STIMULATION OF GASTRIN RELEASE BY THE INTRA-ABOMASAL INFUSION OF RUMEN FLUID IN SHEEP

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Introduction

Circulating levels of gastrin increase when sheep on a restricted feeding regime eat freshly provided food (Reynolds et al., 1978). These increases are closely followed by increases in abomasal output of acid and pepsin, reflecting the gastric acid secretegogue action of gastrin. The mechanisms controlling gastrin release have been extensively studied in non-ruminant animals (see Walsh, 1988). Ruminal nutrients stimulate the G cells of the gastric antrum to release gastrin into the general circulation, as does activation of neural reflexes by distension of the stomach. Acidification of the gastric antrum inhibits gastrin secretion whereas alkalinization removes this inhibition.

In adult ruminants, digesta, previously fermented in the forestomach, enters the abomasum and may contain stimulants to gastrin release. To test for the presence of such stimulants, we determined the effect in sheep of the intra-abomasal infusion of rumen fluid on circulating gastrin concentration.

Materials and Methods

Rumen fluid, collected from 2 adult sheep with rumen fistulae 3 h after they were allowed to eat freshly provided lucerne chaff, was centrifuged at 2000 rpm for 5 min. The supernatant was infused at a rate of 250 ml/h into the body region of the abomasum of 3 sheep which had cannulae in the body and antral regions of the abomasum. All experiments were begun at approximately 9:00 a.m., 18 h after the animals had been given their daily ration of 800 g of lucerne chaff. Blood samples (6 ml) for gastrin determinations were collected every 15 min through a silastic cannula chronically implanted in a jugular vein and the serum stored frozen. Samples of abomasal contents, for pH determinations, were collected from the antral cannula within 1 min after each blood sample. The infusion of rumen fluid was begun after the third blood sample and continued for either 1 or 2 h (n=6 and n=2 respectively). Samples of blood and abomasal contents were collected for a further 1.5 h after the infusion was stopped. Mannitol (300 mOsm/l) was infused at 250 ml/h during control experiments (n=3). Radioimmunoassay using Hansky's antibody Ab74 which recognises all major forms of gastrin and cross reacts equally with human and ovine gastrin, was used to measure gastrin concentrations.

Results

Serum gastrin concentrations exceeded control levels in each of the eight experiments in which rumen fluid was infused into the abomasum (table 1).

The increases in gastrin began within 15 min of the start of the infusion and were accompanied by increases in the pH of the abomasal contents (table 2). Both circulating gastrin levels and abomasal pH remained elevated throughout the infusion of

TABLE 1. CHANGES IN SERUM GASTRIN LEVELS IN RESPONSE TO THE INTRA-ABOMASAL INFUSION OF RUMEN FLUID

	Gastrin concentration (pM)			
		Infusion		Post-
	Control	15-30 min	45-60 min	infusion**
Sheep A	35	89	94	53
n=3	26-46	81-96	66-119	36-71
Sheep B	12	46	42	12
n=3	6-15	41-53	31-51	9-17
Sheep C	20	46	49	30
n=2	16-24	41-56	47-51	23-39

*Values shown as means and ranges.
**30-45 min after the end of the infusion.

TABLE 2. CHANGES IN ABOMASAL pH IN RESPONSE TO THE INTRA-ABOMASAL INFUSION OF RUMEN FLUID

	Abomasal pH			
		Infusion		Post-
	Control	15-30 min	45-60 min	infusion**
Sheep A	2.8	4.4	3.8	2.9
n=3	2.7-3.1	4.1-4.9	3.2-4.4	2.6-3.0
Sheep B	2.4	3.7	3.3	2.2
n=3	2.0-2.8	3.3-3.9	2.5-3.9	1.6-2.7
Sheep C	2.8	3.7	3.6	2.8
n=2	2.6-3.1	3.3-4.1	3.2-3.8	2.6-2.9

*Values shown as means and ranges.
**30-45 min after the end of the infusion.

rumen fluid and returned to control levels within 30 min of ending the infusion. During the infusion of mannitol, neither serum gastrin nor abomasal pH increased.

Discussion

It is well established that increasing the level of food intake in sheep increases both the rate of flow of digesta along the gut and abomasal secretion of acid (Ash, 1961). The relationship between acid secretion and flow of digesta has not been demonstrated to involve stimulation of gastrin release. The increases in circulating gastrin levels reported here provide the most direct evidence to date that digesta entering the abomasum from the forestomach is a stimulus to gastrin release. Gastrin release is unlikely to have arisen from distension of the abomasum as the infusion of the same volume of mannitol had no effect on gastrin levels.

The chemical composition of the digesta entering the abomasum may be important in determining its efficacy as a stimulus to gastrin release. The pH of the rumen contents is normally between 6 and 7 and is buffered by the large amounts of bicarbonate and phosphate contained in swallowed saliva. McLeay and Titchen (1977) have provided indirect evidence that gastrin release from antral pouches in sheep is inhibited by antral acidification to pH 2.7 or less. In the present experiments, mean pH values during the infusion were between 3.3 and 4.4. Thus the increases in circulating gastrin levels seen here may have been due, wholly or partly, to increases in abomasal pH which resulted in removal of an acid inhibition of gastrin release. Other solutes contained in the digesta entering the abomasum which need to be considered as possible stimulants to gastrin release include volatile fatty acids, amino acids, microbial protein and electrolytes.

(Key Words: Gastrin, Rumen Fluid)

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