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Effect on ruminal lactic acid utilization and lactic acid-utilizing bacteria

G.W. Miller

Tiruvoor G. Nagaraja

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Abstract

The effect of diet on in vitro lactic acid utilization rate and counts of lactic add-utilizing bacteria was determined in ruminally cannulated steers. The steers were adapted to an alfalfa diet and gradually switched to an all-grain diet. The in vitro lactic acid fermentation rate increased with increased grain intake. Concurrently, the proportion of lactic acid-utilizing bacteria also increased. The increased population of lactic acid-utilizing bacteria is responsible for preventing lactic acid accumulation in the rumen of cattle adapted to consume a high-grain diet.; Dairy Day, 1986, Kansas State University, Manhattan, KS, 1986;

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EFFECT OF DIET ON RUMINAL LACTIC ACID UTILIZATION AND LACTIC ACID-UTILIZING BACTERIA

G.W. Miller and T.G. Nagaraja

Summary

The effect of diet on in vitro lactic acid utilization rate and counts of lactic acid-utilizing bacteria was determined in ruminally cannulated steers. The steers were adapted to an alfalfa diet and gradually switched to an all-grain diet. The in vitro lactic acid fermentation rate increased with increased grain intake. Concurrently, the proportion of lactic acid-utilizing bacteria also increased. The increased population of lactic acid-utilizing bacteria is responsible for preventing lactic acid accumulation in the rumen of cattle adapted to consume a high-grain diet.

Introduction

Ruminal acidosis is a metabotic disease caused by the excessive ingestion of feeds that contain readily fermentable carbohydrates. Carbohydrates in high grain diets are fermented to lactic acid by ruminal bacteria and protozoa. If the lactic acid is not utilized fast enough, it increases in concentration, lowers ruminal pH, and leads to acidosis. The utilization of lactic acid is dependent upon the establishment of lactate- utilizing bacteria in the rumen. In most management systems, this is achieved by a gradual increase in the concentrate portion of the diet. The purpose of this experiment was to determine the effect of diet on rate of lactate fermentation and on the counts of lactate-utilizing bacteria.

Procedures

Three ruminally cannulated steers were adapted to an alfalfa (dehydrated pellets) diet and gradually switched to 50:50 and 0:100 alfalfa:grain diets (12% crude protein) at 2-wk intervals. The composition of the grain portion of the diet was corn (49.3%), milo (49.3%), dicalcium phosphate (0.75%), trace mineral salt (0.5%), and vitamins A and D (0.2%). The diet was fed in equal amounts 12 times a day. Ruminal fluid samples were collected from steers on 100:0, 50:50, and 0:100 alfalfa:grain diets. In each sampling period, samples were collected from each steer on 3 consecutive days. Ruminal fluid samples were strained through four layers of cheesecloth and used to determine in vitro lactate fermentation rate and counts of total viable anaerobic and lactate-utilizing bacteria. The in vitro lactate fermentation rate was determined by incubating ruminal fluid in a buffered medium containing sodium lactate under anaerobic conditions. The fermentation rate was determined by the rate of disappearance of lactate during a 2-h incubation.

Results and Discussion

In vitro lactate fermentation rate and counts of total anaerobic and lactate-utilizing bacteria are shown in Table 1. With increasing amounts of grain in the diet, the in vitro lactate fermentation rate for L(+) and D(-) lactic acid, respectively, increased from 16.2 mg/100 ml ruminal fluid/hour and 18.0 mg/100 ml ruminal fluid/hour at 100% alfalfa diet to 106.1 and 80.4 mg/100 ml ruminal fluid/hour at 100% grain diet. Concurrently, the proportion of lactic acid-utilizing bacteria increased from 9.0 to 39.7% of the total bacterial population. Increased grain intake also increased the total bacterial counts.

Gradual adaptation of cattle to a high-grain diet results in increased numbers of lactic acid-utilizing bacteria. Higher numbers of these bacteria metabolize lactic acid produced as a result of the high grain diet and, therefore, prevent accumulation of lactic acid in the rumen.

Table 1. Dietary effect on bacterial counts and in vitro lactate disappearance rates

Diet (%)		Bacterial Counts[1]			In Vitro Lactate Disappearance Rates[2]	
Alfalfa Pellets	Grain	Total Anaerobic	Lactic Acid-utilizing counts	%	L(+)	D(-)
100	0	13.4	1.2	9.7	16.2	18.0
50	50	47.2	4.6	9.9	66.3	30.5
0	100	74.5	29.6	39.7	106.1	80.4

1 In billions per gm of ruminal dry matter.

2 Mg of lactate/100 ml of rumen fluid/h.