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Research Article

EFFECT OF DEFAUNATION ON RUMEN FERMENTATIVE PATTERN IN BUFFALOES

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ABSTRACT

An experiment was conducted to evaluate the effect of defaunation on rumen fermentation pattern in buffaloes maintained on diet containing 40% roughage and 60% concentrate. Three healthy fistulated male buffalo calves fed twice daily were included in this experiment. These buffalo calves were defaunated by intra-ruminal infusion of sodium-dioctyl-sulphosuccinate. The results revealed that total volatile fatty acids (TVFA) concentration in the rumen liquor did not differ significantly between faunated and defaunated animals. However, the concentration of propionate increased, and that of butyrate decreased but acetate remained unaffected as a result of defaunation.

Key words: Volatile fatty acids, defaunation, rumen fermentation, buffaloes

Rumen digestion is an extremely complex system of interacting processes involving microbes, feed and animal. The microbial population of the rumen is composed of a complex mixture of bacteria, protozoa and fungi. Each of these groups are morphologically and bio-chemically diverse but their carbohydrate substrate utilization spectra overalp. This versatility compliments the intricate physical structures of the microbial community within the ruminal ecosystem and enables ruminant animals to consume a wide variety of feed stuffs without causing large fluctuations in the amount or type of microbial products produced. Elimination of protozoa greatly modifies the microbial environment of the rumen, however, these modifications are not systemic and the results vary with the experiment. It has been reported that there is decreased availability of metabolisable nutrients or less efficient use of nutrients by animals that have a large protozoal biomass in the rumen. Defaunation is one the means of manipulating rumen fermentation. Most of the studies have been conducted on defaunated sheep and cattle. Information on buffaloes is scanty. The present investigations describe the effect of defaunation on rumen fermentation pattern in buffaloes.

MATERIALS AND METHODS

Three healthy male fistulated buffalo calves of about 2 years age were fed twice daily on a ration containing concentrate mixture and chopped wheat straw in 40:60 ratio for a period of four weeks. The concentrate mixture comprised of maize (30%), gram (30%), groundnut cake (20%), oats (10%) and barley (10%) having 15.77% DCP and 77.35% TDN. The quantity of the ration fed to each animal was computed according to the standards recommended by National Research Council (1978). The daily ration was divided into two equal parts and offered at 9 AM and 4 PM daily, respectively. The calves had free access to clean drinking water. The animals were kept indoor under proper hygienic management. At the end of 4 weeks adaptation period, rumen liquor samples were collected from individual calf before feeding (0 h) and at 2, 4, 6, 8, 10 h post feeding for three consecutive days. These animals served as control group (faunated group).

Thereafter, these animals were defaunated by intra-ruminal infusion of sodium dioctyl-sulphosuccinate (Nangia and Garg, 1990). A dose of 15 gm of sodium dioctyl-sulphosuccinate dissolved in 250 ml of luke warm water was directly infused into the rumen of the animals twice at a week interval. Samples of rumen liquor were taken 4 weeks after complete defaunation at the same intervals as in faunated animals. These animals served as treatment group (defaunated group). Total volatile fatty acids (TVFA) and individual volatile fatty acids in

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collected rumen samples were determined by gas chromatography (Bapat, 1981). The mean and their S.E. were calculated as per standard technique (Snedecor and Cochran, 1967). The critical difference among various means were worked out by least square difference method.

RESULTS AND DISCUSSION

Total volatile fatty acids: The data presented in table-1 indicated that in faunated buffalo calves, TVFA concentration was lowest before feeding and then increased at subsequent intervals to reach maximum at 4th hour post-feeding and again declined slightly at 6th hour post-feeding which remained significantly higher than the pre-feeding value and then again showed increasing trend till 10th hour because of two times feeding. The similar trends in TVFA concentration have been reported in other ruminants by (Bhatia *et al.*, 1980, Bapat, 1981, Hart and Polan, 1984) which could be attributed to the availability of substrate as a result of ingestion of food. However, the post prandial trend of TVFA concentration observed in defaunated animals was strikingly different. TVFA concentration attained the peak value earlier at 2 h post-feeding and then declined slightly at subsequent intervals. Protozoa store polysaccharides for subsequent fermentation when readily available fermentable substrate is available. When protozoa were removed, readily fermentable carbohydrates may have been fermented immediately by large bacterial population. Similar trend has been observed in buffaloes (Nangia and Garg, 1990).

