Influence of Ionophore Addition to High-grain Diets on Net Nutrient Absorption

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Summary

Adding ionophores to a high grain diet increased glucose absorption and decreased the transport of urea back into the gut. These changes are consistent with the antibiotic effects of these compounds. Decreased microbial activity in the gut and shifts in the pattern of absorbed nutrients may help explain the improvements in feed efficiency seen with ionophore addition.

Introduction

Ionophore antibiotics play a central role in U.S. beef production. The ionophores, Rumensin® (monensin) and Bovatec® (lasalocid), are added to diets of the majority of the feedlot cattle in this country. Their main effect is to increase feed efficiency. Recently, the effectiveness of a new ionophore, salinomycin, has been investigated. Ionophores affect the pattern of nutrients produced by ruminal microbial fermentation. Our objective was to evaluate how these changes in ruminal fermentation translated into nutrients absorbed into the portal blood system.

Experimental Procedures

Three Hereford heifers (770 lbs) were surgically fitted with catheters in the hepatic portal vein, a mesenteric vein, and the abdominal aorta, as well as with a permanent rumen fistula. The diet was 85% cracked corn and 15% alfalfa, with and without ionophore addition. Animals were fed at 2-hour intervals with 12 sets of blood samples taken per sampling period. Treatments were control, monensin (300 mg/head/day), or salinomycin (100 mg/head/day). Blood flow was determined by continuous infusion of p-aminohippuric acid, and net nutrient absorption into the portal system was calculated.

Results and Discussion

Dry matter intake (Table 6.1) was slightly less ($P>.10$) for animals receiving the control diet, as was blood flow ($P=.11$). Adding monensin increased net glucose absorption ($P<.05$) but lactate, betahydroxybutyrate, and ammonia were unaffected. Both ionophores decreased the transport of urea back into the gut ($P<.10$) and tended to increase the absorption of alpha-amino-nitrogen. Both ionophores increased the net absorption of glutamate ($P<.10$). The amount of a nutrient flowing to the portal system can increase because 1) more of the nutrient is being absorbed or 2) less of the nutrient is being utilized by gut tissue itself. A

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negative flow of portal nutrients means that either 1) the nutrient is flowing back into the gut (urea is an example) or 2) the gut wall is utilizing more of the nutrient than is being absorbed. As ruminal fermentation was altered by the ionophores, there was an increase in the net absorption of glucose and an increased gut uptake of glutamine with an increase in the appearance of glutamate and alanine. The increased glucose absorption may have been caused by more starch entering the small intestine because of decreased ruminal microbial activity, or by decreased utilization of glucose by gut tissues.

Table 6.1. Dry Matter Intake, Blood Flow, and Net Nutrient Absorption in Heifers Fed a High Concentrate Diet

	Treatment		
Item	Control	Salinomycin	Monensin
Intake (lbs dry matter)	9.6	11.4	11.2
Portal blood flow, liter/h	564.2	747.6	701.9
Net absorption, mmol/h			
Glucose[a,b]	-27.7	-20.5	14.0
L-lactate	89.5	59.4	69.6
ß-hydroxybutyrate	94.5	72.1	91.8
Ammonia	150.6	199.6	117.7
Urea-N[a]	-126.8	-51.3	-21.1
Alpha-amino-N	138.3	228.8	193.3
Glutamate[a,b]	-4.14	-2.55	-.24
Glutamine	-1.15	-11.74	-18.33
Alanine	11.90	29.20	41.25

[a]Control vs. ionophores ($P<.10$).

[b]Salinomycin vs. Monensin ($P<.10$).