

## Abomasal secretion and gastrin blood level in sheep fed diets with different fibre content\*

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### ABSTRACT

The effect of dietary fibre on abomasal secretion and gastrin postprandial level was studied in four sheep. Two isonitrogenous diets differing only in crude fibre content (LFD, 14% or HFD, 23%) were used. Volume, hydrogen and chloride ion output, sodium concentration in pure abomasal juice were higher in HFD treatment. Pepsin activity and pH was lower in that group, while both treatments did not affect protein output and potassium concentration. Postprandial gastrin serum concentration was elevated at 30, 60 and 120 min in HFD as compared to LFD group. Results suggest that fibre stimulates abomasal secretion and elevates gastrin level.

KEY WORDS: gastric juice, abomasum, fibre, gastrin, sheep

### INTRODUCTION

Fibre in the GI tract of monogastric animals influence bile and pancreatic secretion and exert trophic action on GI tract tissue, which leads to an enlargement of GI tract mass (Stanogias and Pearce, 1985). In the simple-stomached animals, fibre modifies the gastric emptying rate, pancreatic and bile secretion, and also stimulates gastric secretion (Low, 1985; Tadesse, 1986). In contrast to monogastrics animals, data concerning the influence of dietary fibre on abomasal secretion in ruminants is scarce.

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## MATERIAL AND METHODS

The study was carried out on four Polish Merino male sheep of  $46 \pm 2.4$  kg BW. The animals were fed - in turn - two isonitrogenous diets - 14% crude protein (CP) in DM, that consisted of meadow hay, rapeseed meal and barley. Crude fibre DM content was adjusted to 14% in the low fibre diet (LFD) and 24% in the high fibre diet (HFD). The animals were adapted to the diet 10 days before surgery and between the treatments. The daily allowance was divided into four equal portions given every 6 h. The sheep were prepared with innervated fundic abomasal pouches (Grosskopf, 1954). A round base cannulae made from medical grade silicon was placed in the pouch and kept open. One day before each experiment, animals were equipped with catheters in external jugular vein. Abomasal juice was collected 14 h per day, during 4 consecutive days for each treatment. The juice was collected every hour and kept in crashed ice. Blood sample for gastrin determination was collected 20 min before feeding (8.00, 14.00, 20.00) and every 30 min for 2 h after. Protein concentration in abomasal juice was measured by the Lowry method, Cl ions concentration by the method of Vohlard (AOAC, 1990) and Na and K concentration by flammable atomic absorption method. Total acidity of abomasal juice was measured by titration 0.1 N NaOH. Pepsin (EC 3.4.23.1) activity was measured according to Ryle (1970). Blood gastrin level was measured by RIA (Konturek et al., 1982). All values are expressed as means  $\pm$  SD. Statistical significance of difference was assessed by Kruskal-Wallis test, Wilcoxon- paired test (gastrin) using STATISTICA 5.1 software (StatSoft, Tulsa, OK, USA).  $P < 0.05$  was assumed as the level of the significant statistical difference.

## RESULTS

Most of the parameters of abomasal secretion were significantly higher in animals fed HFD than LFD (Table 1). Only pepsin activity in abomasal juice was significantly lower in the HFD group.

Table 1. Abomasal juice secretion in sheep fed diets with different fibre content (means, n=96)

	Diet				P<
	LFD	SD	HFD	SD	
Volume, ml h <sup>-1</sup>	11.72	5.92	13.04	3.63	0.01
pH	1.52	0.21	1.48	0.21	0.05
H <sup>+</sup> output, mmol h <sup>-1</sup>	0.71	0.47	0.75	0.38	0.05
Cl <sup>-</sup> output, mmol h <sup>-1</sup>	1.77	0.93	1.93	0.60	0.001
Na <sup>+</sup> concentration, mmol l <sup>-1</sup>	1.98	0.41	1.67	0.31	0.05
K <sup>+</sup> concentration, mmol l <sup>-1</sup>	0.11	0.03	0.11	0.03	NS
Pepsin activity, IU ml <sup>-1</sup>	0.70	0.32	0.50	0.35	0.001
Protein output, mg h <sup>-1</sup>	35.27	20.17	30.88	9.15	NS

NS - not statistically significant

Gastrin serum concentrations at 0.5, 1 and 2 h after feeding were significantly higher in animals, which have received HFD. There was a tendency ( $P=0.504$ ) towards higher preprandial (control) gastrin concentration in HFD animals. However, gastrin serum level up to 2 h after feeding was similar in each treatment (HFD or LFD) (Table 2).

Table 2. Gastrin serum concentration ( $\text{pmol l}^{-1}$ ) in sheep fed diets with different fibre content (means,  $n=24$ )

Time after feeding, h	Diet				P<
	LFD	SD	HFD	SD	
0	51.06	20.97	68.46	42.63	NS
0.5	52.80	22.80	70.10	40.40	0.05
1	49.41	25.19	67.20	44.27	0.05
1.5	50.60	27.54	63.59	29.98	NS
2	52.10	25.23	65.41	28.92	0.05

NS - not statistically significant

## DISCUSSION

The results are in general agreement with our previous data from pigs with innervated and denervated gastric pouches (Korczyński et al., 1997). Dietary fibre because its water binding properties (distension effect), can activate the vagal and intramural nervous reflexes in the area of the stomach and secretory mechanisms (Low, 1985) may increase GI tract cells proliferation and gastrin release (Johnson, 1988). As a substrate for rumen fermentation fibre is turned into volatile fatty acids (VFA) - potent stimulators of abomasal secretion (Hill, 1960). However, acetic and butyric acid concentration in the rumen 2 h after feeding was not different between the LFD and HFD diet (Korczyński, 2000). In this study  $\text{Cl}^-$  ion output was higher than measured in preruminant calves (Guilloteau and Toullec, 1983). Moreover, we cannot confirm the findings of mentioned authors who postulated the cyclic variations of the  $\text{Cl}^-$  level in abomasal juice (data not shown). Lower pepsin activity cannot be fully explained as an effect of possible immobilization (diluting) how it was observed in the study on rats (Shah et al., 1986). However, pepsin activity in duodenal digesta was also lower in sheep fed HFD than LFD (Korczyński, 2000). Feeding has no effect on blood gastrin concentration measured every 30 min up to 2 h. It confirms the results of Carter et al. (1990) who have not found changes in blood gastrin level in sheep fed lucerne hay few times a day. Also, in the study of Thorniley et al. (1996) there were no correlation between gastrin level and feeding in cows and sheep. Higher postprandial gastrin blood concentration at 30, 60 and 120 min in HFD fed animals, cannot be related to stimulatory effect of proteins, because the diets were isonitrogenous.

## CONCLUSIONS

The results presented indicate that dietary fibre can stimulate abomasal secretion in sheep and influence blood level of gastrin.

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