DIGESTA MOVEMENT AND GUT MOTILITY IN THE PRERUMINANT CALF

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Earlier experiments showed that after a milk feed, abomasal digesta enters the small intestine of the duodenally fistulated calf in a series of gushes apparently controlled by mechanisms initiated in the duodenum (Sissons and Smith, 1978). When digesta flow from the abomasum was withheld from the duodenum or replaced by other solutions or suspensions, variations in abomasal emptying rates were observed (Smith and Sissons, 1975; Sissons and Smith, 1978). In part of the present investigation digesta flow to the duodenum has been examined in more detail and the effects of changes in milk intake studied.

In milk fed calves cyclic patterns of electrical activity have been reported to arise in the duodenum and to migrate towards the ileum following the flow of digesta (Ruckebusch and Bueno, 1973; Dardillat and Marrero, 1977). Possible links between variation in digesta flow, particularly in relation to disorders induced by soyabean products, and changes in electrical activity of the muscle of the alimentary tract of the calf form a further part of the present study.

Material and Method

Milk fed friesian calves were equipped either with abomasal and re-entrant proximal duodenal cannulae (Sissons and Smith, 1978) or with stainless steel electrodes implanted at 8 sites between the antrum and distal ileum. One of the latter calves was also provided with abomasal and re-entrant ileal cannulae.

Digesta flows at the cannulated sites were measured either by automatic collection and return of digesta (Sissons and Smith, 1978) or with an electromagnetic flow transducer. Electrical activity from the electrodes was measured electromyographically.

When calves were 6 weeks old some milk feeds were replaced, at 2-3 d intervals, by test feeds given either by mouth or abomasal infusion. These feeds, some containing non-absorbable markers, consisted of whole milk or a synthetic milk prepared from calcium caseinate (CAS.) or heated soyabean flour (HSF) as the sole protein source (Smith and Sissons, 1975).

Results and discussion

Electromagnetic measurement of digesta movements through a duodenal cannula confirmed earlier observations (Sissons and Smith, 1978) that abomasal outflow occurs mainly in gushes, but showed also that appreciable reverse flow occurs (fig. 1a). During 1-2 h after feeding forward

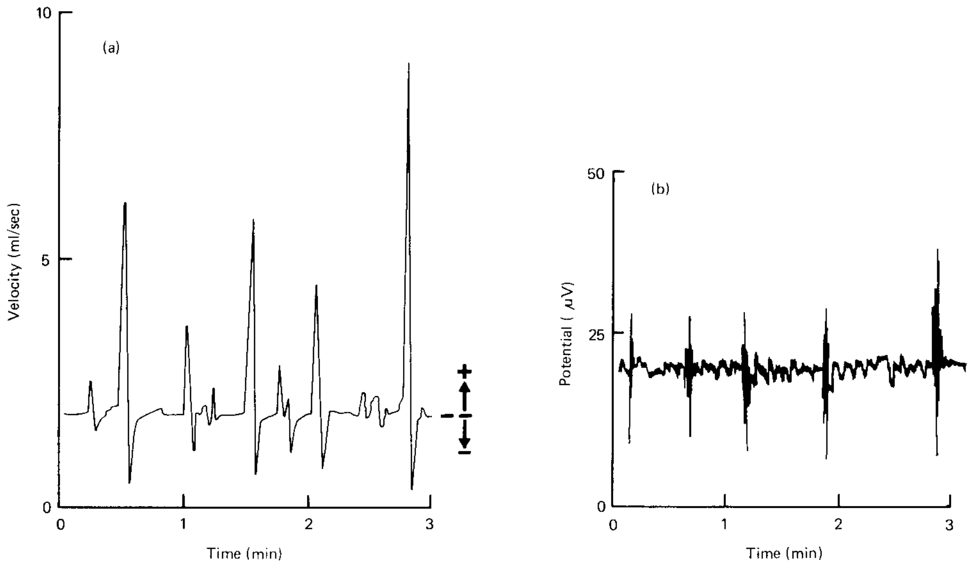

Fig. 1. — Tracings of a) velocities of bidirectional digesta movements (+ and −) from an electromagnetic flow transducer in a duodenal cannula and b) electrical potentials in smooth muscle at the pylorus recorded 3-4 h after calves were given whole milk.

gushes averaged 20 ml and backward gushes 8 ml, whilst ratios of forward to backward flow varied from about 2: 1 soon after feeding to about 10: 1 after a 16 h fast. Although collecting and returning digesta at a disconnected cannula interfered with bidirectional movement it did not greatly affect net forward flow.