The statistical analysis of the data revealed that the TVFA concentration in faunated and defaunated animals did not differ significantly. Some workers have reported higher rumen TVFA concentration (Grummer *et al.*, 1983, Viera *et al.*, 1983, Sahoo *et al.*, 2005) whereas others reported lower TVFA concentration in rumen liquor (Abbou Akkada and El-Shazly, 1964, Kurihara *et al.*, 1968, Eadie and Gill, 1971) while another group did not report any change in calves in rumen TVFA concentration as a result of protozoal elimination from the rumen (Williams and Dinusson, 1973).

Acetate: Mean concentration or individual volatile fatty acids and their molar concentration in % is depicted in table 1 and table 2, respectively. Acetate concentration in faunated animals increased after feeding to attain peak concentration at 4th h post-feeding and then slightly decreased but was significantly higher than pre-feeding level. Acetate concentration in defauanted animals however attained peak value earlier, at 2 h post-feeding and then declined subsequently. Acetate molar concentration in rumen liquor of faunated and defaunated animals was higher before feeding and then declined and remained low at all post-feeding intervals.

The statistical analysis of the data on overall average values revealed that absolute as well as molar concentration of acetate did not differ significantly between faunated and defaunated animals. Variable results have been reported. Some workers have reported higher concentration of acetate as a result of defaunation (Abou Akkada and El-Shazly, 1964, Christiansen *et al.*, 1965) whereas in other experiments, defaunation has been associated with lower proportion of acetate (Males and Purser, 1970, Grummer *et al.*, 1983) and others have reported no change due to defaunation (Willliams and Dinusson, 1973, Viera *et al.*, 1983).

Propionate: Rumen propionate concentration in faunated animals increased at various post feeding intervals and peak concentration was reached at 4th h. Similar trend was observed in defaunated animals but the peak was recorded at 2nd h post-feeding. Higher earlier peak of propionate concentration along with concomitant TVFA peak obtained in the defaunated animals may be ascribed to the easy and immediate availability of the readily fermentable carbohydrates to the enhanced bacterial population due to the absence of protozoa. The statistical analysis of the data revealed that defaunated animals had significantly higher absolute as well as molar concentration of propionate in their rumen liquor as compared to faunated animals. Similar observations have been reported in cattle (Grummer *et al.*, 1983, Nagaraja *et al.*, 1992) where higher proportion of propionate was associated with absence of protozoa.

Butyrate: In faunated animals butyrate

Table1

Effect of defaunation on concentration (mEq/L) of rumen volatile fatty acids in high roughage diet fed animals

Nature of fatty acid		Hours post-feeding						Overall mean
		0	2	4	6	8	10	
TVFA	HRC	68.19^{a}±1.99	93.70^{a} ± 2.16	119.36^{a} ± 2.72	92.48^{a} ± 2.22	102.09^{a} ± 2.43	110.11^{a} ± 2.52	97.65^{a} ± 16.00
	HRD	60.46^{a}±2.15	124.88^{b}±315	105.04^{b} ±2.84	83.49^{b} ±2.98	100.54^{b} ±3.14	121.44^{b} ±3.27	99.30^{b} ±22.80
Acetate	HRC	55.76^{a}±1.23	68.42^{a} ±1.34	86.98^{a} ±1.26	73.86^{a} ±1.34	75.47^{a} ±1.00	77.17^{a} ±0.65	72.94^{a} ±9.80
	HRD	50.61^{a}±1.30	88.16^{b} ±1.66	80.05^{b} ±1.67	68.14^{a} ±1.64	74.77^{a} ±1.53	86.37^{b} ±1.62	74.68^{a} ±9.60
Propionate	HRC	7.72^{a} ± 0.46	19.25^{a}± 1.00	25.90^{a} ± 0.89	19.51^{a} ± 0.44	21.00^{a} ± 0.81	23.53^{a} ± 0.61	19.48^{a} ± 2.01
	HRD	8.51^{a} ± 0.63	27.61^{b} ± 1.18	23.81^{b} ± 1.46	19.18^{b} ± 1.61	24.78^{b} ± 1.60	26.66^{b} ± 1.25	21.75^{b} ± 1.98
Butyrate	HRC	3.36^{a} ± 0.50	5.30^{a} ± 0.49	7.36^{a} ± 0.51	5.31^{a} ± 0.48	4.17^{a} ± 0.54	5.16^{a} ± 0.56	4.77^{a} ± 1.09
	HRD	1.95^{b} ± 0.11	4.64^{b} ± 0.41	3.60^{b} ± 0.41	1.65^{b} ± 0.17	3.47^{b} ± 0.40	4.60^{b} ± 0.37	3.37^{b} ± 1.06
Others	HRC	4.80^{a} ± 0.99	6.35^{a} ± 1.55	7.17^{a} ± 1.50	2.59^{a} ± 0.47	4.12^{a} ± 0.45	6.19^{a} ± 1.51	5.20^{a} ± 1.54
	HRD	2.63^{a} ± 1.43	9.32^{a} ± 2.59	4.40^{a} ± 1.56	2.07^{a} ± 0.21	5.04^{a} ± 0.45	9.24^{a} ± 1.50	5.45^{a} ± 2.88

Means with common superscript do not differ significantly between treatments ($P < 0.01$).

