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Steers receiving Rumensin had reduced acidosis as indicated by elevated ruminal pH and reduced area of ruminal pH below 5.6. Therefore, Rumensin can be used as a management tool to aid in reducing acidosis and thereby increasing feedlot performance.

Summary

Six ruminally-fistulated steers were used to evaluate the effect of Rumensin and feed intake variation on ruminal pH. Steers were adapted to a 92.5 percent concentrate diet and then subjected to three levels of intake variation: ad libitum, intake variation of 2 lb/day, and intake variation of 4 lb/day. Feed intakes and ruminal pH were monitored continuously throughout the entire trial. Results indicate that Rumensin reduced acidosis by elevating average ruminal pH and decreasing area of ruminal pH below 5.6. In addition, Rumensin stabilized rate of intake and daily ruminal pH fluctuation at the high level of intake variation.

Introduction

Changes in dry matter intake by cattle fed high-concentrate diets can negatively influence feedlot gain and efficiency as well as predispose digestive disorders such as acidosis. Subacute acidosis increases variation in feed intake and decreases dry matter intake of cattle consuming high-grain diets. During acidosis, cattle will reduce feed intake until ruminal pH increases to approximately 5.6. Thus, ruminal pH must affect feed intake. On the other hand, it is not totally clear whether ruminal pH causes feed intake variation or whether feed intake variation changes ruminal pH, and how these factors are controlled in cattle. Rumensin is an ionophore widely used in the feedlot industry to increase feed efficiency. It has been widely observed and recently shown that Rumensin reduces feed intake variation and may reduce digestive disturbances and death loss. This effect of Rumensin and its mechanism have been difficult to measure and explain. Therefore, a system of continuous acquisition of feed intake and ruminal pH data was developed so that a more complete understanding of the interactions between ruminal pH and feed intake variation would be possible. The objectives of this trial were to evaluate the effects of Rumensin and feed intake variation on ruminal pH through continuous data acquisition.

Procedure

Six ruminally-fistulated steers (860 lb) were used in a 111-day metabolism finishing trial. To have the steers used in this trial respond in intake and performance similar to yearling cattle coming off grass and going to the feedlot in early fall, the steers were cannulated in the spring at approximately one year of age and then summered on grass until the start of the trial in mid-October.

Table 1. Composition of finishing diet.

Item	% of DM
Dry-rolled corn	81.95
Alfalfa hay	7.50
Molasses-urea supplement	6.36
Dry supplement[a]	4.19

[a]Contained minerals, vitamins, and Tylan, with or without Rumensin.

Steers were then allotted randomly to one of two dietary treatments, a 92.5 percent concentrate diet with or without Rumensin at 25 g/ton (Table 1). Steers were adapted to the finishing diet through a 20-day, four step grain adaptation period. Each step was fed for a 5-day period and consisted of 45, 35, 25, and 15% (DM basis) alfalfa hay in place of dry-rolled corn for steps one through 4, respectively. All steers were then subjected to three levels of intake variation: ad libitum intake with no controlled intake variation on days 21-47 and 60-98 (NV), low daily intake variation of 2 lb/day of dry matter on days 48-53 and 99-104 (LV), and high daily intake variation of 4 lb/day of dry matter on days 54-59 and 106-111 (HV). Dietary treatments were switched on day 78, with the three steers receiving Rumensin going to the control diet and the three steers already on the control diet going to the Rumensin treatment.

Throughout the entire trial, steers were tethered in individual metabolism stalls. Feed intakes were monitored continuously with individual feed bunks that were suspended from load cells. Ruminal pH was also monitored continuously with submersible pH electrodes suspended through the plugs of the rumen cannulas of each steer. Each pH electrode was encased in a weighted four-wire metal shroud to keep the electrode in a stationary position approximately five to ten inches above the ventral floor of the rumen, while allowing rumen contents to flow freely through it. Load cells and pH electrodes were linked directly to a computer allowing data acquisition software to record both feed weight and ruminal pH every minute for each steer over the entire feeding period.

Analysis included DM intake, rate of DM intake, average ruminal pH, area of ruminal pH below 5.6, daily magni-

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Table 2. Effect of Rumensin during grain adaptation period.