Effects of milk intake (0-8 kg) on duodenal flow measured by collecting and returning digesta are shown for one calf in fig. 2. It appeared that up to 2 h after feeding between 1-6 kg of milk, control was exercised by the duodenum, rather than the volume of digesta in the abomasum, but for intakes above 6 kg duodenal control began to break down. Considerable variations in flow between calves appeared to be due, in part, to marked differences in endogenous flow. Thus, if the flow between 0-6 h after feeding was represented as a linear regression equation: A + kI, where A is flow for zero intake (kg) and I is intake (kg), then for two calves values for k were similar (0.72 and 0.65), but those for A were 2.45 and 1.45 kg respectively. Differences in feed intake had relatively little effect on size of gushes into the duodenum; for one calf given 2, 4, 6 and 8 kg milk values for gush

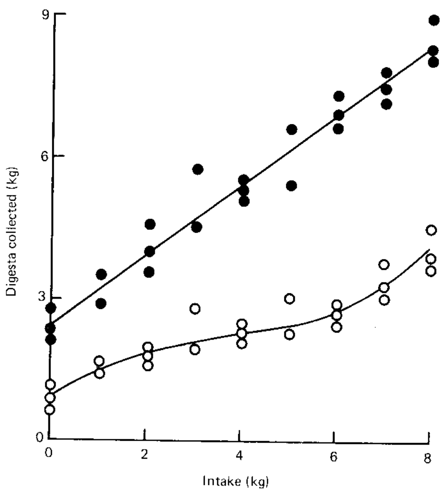

Fig. 2. — Cumulative flows of digesta at the duodenum between 0-2 h (○) and 0-6 h (●) after giving different amounts of whole milk.

size were 4.3, 4.5, 5.0 and 6.1 g/gush respectively.

In the fasting calf changes in electrical potentials in the duodenum, jejunum and ileum were similar to those described by

Table 1. — Effect of dietary protein source on interval between MMC (min), mean ileal flow rate over 21 h (g/h) and transit time through the small intestine (h).

Calf	Feed	Time between MMC			Il. flow	Trans. time
		Duod.	Jej.	Il.		
3	Milk	44	40	46	35	3.2
	CAS.	50	45	51	62	3.0
	HSF	41	26	42	248	1.0
4	Milk	54	56	59	—	—
	CAS.	52	49	60	—	—
	HSF	38	38	35	—	—

Ruckebusch and Bueno (1973); activity consisted of spike potentials (10-50 μV) superimposed on a basal electrical rhythm (about 5 μV) (fig. 1b). Cycles of activity were repeated at intervals of about 55 min. each culminating in regular phases of spike potentials lasting 3-6 min. Sequences of spike potentials first appeared at the pylorus and migrated towards the distal ileum (migrating myoelectric complexes) (MMC). Giving a feed to a calf sometimes led to a temporary disturbance of the final phase of activity. Similarities in patterns of outflow of abomasal digesta and electrical activity from the pylorus (fig. 1) suggested the possibility of an association between these phenomena.

In calves given cows milk there was no appreciable change in the frequency of MMC with age between 6-20 weeks. When HSF, rather than casein feeds, replaced whole milk there was an increase in MMC frequency (table 1). Soya feeds also led to a disturbance in the regular phase of spike potentials. These changes in frequency and pattern of MMC may have been associated with the disorders in digesta movement through the small intestine reported in table 1 and may form part of the total allergic response to soya containing feeds discussed previously (Smith and Sissons, 1975; Sissons and Smith, 1976).

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