INHIBITION OF ABOMASAL OUTFLOW AND FEED INTAKE BY INTRA-DUODENAL INFUSION OF ACETIC ACID IN SHEEP

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Introduction

It has been reported that an increase in the ruminal or duodenal concentration of VFAs inhibits gut motility in sheep (Ash, 1959; Ehrlein and Hill, 1970; Studzinski et al., 1979; Gregory, 1987).

We recently found in sheep that the rate of digesta flow from the abomasum and the abomasal VFA concentration increased with feeding, reaching peak values at the same time as the animals stopped eating (Yamazaki et al., 1987). These results suggest that components of duodenal digesta affect digestive tract motility and feeding behavior in sheep.

In this experiment, the effects of an intra-duodenal infusion of acetic acid on abomasal digesta flow and feeding behavior were investigated using sheep fitted with re-entrant duodenal cannulae.

Materials and Methods

Four cross-bred castrated male sheep weighing 47-60 kg each fitted with a single T-shaped re-entrant type duodenal cannula were held in wooden metabolic cages under continuous lighting, and were fed alfalfa hay cubes from 11:00 h for three hours every day. Water was available *ad lib*.

At 09:00 h, a balloon catheter was inserted into the distal side of the cannula to stop abomasal digesta flow into the distal part of the duodenum and to remove all the digesta. A 1.85 mM acetic acid solution (basal solution), warmed to 40°C, was then infused into the distal part of duodenum through the catheter to remove the duodenal digesta. At 11:00 h, the basal solution was replaced with one of the other solutions listed in table 1. Food was provided at this time and the infusion was continued for 3 hrs. The infusion rate was adjusted to 0.325 ml/min·kgBW. Feed and water intakes and the volume, pH and osmolality of the digesta flowing out from the abomasum were measured. In the control experiment, the cap of the cannula was closed, and the duodenal digesta was not sampled. The significance of differences among the treatments was determined using ANOVA and the least significant difference.

Results

Total feed and water intakes over three hours were significantly inhibited by the infusion of 120 mM acetic acid (table 2). The inhibition of feed intake evoked by the 120 mM acetic acid solution was observed within 30 minutes after the start of feeding.

The mean digesta flow from the abomasum was constant during the infusion of the basal solution before feeding, with no difference among the treatments. However, the digesta flow was inhibited by the infusion of 62 mM and 120 mM acetic acid solutions. The inhibition was dose-dependent. The digesta flow completely stopped 45 minutes after the infusion of 120 mM acetic acid solution. The high osmolality solution did not affect either feed or water intakes or the abomasal digesta flow.

Discussion

TABLE 1. COMPOSITION OF THE INFUSION SOLUTIONS

Treatment	Composition of the solution	Osmolality (mosm/l·H_2O)	pH
Control	(No infusion)		
Ionic solution	Ionic solution	262	3.2
Solution 1 (Basal solution)	1.85mM-acetic acid in ionic sol.	253	3.2
Solution 2	62mM-acetic acid in ionic sol.	311	3.2
Solution 3	120mM acetic acid in ionic sol.	370	3.2
High osmo. sol.	Ionic sol.	369	3.2
Abomasal fluid	*Filtered abomasal digesta*	287	3.7

pH was adjusted by HCl, except for filtered fluid.
Ionic solution contained the following salts (mM): NaCl, 50; KCl, 25; $NaHCO_3$, 10; $NaH_2PO_4 \cdot 2H_2O$, 15; $CaCl_2 \cdot 2H_2O$, 10; $MgCl_2 \cdot 6H_2O$, 15; $MgSO_4 \cdot 7H_2O$, 5.

TABLE 2. INFLUENCE OF THE INFUSIONS ON FEED AND WATER INTAKE AND ABOMASAL DIGESTA FLOW

Treatments	Total feed intake (g/3hrs)	Total water intake (g/3hrs)	Abomasal digesta flow	
			Pre-feeding (ml/30mins)	Post feeding (ml/3hrs)
Control	1768± 69^{ab}	4140±320^{a}	–	–
Ionic sol.	1663±147^{ab}	4948±801^{a}	615± 87^{a}	3484±476^{a}
Solution 1	1518±139^{a}	4640±945^{a}	505± 83^{a}	3656±725^{a}
Solution 2	1628±111^{ab}	3503±811^{ab}	692±173^{a}	1320± 55^{b}
Solution 3	1070±156^{c}	1573±352^{b}	640±127^{a}	119± 60^{c}
High osmo. sol.	1455± 76^{a}	5390±570^{a}	647± 89^{a}	3416±519^{a}
Abomasal fluid	1920±151^{b}	4023±710^{a}	587±149^{a}	2609±557^{a}

The values expressed are the means of 4 sheep and SE of means, except filtered abomasal fluid (3 sheep).
$^{a-c}$Means in the same column with different letters differ significantly ($p < 0.05$).

In the present experiment, we have shown that acetic acid in the duodenum inhibits gastric motility and feeding behavior. The inhibitions were independent of the osmolality of the infused solution. The inhibition of gastric motility was more sensitive to acetic acid infusion than was feeding behavior. It is not clear at present whether acetic acid directly inhibited food intake and gut motility. It is possible that feed intake was indirectly inhibited by the depressed digesta flow. In conclusion, it is likely that the sheep duodenum is sensitive to acetic acid, thereby regulating gastric emptying and feed intake.

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(**Key Words**: Intestinal Chemosensitivity, Acetic Acid, Sheep)

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