Item	Control	Rumensin
DM intake, lb/day[a]	25.94	23.81
Rate of intake, % of daily intake/min	.77	.79
Ruminal pH	5.79	5.78
Area below 5.6[b]	134.21	98.16
pHDIFF[c]	1.16	1.11
pHVAR[d]	.093	.072

[a]Means differ (P < .10).
[b]Area = ruminal pH units below 5.6 by minute.
[c]Magnitude of daily ruminal pH change.
[d]Variance of daily ruminal pH.

tude of ruminal pH change (pHDIFF), and daily variance of ruminal pH (pHVAR). Rate of intake was calculated as a first-order reaction with units of percent of daily intake per minute. Area of ruminal pH below 5.6 was calculated as time (minutes) by the units of ruminal pH below 5.6. Since it has been shown that on average cattle will reduce intakes at a ruminal pH below 5.6, the area of the ruminal pH curve below 5.6 should provide a measurement of subacute acidosis. Both pHDIFF and pHVAR indicate the degree to which the ruminal pH is changing or fluctuating within a day, where pHDIFF is calculated as the difference between the maximum and the minimum ruminal pH for a steer in a day.

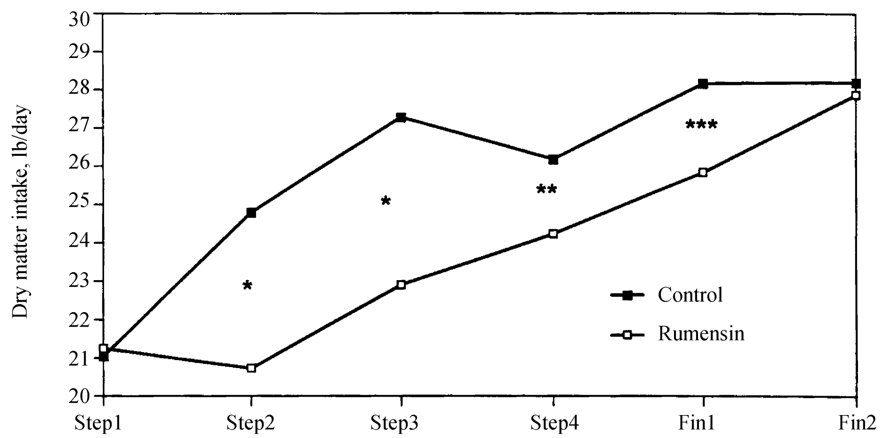
Results

Dry matter intakes and daily gains were typical of yearling feedlot cattle. Dry matter intakes during the finishing period averaged 28.0 lb per day and ADG for the six steers during the trial was 4.0 lb.

Grain Adaptation Period

Analysis of the grain adaptation period included the 5-day average for each step-up diet (1 through 4) plus the average of the first and second five days on the finisher. Steers receiving Rumensin consumed less feed over the grain adaptation period (P < .05) (Table 2), reaching the level of the controls by the second five days on finisher (Figure 1). Dry matter intakes on step one were similar for the steers on the control and Rumensin treatments. On steps two and three, steers receiving Rumensin consumed approximately 16 percent less feed than the controls (P < .01). During step four and the first five days on finisher, steers on the Rumensin treatment tended to consume eight percent less feed than the controls (P < .16). By the second five days on finisher, DM intakes were not different. During the grain adaptation period, rate of DM intake was not affected by dietary treatment or step-up diet.

Average daily ruminal pH was not affected by Rumensin, although it was affected by step-up diet (Table 3). Ruminal pH was relatively constant from step one through step four, averaging 5.87. During the first five days on finisher, average ruminal pH dropped to 5.73 (P < .05, from step 4). During the second five days on finisher, average ruminal pH dropped to 5.50 (P < .05, from first 5 days on finisher). Area of ruminal pH below 5.6 followed the same pattern as average ruminal pH. Steps one through four were not different from each other and averaged 73.90 across dietary treatments. Area of rumi-



* Control vs Rumensin (P<.01).
** Control vs Rumensin (P=.15).
*** Control vs Rumensin (P<.10).
Step 1 through Step 4 are the 5 day average of each respective step-up diet.
Fin1 and Fin2 are the first and second 5 days of finisher, respectively.

Figure 1. Dry matter intakes during grain adaptation period.

Table 3. Effect of step-up diet during grain adaptation period.

