

Ruminal Turnover Rate - Influence of Feed Additives, Feed Intake and Roughage Level

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Story in Brief

Liquid trace mineral (LTM) and bentonite enhanced ruminal turnover rate of liquids while monensin depressed it. Turnover rate increased with feed intake and addition of roughage to a high concentrate ration. Changes in turnover rate of solids tended to parallel liquids. Solid turnover rate was much lower with high roughage rations than high concentrate rations.

Introduction

Solids which leave the rumen undigested often are poorly digested in the intestines, so increased turnover rate may depress digestibility. However, processed grain rations, which can be digested in the intestines, are more efficiently utilized if digested in the intestines than in the rumen. Furthermore, the faster bacteria grow in the rumen, the more efficiently they grow since less energy is wasted for maintenance. Consequently, increased turnover should increase the efficiency of both bacterial protein production and feed use with well processed rations. These studies examined the influence of several additives, intakes and roughage levels on ruminal turnover rates of liquids and solids.

Materials and Methods

Fistulated steers were used in all trials. These ranged in weight from 600 to 1100 lb in different trials. In all trials, steers were rotated among rations so that the comparison between additives or feed composition was not influenced by animal size or weight. Animal numbers varied from trial to trial. Preliminary periods lasted a minimum of seven days and were typically 14 days long. Polyethylene glycol or chromium EDTA served as "markers" to track the liquid fraction and in some trials chromic oxide tracked the solid fraction. Markers were either fed or dosed via cannula. After dosing, a series of samples of rumen contents were obtained from 4 to 30 hr later to calculate outflow. Level of additives, feed intake and roughage are presented in tables with results.

Results and Discussion

The effects of feed additives on rumen turnover rate are shown in Table 1. When LTM was added to the basal ration, liquid turnover rate increased. Niacin also tended to enhance turnover. Changes in turnover rate for the solid phase tended to parallel that of liquid. Addition of bentonite (2 percent of the ration) also increased liquid turnover. In two trials with addition of bicarbonate (1 percent and 1.5 percent), liquid phase turnover declined slightly. Addition of either cement kiln dust (3.5 percent) or Ronnel (.18 lb/ton) slightly decreased liquid turnover rate. Monensin in two trials depressed rumen turnover rate for both liquids and solids. As feed intake increased, from a maintenance to twice maintenance (Table 2), ruminal liquid turnover rate tended to increase at an increasing rate.

Table 1. Feed additives and ruminal turnover.

Ration	Number of animals	Ruminal turnover, %/hr	
		Liquid	Solid
Basal ^a	9	8.34 ^f	4.40
1 + LTM	9	9.58 ^g	5.45
1 + Niacin	9	9.10 ^g	---
Basal ^b	4	6.70 ^h	---
2 + bentonite, 2%	4	7.60 ⁱ	---
Basal	4	6.98	---
2 + bicarbonate, 1%	4	6.71	---
Basal ^c	8	7.32	---
3 + cement kiln dust, 3.5%	8	6.39	---
3 + Ronnel, .18 lb/ton	8	6.69	---
3 + bicarbonate, 1.5%	8	6.50	---
Basal ^d	4	7.40 ^f	4.92
4 + monensin (.006 oz/day)	4	5.59 ^g	4.39
Basal ^e	16	6.53 ^h	2.73 ^f
5 + monensin	16	4.52 ⁱ	1.54 ^g

^a11.9 lb/day of ration B010 (17.9 lb DM/day of 63% rolled corn, 10% soy, 14% cottonseed hulls, 6% alfalfa, 5% molasses) fed to 1100 lb steers.

^b13.9 lb/day of ration B010 fed to 1100 lb steers.

^c17.9 lb DM/day of B010 ration for 1100 lb steers.

^d11.6 lb DM/day of ration B010 fed to 1000 lb steers.

^eAd lib fed prairie hay (11.5 and 9.7 lb) plus 2 lb of a 40% protein soybean meal supplement per 1000 lb steer daily.

^{fg}Means within a trial with different superscripts differ statistically ($P < .05$).

^{hi}Means within a trial with different superscripts differ statistically ($P < .10$).

Table 2. Feed intake and ruminal turnover.

Ration ^a	Number of animals	Ruminal turnover Liquid
Maintenance (M)	4	3.04
1.33 x M	4	3.45
1.67 x M	4	3.95
2 x M	4	5.29

^aMultiples of 5.6 lb DM/day of an 84% rolled corn, 5% cottonseed hulls, 5% alfalfa, 5% soybean meal ration for 628 pound steers.

Level of roughage in the ration had a marked effect on liquid phase turnover rate (Table 3). Addition of 30 percent cottonseed hulls increased apparent liquid turnover rate greatly. In further study of roughage levels, three different rations-100 percent rolled corn grain, 100 percent chopped alfalfa hay and a mixture of 50 percent of each-were fed. Liquid turnover rate increased as some alfalfa was added but declined again when 100 percent alfalfa hay was fed. Although outflow (gallons per day) increased with each addition of alfalfa, rumen volume increased as well. This compensated to reduce rate of liquid turnover when expressed on a percent of liquid flowing out per hour. The changes in solid phase turnover tended to parallel those of the liquid phase.

Table 3. Roughage level and source.

Ration	Number of animals	Ruminal turnover, %/hr	
		Liquid	Solid
High concentrate ^a	4	5.7 ^a	---
70% concentrate ^a	4	18.8 ^b	---
High concentrate ^b	6	6.43 ^a	4.38
50% concentrate, 50% alfalfa ^b	6	7.80 ^b	5.91
Alfalfa ^b	6	6.31 ^a	3.37
High concentrate ^c	10	5.3	4.5
High roughaged ^d	4	5.2	2.2

^aFed 11.9 lb DM/day of 87 or 62% rolled corn, 5 or 30% cottonseed hulls, 5% soybean meal ration to 1000 lb steers.

^bFed at a rate of 1.5% of body weight to 1000 lb steers.

^cFed 13.5 lb DM/day of 91% rolled corn, 5% cottonseed hulls, 1% alfalfa, urea and minerals to 1100 lb steers.

^dFed 13.3 lb DM from prairie hay plus 1.8 lb of a 20 or 40% protein supplement per day to 1100 lb steers.

Table 4. Particle size and ruminal turnover rate.^a

Screen size	Number of animals	Ruminal turnover liquid
1/8 inch	4	4.52
3/16 inch	4	6.54
5/16 inch	4	6.23
Whole	4	5.88

^aSame ration as table 2.

Corn was ground through different screens to achieve various particle sizes (Table 4). No definite relationship between grinding of corn and rumen liquid turnover rate was detected.

Feed additives which increase ruminal turnover rate appear in general to increase efficiency of feed use during early portions of a finishing trial but depress digestibility. Additives which reduce ruminal turnover rate generally enhance digestibility but may depress intake. If protein supply limits performance at feedlot steer weights below 750 lb and energy availability limits efficiency of feed use at heavier weights, use of a stimulant early and a depressant later may prove useful.