DIGESTION OF STARCH AND NITROGEN IN DIFFERENT PART OF THE ALIMENTARY CANAL OF DEFAUNATED MURRAH BUFFALO (*Bubalus bubalis*) CALVES

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Summary

Four Murrah male buffalo calves with an average body weight of 188 ± 1.6 kg each fitted with rumen and abomasal cannula were subjected to defaunation followed by refaunation. The animals were offered wheat straw and a concentrate mixture. There was no difference in dry matter, starch and nitrogen intake in defaunated and refaunated buffalo calves. Production of ruminal total volatile fatty acid and acetate : propionate ratio decreased ($p < 0.01$) whereas, molar proportion of propionate increased (25.8 Vs 19.4% $p < 0.01$) in defaunated animals. Fermentation of starch in rumen increased (73.9 Vs 65.8%, $p < 0.01$) but in small intestine decreased (20.2 Vs. 28.2%, $p < 0.05$) in defaunated calves. The flow of non ammonia nitrogen (NAN) to abomasum (75.1 Vs 68.8 g/d, $p < 0.01$) and its digestion in small intestine (37.6 Vs 32.5 g/d, $p < 0.01$) was improved due to defaunation. However, No difference in the total tract digestibility of starch and nitrogen was found in defaunated and refaunated buffalo calves.

(**Key Words** : Ciliate Protozoa, Buffalo Calves, Starch, Nitrogen)

Introduction

Ciliate protozoa are the part of ruminal ecosystem. Elimination of protozoal population from the rumen (defaunation of rumen) increases live weight gain and wool growth (Bird et al., 1979; Ushida et al., 1991; Demeyer 1992; Ivan et al., 1992). It is being observed that rumen protozoa has a significant role in stabilizing ruminal pH and reducing the *in vitro* rate of starch digestion (Eadie and Mann, 1979; Kariya et al., 1989; Kabayashi et al., 1991). However, information related to effect of defaunation on ruminal and intestinal starch digestion is scares and some of the reported results are in sheep. Viera et al. (1983) reported higher ruminal starch digestion in defaunated sheep. Whereas, no difference in the total tract starch digestibility in defaunated and faunated sheep was observed by Mendoza et al. (1991). To our knowledge there is no report on starch digestion in defaunated buffaloes. Therefore, the present experiment was conducted to study the role of ciliate protozoa on the site and extent of starch and nitrogen digestion in buffalo calves.

Materials and Methods

Animals and treatment

Four Murrah buffalo calves (average body weight 188 ± 1.6 kg) fitted with cannula in rumen and abomasum were selected. The experiment was completed in two phases. In phase I the animals were defaunated introducing manoxol (BDH London) into the rumen at a dose rate of 10 g Manoxol per 100 kg body weight for two successive days. A fasting of 24 hours was done before treatment started. Defaunated animals were housed in an isolated room to avoid refaunation. In phase II the calves were refaunated by introducing 200 ml rumen content for two successive days, obtained from normally faunated animals maintained on same diet.

Diets and sampling procedure

Calves in both phases were fed on wheat straw *ad libitum* and concentrate mixture as per requirement (Sen et al., 1978). The ingredients and chemical composition of concentrate mixture is given in table 1.

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TABLE 1. INGREDIENTS AND CHEMICAL COMPOSITION OF CONCENTRATE MIXTURE

Ingredient (g/kg)	
Maize	500
Groundnut cake	300
Wheat bran	170
Mineral mixture	20
Salt	10
Chemical composition (% of DM)	
Organic matter	88.20
NDF	54.16
ADF	11.13
Crude protein	22.50
Starch	42.46

Chromium mordanted wheat straw (Cr-MS) was prepared as described by Uden et al. (1980). 286 g of Cr-MS (total chromium 28 g) divided into 8 equal parts was introduced into the rumen at 3 hourly intervals starting 6 days before the abomasal sampling. The total duration of the experiment was 81 days including 2 phases of 30 days each and 21 days for adaption in between two phases. Sampling was started on 22nd days of each phase. The first three days of each nine days of the sampling period, rumen liquor samples were drawn, the next four days faecal samples were collected and in the following two days abomasal digesta samples were obtained. These samples were pooled and stored in refrigerator until analysed. On the last day of the collection total volatile fatty acid (TVFA) production rates were determined by single isotope infusion techniques using 1-2 (C^{14}-Sodium acetate (200-250/p ci/dose/animal) and aquous scientillation fluid was used for counting (Gupta et al., 1988).

Chemical analysis

The feed, faeces and abomasal digesta were ground after oven drying to pass a 1 mm screen. Neutral detergent fibre (NDF) acid detergent fibre (ADF) were estimated by Goering and VanSoest (1970) method. Chromium was determind using methods of Christion and Coup (1954). Microkjeldahl technique was used for crude protein (CP) estimation and non ammonia nitrogen (NAN) was calculated by subtracting ammonia nitrogen from total nitrogen. Rumen liquor VFA analysis was carried out by gas liquid chromatography (Erwin et al., 1961). For starch estimation the samples were extracted (Hillard and Daynord, 1974), followed by colorimeteric determination (Blakeney and Mutton, 1980) of its concentration.

Statistical analysis

Data were analysed to test the significance of differences between mean using T-tests as described by Snedecor and Cochran (1968).

