THE EFFECTS OF INTERMITTENT AND CONTINUOUS INFUSIONS OF PROPIONIC ACID ON PLASMA INSULIN

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Propionic acid was infused continuously or in pulses into the rumen of dairy cows sustained by intragastric infusions. Peaks of insulin were observed, corresponding to the pulses of propionic acid.

Key words: Cattle, propionic acid, insulin

The development of the technique of intragastric nutrition in large ruminants (MacLeod et al. 1982) allows detailed studies of host animal metabolism. In a preliminary experiment the technique was used with lactating diary cows to simulate a comparison of feeding methods. The volatile fatty acids (VFA) were all infused continuously into the rumen or alternatively part of the propionic acid (C_3) was infused in pulses. At the end of the pulses, the concentration of plasma insulin was about three times that previously encountered and the concentration of plasma C_3 was six times (Table 1).

Table 1. Concentration of insulin, glucose and propionic acid in the plasma before and after the pulses of propionic acid

	Before pulses	After pulses
Insulin (μU/mL)	31.9	94.6
Glucose (mg/100 mL)	69.9	68.4
Propionic acid (mmole/L)	0.04	0.23

These observations were followed by a further two trials with lactating cows. In exp. 1, two cows in their 6th month of lactation were nourished by intragastric infusion. 4.8 kg of VFA (87.1 MJ) in molar proportions of 650 acetic acid, 175 propionic acid and 175 butyric acid were infused into the rumen and 1.1 kg of casein (25.4 MJ) into the abomasum. The feeding of a complete mixed diet was simulated by infusing the VFA continuously while an intermittent feeding was simulated by two equal 3-h pulses of C_3 at 1100 and 2300 h. 0.32 kg (6.7 MJ) of C_3 was infused during each of the pulses. Periods were of 10 days duration with milk being analyzed for the last 5 days and blood analyzed for the last 2.

In exp. 2, two other cows in their 7th week of lactation were infused in a similar trial. The gross energy of the VFA was 88.5 MJ and casein was 29.1 MJ. Each period was of 14 days and a further period of 21 days was employed at the end to repeat the observation from period 1.

In exp. 1, over the two periods, a daily decrease of 0.1 kg of milk was observed irrespective of treatment. The fat content was on average 39 g/kg and was not influenced by the method of infusion of C_3. In exp. 2, the decline in milk yield amounted to 0.180 kg. The average fat content was 31 g/kg. This work is currently being extended with further lactating cows.

In both experiments all the animals responded similarly to pulses of C_3 with peaks of plasma insulin to about double that when infusion was continuous (Fig. 1). The peaks of insulin in our experiments were of similar magnitude and duration to those of cows normally fed at 12 h intervals (pulses) (Hart 1983). The concentration of insulin was relatively constant during the continuous infusions and comparable to the cows of

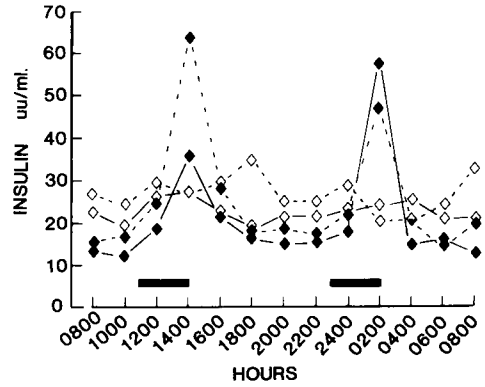

Fig. 1. Effects of the infusion of pulses of propionic acid (bars) on plasma insulin of cows nourished by total infusion. ◇, continuous infusion; ◆, pulses; ——, exp. 1; – – –, exp. 2.

Hart (1983) normally fed at 4-h intervals. Observation from the preliminary trial indicated that C_3 concentration in the plasma at the end of the pulses was higher than before and that this increase was associated with a slight decrease in glucose concentration (Table 1). It is postulated therefore that during the pulses of C_3, the liver became overloaded and some of the C_3 escaped metabolism. This spill-over of C_3 then entered the peripheral blood giving rise to the elevated concentration observed (Fig. 1) and stimulated insulin production by the pancreas.

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