ± S.E.		Significance of difference
		F	DF	
Total VFA (mEq/l)	WSC	66.70 ± 3.34	110.56 ± 4.53	*
	UWS	69.97 ± 2.43	85.98 ± 2.76	*
	AWSC	76.47 ± 2.75	108.51 ± 3.46	*
	AWS	68.35 ± 2.67	77.58 ± 3.22	NS
Acetate (% Molar)	WSC	50.80 ± 0.80	53.39 ± 0.52	*
	UWS	56.89 ± 1.42	55.00 ± 0.42	*
	AWSC	50.71 ± 0.84	53.59 ± 0.04	*
	AWS	54.96 ± 0.96	63.84 ± 0.73	*
Propionate (% Molar)	WSC	26.95 ± 0.45	32.80 + 0.65	*
	UWS	27.05 ± 0.51	32.03 ± 0.47	*
	AWSC	28.08 ± 0.57	35.07 ± 1.10	*
	AWS	29.47 ± 0.90	26.70 ± 0.67	*
Butyrate (% Molar)	WSC	11.12 ± 0.32	8.97 ± 0.26	*
	UWS	7.73 ± 0.32	7.40 ± 0.22	NS
	AWSC	10.78 ± 0.46	6.11 ± 0.31	*
	AWS	7.44 ± 0.24	3.72 ± 0.21	*

* Indicates significant difference in a row at $p < 0.05$
NS; Nonsignificant F; Faunated DF; Defaunated

between faunated and defaunated animals. Various research workers have consistently reported lower ammonia N concentration in ruminants as a result of defaunation. The important activity of the ciliates is that they engulf and digest bacteria and release digestion products, which are mainly amino acids, back into the surrounding medium which are fermented by the remaining bacteria to ammonia which can be lost to the host. As a result rumen ammonia concentrations are almost always higher in faunated than defaunated animals on low protein rations, this behaviour of protozoa may result in a critical loss of protein to the host.

The overall mean values of MPN in defaunated animals were significantly higher in all the other dietary schedule except in those fed WSC, where the values of MPN did not differ significantly between faunated and defaunated animals. The turnover of cellular nitrogen in the rumen that occurs upon death of bacteria or their engulfment by protozoa has been attributed for lower efficiencies of net microbial protein synthesis (Bird and Leng, 1985). However, regardless of the mechanism, the protein concentration of rumen liquor has been reported higher in defaunated than faunated animals (Meyer *et al.,* 1986).

Total VFA concentrations in rumen fluid (table 2) were higher in defaunated animals in all the dietary treatments as compared to their faunated counterparts under identical feeding schedule. The molar proportions of acetate and propionate increased, whereas that of butyrate were lowered as a result of defaunation. Variable results have been reported on TVFA concentration as a result of defaunation. Some workers have reported higher rumen TVFA, whereas other have reported lower TVFA concentration in the rumen of protozoa free animals. However, the question is still not resolved as to whether defaunation alters the amount of energy available to the animal. The present investigations however, suggest that under the dietary conditions of the present study removal of protozoa increased VFA concentration in the rumen, which may be attributed to increased numbers of rumen bacteria in the absence of protozoa, since bacteria are mainly responsible

TABLE 3. COMPARISON OF *IN VITRO* FERMENTATION RATE, MAXIMUM FERMENTATION RATES AND NET GROWTH OF MICROBES BETWEEN FAUNATED AND DEFAUNATED BUFFALOES

Parameters	Diets	Overall mean ± S.E.		Significance of difference
		F	DF	
Fermentation Rate (μl/g/min)	WSC	7.10 ± 0.35	10.30 ± 0.30	*
	UWS	5.77 + 0.26	9.05 + 0.28	*
	AWSC	9.75 ± 0.32	11.20 ± 0.70	NS
	AWS	6.50 ± 0.25	9.30 ± 0.29	*
Maximum fermentation rate (pre-incubation) (μl/g/min)	WSC	38.00 ± 1.03	45.90 ± 1.17	*
	UWS	26.70 ± 0.85	40.80 ± 1.04	*
	AWSC	39.00 ± 0.81	46.00 ± 1.11	*
	AWS	26.90 ± 0.86	41.60 ± 0.95	*
Maximum fermentation rate (post-incubation) (μg/g/min)	WSC	42.30 ± 1.53	55.20 ± 1.59	*
	UWS	29.20 ± 0.89	50.00 ± 1.57	*
	AWSC	43.50 ± 1.16	57.00 ± 1.67	*
	AWS	29.40 ± 1.00	50.00 ± 1.29	*
Net growth of microbes (% per h.)	WSC	10.86 ± 1.29	19.97 ± 1.29	*
	UWS	8.93 ± 0.58	21.82 ± 1.51	*
	AWSC	11.62 ± 1.13	24.54 ± 0.86	*
	AWS	9.50 ± 0.67	20.09 ± 1.12	*

* Indicates significant difference in a row at $p < 0.05$;
NS; Nonsignificant F; Faunated DF; Defaunated;

for VFA production.

In vitro fermentation rates, maximum fermentation rates and net growth of rumen microbes (table 3) were all significantly increased in protozoa free animals as compared to their faunated counterparts under all the four dietary conditions. Similar results have been reported by various research workers. Demeyers and Van Nevel (1979) suggested that bacteria grow more efficiently in the absence of protozoa than when there is a mixed microbial population. The efficiencies of both total and net microbial growth have been reported to increase as much as two fold by defaunation (Lindsay & Hogan, 1972). The production of gas is an indirect index of fermentation rate and change in gas production reflects the microbial activity. Therefore, higher fermentation rate in defaunated animals may be due to their higher bacterial population.

(**Key Words:** Buffaloes, Defaunation, Wheat Straw Diets)

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