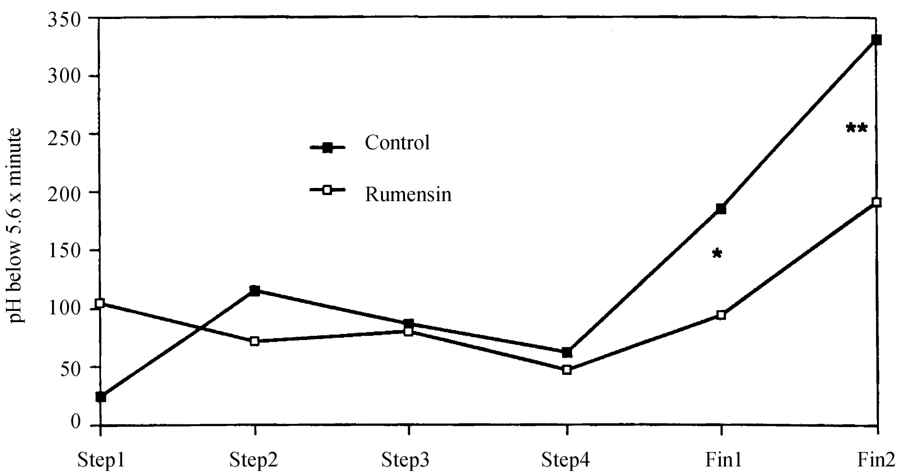
	Diet[a]					
Item	Step1	Step2	Step3	Step4	Fin1	Fin2
DM intake, lb/day	21.15^{b}	22.76^{c}	25.09^{d}	25.21^{d}	27.0^{e}	28.04^{e}
Rate of intake, % of daily intake/min	.72^{bc}	.50^{b}	.81^{bcd}	.82^{bcd}	.91^{cd}	.94^{d}
Ruminal pH	5.89^{b}	5.80^{bc}	5.88^{b}	5.92^{b}	5.73^{c}	5.50^{d}
Area below 5.6[f]	64.88^{b}	93.41^{b}	83.23^{b}	54.40^{b}	139.50^{b}	261.66^{c}
pHDIFF[g]	.99^{b}	1.08^{bc}	1.36^{d}	1.21^{c}	1.18^{c}	1.0^{b}
pHVAR[h]	.058^{bc}	.073^{bcd}	.130^{e}	.094^{d}	.088^{cd}	.050^{b}

[a]Step1 through Step4 are the 5 day average of each respective step-up diet. Fin1 and Fin2 are the first and second 5 days of finisher, respectively.
[b,c,d,e]Means differ (P < .10).
[f]Area = ruminal pH units below 5.6 by minute.
[g]Magnitude of daily ruminal pH change.
[h]Variance of daily ruminal pH.

Table 4. Effect of Rumensin during finishing period.

Item	Control	Rumensin
DM intake, lb/day	28.34	27.61
Rate of intake, % of daily intake/min	.61	.55
Ruminal pH[a]	5.59	5.73
Area below 5.6[bc]	216.09	98.18
pHDIFF[d]	1.10	1.07
pHVAR[e]	.063	.055

[a]Means differ (P = .11).
[b]Area = ruminal pH units below 5.6 by minute.
[c]Means differ (P < .10).
[d]Magnitude of daily ruminal pH change.



*Control vs Rumensin (P=.25).
**Control vs Rumensin (P=.08).
Step1 through Step4 are the 5 day average of each respective step-up diet.
Fin1 and Fin2 are the first and second 5 days of finisher, respectively.

Figure 2. Area of ruminal pH below 5.6 during grain adaptation period.

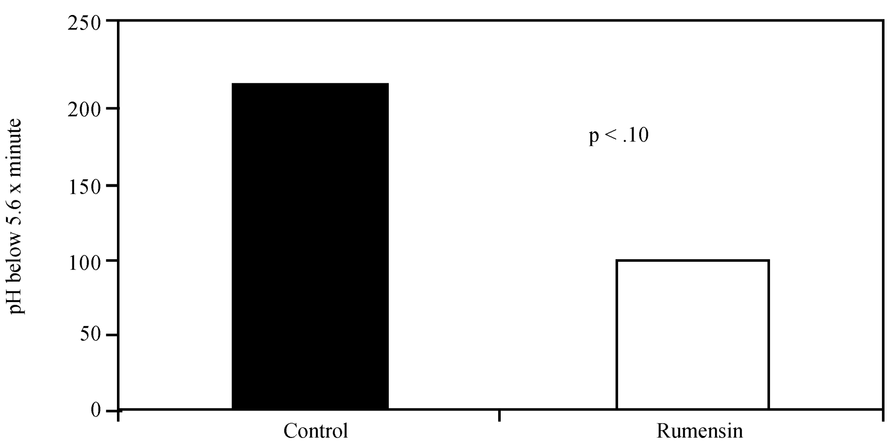


Figure 3. Area of ruminal pH below 5.6 during finishing period.

nal pH below 5.6 tended (P = .16, from step 4) to increase during the first five days on finisher to an average of 139.50. Area again increased during the second five days of finisher to an average of 261.66 (P < .05, from first 5 days on finisher). For steers on the Rumensin treatment, area of ruminal pH below 5.6 was numerically lower (P = .25) during the first five days on finisher and was significantly lower (P = .08) during the second five days on finisher compared to the controls (Figure 2).

