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Ruminal metabolic development in conventionally or early weaned calves

Abstract

Accelerating the weaning age of calves appeared to increase their ruminal metabolic activity. This was indicated by the lower ruminal pH and increased, total volatile fatty acid concentration of calves weaned at 4 wk of age compared with those weaned at 6 wk of age.; Dairy Day, 1986, Kansas State University, Manhattan, KS, 1986;

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RUMINAL METABOLIC DEVELOPMENT IN
CONVENTIONALLY OR EARLY WEANED CALVES

K. L. Anderson, T. G. Nagaraja

and J. L. Morrill

Summary

Accelerating the weaning age of calves appeared to increase their ruminal metabolic activity. This was indicated by the lower ruminal pH and increased, total volatile fatty acid concentration of calves weaned at 4 wk of age compared with those weaned at 6 wk of age.

Introduction

A relationship between dry feed consumption and rumen development of newborn calves has been well established. Although the rumen has an innate ability to develop, feeding only liquid or low amounts of dry feed will greatly decrease the rate of ruminal development. An early weaning program has been shown to increase feed consumption of calves and thereby allow weaning by 4 wk of age. The objective of this investigation was to monitor changes in the metabolic products in the rumen of early-weaned or conventionally weaned calves from birth to 3 mo of age.

Procedures

Eight bull calves were removed from their dams within 24 hours postpartum and placed in calf hutches. The calves were fed colostrum until 3 days of age, and then fed whole milk, at 8% body weight, until weaned. At 3 days of age, the calves were ruminally cannulated and placed into one of two groups. Calves in one group were placed on the early weaning program and weaned at 4 wk of age. The second group comprised the conventionally weaned calves. They were fed a calf starter ad libitum and weaned at 6 wk of age.

At 1, 4, 8 and 12 wk of age, ruminal fluid was collected from all calves at 0, 1, 2, 3, 4, 6, 8 and 12 h postfeeding. The samples were analyzed for pH, and volatile fatty acid (VFA), lactic acid, and ammonia concentrations.

Results and Discussion

Calves in both groups exhibited similar trends for ruminal pH during the 12-hour sampling periods, with the pH decreasing for 1-3 hours postfeeding, and then gradually increasing to prefeeding levels by 12 hours. However, early-weaned calves consistently had lower ruminal pH than the conventionally weaned group (Table 1). This indicated a higher metabolic activity in the early-weaned calves. Concurrently, the total VFA concentration peaked at 1-3 hours postfeeding and then decreased. Again, early-weaned calves consistently had higher total VFA concentrations than calves in the conventionally weaned group (Table 2).

Milk was the major portion of the calves' diet at 1 wk of age, and this resulted in a high proportion of acetate in the rumen. As dry feed consumption of the calves gradually increased and milk consumption stopped, the overall proportion of acetate diminished and the proportion of propionic acid increased. No significant difference in the proportions of acetic acid or propionic acid was found between the two groups. On the other hand, the proportion of butyric acid was significantly higher in early-weaned calves than in the control group. Low pH stimulates the production of butyric acid, thus, the lower pH of the early-weaned calves may be associated with their higher percentage of butyric acid.

Lactic acid concentrations were highest at 4 wk of age for both groups and then decreased by the 8th week of age. Although no significant difference between the two groups was found, there was a trend toward higher lactic acid concentrations in the early-weaned calves (Table 3). Ruminal ammonia concentration decreased as the calves aged. This is indicative of increased bacterial utilization and ruminal absorption of ammonia. Although no significant difference in ammonia concentration was found between the two groups, milk intake has been shown to increase ruminal ammonia concentrations, and unweaned calves generally have higher ruminal ammonia than weaned calves.

Table 1. Ruminal pH

Treatment Groups	Age in Weeks			
	1	4	8	12
Early-Weaned	6.8	5.8	5.7	6.0
Conventionally weaned	6.8	6.1	6.2	6.2

Table 2. Total ruminal volatile fatty acid concentrations (mM)

Treatment Groups	Age in Weeks			
	1	4	8	12
Early-weaned	20.2	67.4	100.9	110.2
Conventionally weaned	22.9	50.9	91.6	89.5

Table 3. Total ruminal lactic acid concentration (mM)

Treatment Group	Age in Weeks			
	1	4	8	12
Early-weaned	.04	2.3	.19	1.0
Conventionally weaned	.10	.35	.06	.02



Dr. T. G. "Nag" Nagaraja and Kevin Anderson, graduate research assistant, prepare to sample through a rumen fistula in a research calf