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Effects of Monensin and Sodium Propionate on Net Nutrient Absorption in Steers Fed High-grain Diets

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Summary

Adding either monensin or sodium propionate alone or in combination to the diet of steers fed high-grain diets resulted in increased net absorption of glucose. Monensin reduced ammonia output and gut uptake of urea. We propose that increased propionate availability reduces the utilization of glucose by gut tissues, allowing more glucose to reach the portal system. These changes may contribute to the increased feed effeciency seen when monensin is fed.

Introduction

Ionophore antibiotics like monensin (Rumensin®) shift ruminal fermentation to increased production of propionic acid. This may be a major contributor to the increased feed effeciency seen when these compounds are fed. The previous paper investigated how this change in fermentation was reflected in the nutrients absorbed into the portal blood stream. One of the changes we noted was an increase in the net absorption of glucose. The present study was conducted to separate the effects of increased propionic acid production from the direct effects of ionophores.

Experimental Procedures

Four Holstein steers (464 lbs) surgically fitted with catheters in the hepatic portal vein, a mesenteric vein, and a carotid artery were utilized to study how addition of monensin (300 mg/head/day) and/or sodium propionate (1 lb/head/day) to a high-grain diet influenced the pattern of absorbed nutrients. The diet consisted of 15% chopped alfalfa with the remainder of the diet made up of cracked corn and supplement to supply 11.5% crude protein, .62% calcium, and .4% phosphorous. Animals were fed in 12 portions daily every 2 hours using an automatic feeding system. Three samples of portal and arterial blood were taken at hourly intervals for 3 consecutive days during each sampling period. Blood flow was determined by continuous infusion of p-aminohippuric acid.

Results and Discussion

Dry matter intakes (Table 5.1) were not affected by addition of either monensin or propionate, nor was portal blood flow. Adding monensin tended to decrease the net gut uptake of glucose (P=.16), whereas adding propionate increased (P<.05) net glucose uptake. No differences were seen in the net absorption of lactate or beta-hydroxybutyrate, but adding monensin decreased net

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ammonia absorption and decreased the transport of urea back into the gut. Both of these changes are consistant with the antibiotic activitiy of monensin. It decreases ruminal protein and urea hydrolysis because rumen microbial activity is decreased. However, the decreased proteolytic activity was not reflected in the net absorption of alpha-amino-nitrogen. Adding propionate, however, decreased ($P<.05$) the net absorption of alpha-amino-nitrogen. No significant changes in the net absorption of glutamate, glutamine, or alanine were seen in either treatment.

It appears that increased propionate availability, whether achieved by altering ruminal fermentation with ionophores or by adding propionate directly to the diet, may reduce the utilization of glucose by gut tissues. This, in turn, would make more glucose available for absorption, which may be one reason why feed efficiency improves when ionophores are added to the diet.

Table 5.1. Main Effects of Dry Matter Intake, Blood Flow, and Net Nutrient Absorption in Steers Receiving Monensin and Sodium Propionate

Item	- Monensin	+	- Propionate	+
Intake (lbs. dry matter)	11.1	10.9	11.1	11.0
Portal blood flow, liter/h	651.1	668.7	681.2	638.6
	Net absorption, mmol/h			
Glucose[b]	-22.6	-3.8	-31.9	5.5
L-lactate	40.1	84.2	51.5	72.9
ß-hydroxybutyrate	46.3	26.6	26.1	46.8
Ammonia[a]	120.9	93.8	111.7	103.0
Urea-N[a]	-45.8	-11.4	-29.2	-29.1
Alpha-amino-N[b]	136.2	131.9	170.6	97.5
Glutamate	-6.0	-5.4	-7.5	-3.9
Glutamine	-9.7	-12.1	-7.7	-14.1
Alanine	16.4	20.3	20.1	16.6

[a]Significant Monensin effect ($P<.05$)

[b]Significant Propionate effect ($P<.05$)