Results and Discussion

The manoxol was very effective in excluding protozoa from the rumen and the calves were free from ciliates thoughout the phase I of the experiment. The average total protozoal numbers in the rumen liquor of refaunated animals were 1.29×10^5/ml. Out of this about 95% were entodinomorphs and only 5% holotrichs. Production of ruminal TVFA and acetate : propionate ratio reduced significantly ($p < 0.05$) whereas, moler proportion of propionate increased (25.7 Vs. 19.4%, $p < 0.01$) in defaunated calves (table 2). The higher VFA production rate in refaunated calves may be due to higher fermentation of fibrous materials (Chaudhary and Srivastava, 1995). Higher VFA concentration in the rumen liquor of faunated sheep was also reported (Ushida et al., 1986).

TABLE 2. PRODUCTION AND MOLAR PROPORTION OF VOLATILE FATTY ACIDS (VFA) IN THE RUMEN OF DEFAUNATED AND REFAUNATED BUFFALO CALVES

Particular	Defaunated	Refaunated	Significance level
Production of VFA (mol/d)			
Total VFA	7.28 ± 0.13	11.22 ± 0.08	*
Acetate	4.65 ± 0.12	7.72 ± 0.11	**
Propionate	1.85 ± 0.06	2.16 ± 0.09	*
Butyrate	0.67 ± 0.10	1.24 ± 0.13	NS
Molar proportion (%)			
Acetate	64.8 ± 2.75	69.4 ± 2.18	NS
Propionate	25.8 ± 1.70	19.4 ± 1.63	**
Butyrate	9.3 ± 1.00	11.15 ± 1.31	NS
Acetate : Propionate ratio			
	2.51 ± 0.12	3.6 ± 0.19	*

NS : non significant; *$p < 0.05$; **$p < 0.01$.

Intake, excretion and digestion of starch are shown in table 3. No difference in the starch intake was observed between the groups. Flow of starch to abomasum

decreased ($p < 0.01$) whereas its fermentation in the rumen increased ($p < 0.05$) in defaunated calves. This support the concept that protozoa suppress the ruminal starch fermentation (Mackie et al., 1978) and this may be due to the capacity of protozoa to store starch (Abou Akkada and Howard, 1960) and thus reducing the availability of starch for microbial growth. Since ruminal protozoa engulf the bacteria this predatory habbit may be responsible for the suppression of starch fermentation (Coleman, 1964). In the presence of protozoa the amount of starch digested in the intestine was increased but the percentage of starch entering into the intestine was same in both the groups. Further more there was no difference in the apparent total tract starch digestibility in defaunated and refaunated calves. The shift of starch digestion towards intestine in refaunated calves could be beneficial because, digestion in small intestine reduces the loss associated with fermentation in the rumen (Owens et al., 1986).

TABLE 3. INTAKE EXCRETION AND DIGESTION OF STARCH IN DEFAUNATED AND REFAUNATED CALVES

Particular	Defaunated	Refaunated	Significance level
Intake of starch (g/d)	803 ± 5.6	794 ±3.3	NS
Starch flow to abomasum (g/d)	210 ± 8.2	275 ±7.8	**
Starch excreted in faeces (g/d)	48 ± 2.5	52 ±3.3	NS
Starch fermented in rumen			
(g/d)	592 ± 10.5	519 ±9.6	*
Percent of intake	73.9± 2.4	65.8±1.9	**
Starch digested in small intestine			
(g/d)	162 ± 6.3	223 ±7.5	*
Percent of intake	202 ± 1.2	28.2±2.3	*
Percent flow to abomasum	77.2± 2.1	81.0±1.6	NS
Starch digested in total digestive tract			
(g/d)	775 ±13.1	743 ±9.3	NS
Percent intake	94.2± 1.8	93.8±2.5	NS

NS : non significant; *$p < 0.05$; **$p < 0.01$.

Intake of the nitrogen was same in both the groups (table 4). The flow of NAN to abomasum increased significantly ($p < 0.01$) in defaunated animals. Viera et al. (1983) and Ushida et al. (1991) also observed increased flow of NAN to lower digestive tract in sheep. Intestinal NAN digestion was higher in defaunated calves which resulted no difference in the total tract nitrogen digestibility in defaunated and refaunated groups. The shift in the digestion of nitrogen from rumen to intestine in defaunated group will be beneficial for wool production in sheep and body weight gain in young ruminants where requirement is more and supply is limited. No difference in the total tract crude protein digestibility in defaunated and faunated cattle was also reported by Punia et al. (1987).

TABLE 4. INTAKE, EXCRETION AND DIGESTION OF NITROGEN (N) IN DEFAUNATED AND REFAUNATED BUFFALO CALVES

Particular	Defaunated	Refaunated	Significance level
N intake (g/d)	80.6±1.45	79.8±1.42	NS
N flow to abomasum (g/d)	78.9±1.56	73.0±1.39	**
NAN flow to abomasum (g/d)	75.1±1.51	68.8±1.31	**
N excected in faeces (g/d)	37.4±1.96	36.2±1.44	NS
NAN digested in small intestine			
(g/d)	37.6±1.11	32.5±1.08	**
Percent intake	46.4±1.35	40.6±1.22	*
Percent flow to abomasum	50.3±2.01	47.2±1.90	NS
N digested in total gastro intestinal tract			
(g/d)	43.2±0.51	43.6±1.67	NS
Percent intake	53.6±1.15	54.3±1.92	NS

NAN : Non ammonia nitrogen, NS : Non significant.
*$p < 0.05$; **$p < 0.01$.

It is concluded from the results that defaunation increases fermentation of starch in the rumen and flow of NAN to lower tract. Whereas, total tract digestibilities were unaffected in defaunated and refaunated buffalo calves.

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