Daily magnitude of ruminal pH change was not affected by Rumensin. However, pHVAR tended (P = .14) to be lower for the Rumensin treatment compared to the control (Table 2). Both pHDIFF and pHVAR had significant (P < .01) quadratic responses to step-up diet (Table 3). Both started low on step one, were highest on step three, and returned to levels similar to step one by the second five days on finisher.

Therefore, results of the grain adaptation period indicate that Rumensin caused steers to move on feed more gradually, but did not affect DM intake by the second five days on finisher. In addition, Rumensin reduced area of ruminal pH below 5.6 for the first and second five days on finisher, indicating less acidosis while adapting to the final diet.

Finishing period

Analysis of the finishing period included the average of the last two days on each level of intake variation. Dry matter intake was not affected by dietary treatment or level of intake variation and averaged 28.0 lb per day for the finishing period. Rate of intake increased linearly (P < .05) with level of intake variation on the control diet, but was not affected by level of intake variation on the Rumensin diet (data not shown).

Average daily ruminal pH tended (P = .11) to be higher for the steers on Rumensin than the controls across all three levels of intake variation (Table 4). Average daily ruminal pH increased (P < .05, linear) with increasing level of intake variation

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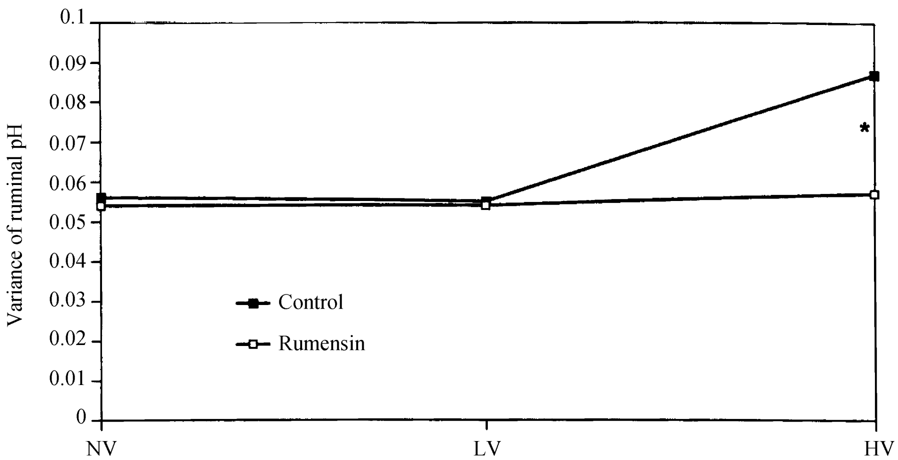
Table 5. Effect of level of intake variation during finishing period.

Item	Level of intake variation[a]		
	No variation	Low variation	High variation
DM intake, lb/day	28.16	27.85	27.92
Rate of intake, % of daily intake/min[b]	.52	.62	.59
Ruminal pH	5.52[c]	5.69[d]	5.76[d]
Area below 5.6[e]	234.03[c]	142.72[d]	94.67[d]
pHDIFF[f]	1.03[c]	1.07[cd]	1.15[d]
pHVAR[g]	.050[c]	.055[c]	.072[d]

[a]No Variation = Ad libitum. Low Variation = 2 lb/day intake variation. High Variation = 4 lb/day intake variation (DM basis).
[b]Significant interaction detected (P = .08). Overall means presented but not statistically analyzed.
[c,d]Means differ (P < .10).
[e]Area = ruminal pH units below 5.6 by minute.
[f]Magnitude of daily ruminal pH change.
[g]Variance of daily ruminal pH.



*Control vs Rumensin (P<.05).
NV = Ad libitum, no controlled intake variation.
LV = Low intake variation.
HV = High intake variation.

Figure 4. Variance of daily ruminal pH during finishing period.

(Table 5). Area of ruminal pH below 5.6 was significantly greater (P = .07) for the steers on control than on Rumensin, indicating more subacute acidosis with the controls (Figure 3). Area of ruminal pH below 5.6 linearly decreased (P < .05) with increasing level of intake variation (Table 5). The reason average ruminal pH increased and area below 5.6 decreased with increasing level of intake variation is unclear.

Daily magnitude of ruminal pH change (pHDIFF) and pHVAR were relatively constant and not affected by dietary treatment across NV and LV. However, with high intake variation, both pHDIFF and pHVAR significantly increased (P < .05) for the control, while remaining constant for the Rumensin treatment (Figure 4).

Therefore, results of the finishing period indicate that the use of Rumensin elevates average ruminal pH and decreases area of ruminal pH below 5.6, while stabilizing rate of intake and daily ruminal pH fluctuation at high levels of feed intake variation.

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