HRC- high roughage control, HRD- high roughage defaunated

Table 2

Effect of defaunation on molar concentration (%) of rumen volatile fatty acids in high roughage diet fed animals

Nature of fatty acid		Hours post-feeding						Overall mean
		0	2	4	6	8	10	
Acetate	HRC	76.71^{a}±0.31	69.02^{a} ± 0.14	68.91^{a} ± 0.40	72.52^{a} ± 0.14	71.30^{a} ± 0.96	68.32^{a} ± 0.82	70.33^{a} ± 2.84
	HRD	78.34^{a}±0.61	68.71^{a} ± 0.32	70.71^{a} ± 0.90	72.57^{a}± 0.12	66.88^{a} ± 0.98	66.65^{a} ± 0.72	70.14^{a} ±2.60
Propionate	HRC	11.32^{a}±0.32	18.54^{a} ± 0.16	16.69^{a} ± 0.11	20.09^{a} ± 0.16	20.57^{a} ± 0.42	20.36^{a} ± 0.14	17.76^{a} ± 1.49
	HRD	14.07^{b}±0.40	20.10^{b} ±0.14	21.66^{b} ± 0.12	20.97^{a} ± 0.11	24.64^{b} ± 0.26	21.75^{b} ± 0.16	20.53^{b} ± 1.82
Butyrate	HRC	4.92^{a} ± 0.14	5.65^{a}± 0.18	6.96^{a} ± 0.71	4.57^{a} ± 0.60	4.08^{a} ± 0.36	4.68^{a} ± 0.36	5.04^{a} ± 0.80
	HRD	3.22^{b} ± 0.43	3.71^{b} ± 0.20	3.42^{b} ± 0.14	2.97^{b} ± 0.42	3.45^{b} ± 0.40	3.78^{b} ± 0.20	3.45^{b} ± 0.60
Other VFA	HRC	7.03^{a} ± 1.96	7.48^{a} ± 0.64	7.04^{a} ± 1.80	2.82^{a} ± 0.14	4.05^{a} ± 0.68	6.64^{a} ± 0.98	5.84^{a} ± 1.62
	HRD	4.34^{a} ± 1.98	7.48^{a} ± 0.42	4.21^{a} ± 1.64	3.49^{a} ± 0.46	5.03^{a} ± 0.96	7.62^{a} ± 1.84	5.39^{a} ± 1.83

Means with common superscript do not differ significantly between treatments ($P < 0.01$).

HRC- high roughage control, HRD- high roughage defaunated

concentration reached peak values at 4th h post feeding and lowest value at 6th h post-feeding. In defaunated animals peak values were attained at 2nd hour post-feeding, then declined gradually and attained lowest level at 6th hour post-feeding. The statistical analysis of the data revealed that absolute and molar concentration of butyrate was significantly reduced in response to defaunation. These findings are in agreement with observations reported in cattle (Willliams and Dinusson, 1973, Grummer *et al.*, 1983, Schonhusen *et al.*, 2003). Several cultural studies have also demonstrated higher butyrate production with addition of protozoa to bacterial cultures and the absence of protozoa from bacterial fermentation inocula was associated with reduction in butyrate concentration (Vendrak *et al.*, 1992). However, Bird and Leng (1978) reported increased butyrate concentration and Viera *et al.*, 1983 did not observe any variation in butyrate concentration in response to defaunation.

Other VFA: The data presented in table1 and 2 indicates that the concentration of other VFA's increased post prandially in both faunated and defaunated animals with the difference that peak concentration was achieved at 4th h in faunated and 2nd h post-feeding in defaunated animals which could be attributed to the TVFA concentration trend observed in the present investigation. The statistical analysis of the data revealed that molar and absolute concentration of other VFA in the rumen liquor did not differ significantly in faunated and defaunated animals suggesting little difference in proteolytic activity of both the groups.

Defaunation had no effect on the TVFA concentration in rumen liquour in buffaloes fed high roughage diet. However, concentration of propionate increased and butyrate decreased but acetate remained unaffected as a result of defaunation.

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