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Abstract

Steers fed diets based on dry-rolled wheat or sorghum grain alone or combined (50:50) showed no differences in net portal fluxes of glucose, L-lactate, ammonia, urea, or α-amino nitrogen. Portal blood flow was increased in steers fed the 50:50 diet. Total volatile fatty acid flux into the portal blood tended to be lower for steers fed the sorghum grain diet, which may partially explain the lower feeding value of sorghum grain compared to wheat or the two grains combined.

Keywords

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Feeding Value of Wheat and Sorghum Grain as Indicated by Absorbed Nutrients

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Summary

Steers fed diets based on dry-rolled wheat or sorghum grain alone or combined (50:50) showed no differences in net portal fluxes of glucose, L-lactate, ammonia, urea, or alpha-amino nitrogen. Portal blood flow was increased in steers fed the 50:50 diet. Total volatile fatty acid flux into the portal blood tended to be lower for steers fed the sorghum grain diet, which may partially explain the lower feeding value of sorghum grain compared to wheat or the two grains combined.

Introduction

Wheat is quickly and completely fermented in the rumen. Typically, more than 90% of wheat starch disappears in the rumen, leaving very little starch available for digestion in the small intestine. Conversely, less than 50% of sorghum grain starch disappears in the rumen, thus shifting digestion postruminally. Researchers have speculated that having starch digested in the small intestine and absorbed as glucose would result in improvements in efficiency; however, no data are available to evaluate the amounts of glucose available to the animal. Mixtures of highly rumen-digestible grains with less rumen-digestible grains have improved cattle performance. Those improvements may be due to partitioning digestion over the entire gastrointestinal tract, resulting in greater overall efficiency. This study was designed to evaluate how shifting digestion postruminally influenced extent of digestion and pattern of absorbed nutrients.

Experimental Procedures

Three Holstein steers (avg. wt. 778 lbs.), surgically fitted with catheters in the hepatic portal vein, a mesenteric vein, and a carotid artery, were used to study the effect on net portal nutrient fluxes of dry-rolled wheat, dry-rolled sorghum grain, or a 50:50 mixture of the two grains in a 90% concentrate diet. Diets were 77% grain, 10% ground alfalfa hay, 3% molasses, and 10% pelleted supplement with Rumensin®, Tylan®, and chromic oxide. Diets were fed in 12 equal portions daily by an automatic feeder. A fecal grab sample was taken daily from each steer during the sampling period and used to determine total tract starch and dry matter digestibilities of the three diets. Net nutrient flux from the portal drained viscera was measured hourly for 4 hours on 3 consecutive days during each sampling period. Blood flow was determined by continuous infusion of p-aminohippuric acid.

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Results and Discussion

There were no differences in dry matter intake from grain treatment (Table 2.1); however, dry matter and starch digestibility decreased linearly (P<.01) with increasing levels of sorghum grain.

Portal blood flow in steers fed the 50:50 diet was higher (p<.10) than that in steers fed either the wheat or sorghum grain diets. No differences were seen in the net portal flux of glucose, L-lactate, ammonia-nitrogen, urea-nitrogen, or alpha-amino-nitrogen, although there was a trend toward greater alpha-amino nitrogen absorption and more urea recycling in steers fed diets containing wheat. Greater rumen microbial growth on the wheat diets contributed to more urea recycling back to the rumen and greater absorption of alpha-amino-nitrogen into the portal blood. Net portal insulin production was similar for all diets. Net flux of acetate into the portal blood tended to be greater for both wheat-containing diets, and net flux of propionate was lower (P<.10) for the sorghum grain diet. Part of the greater net flux of acetate when steers were fed the 50:50 diet was probably due to the increased portal blood flow. Total volatile fatty acid net flux into the portal blood was 1080, 1152, and 918 mmol/h for the wheat, 50:50, and sorghum grain diets, respectively. The lower total volatile fatty acid absorption in steers fed the sorghum grain diet may help explain the lower feeding value of sorghum grain, especially since there was only a small increase in the net absorption of glucose on the sorghum-containing diets.

Table 2.1. Portal Blood Flow, Dry Matter Intake, Digestibility and Net Nutrient Flux in Steers Fed Wheat and Sorghum Grain Diets.

Item	Diet		
	Wheat	50:50	Sorghum
Dry Matter Intake, lbs	13.2	13.4	13.6
Dry Matter Digestibility, %[c]	80	77	70
Starch Digestibility, %[c]	96	92	88
Portal Blood Flow, l/h[d]	741	817	774
Net Flux, mmol/h:			
Glucose	3	22	24
L-lactate	85	107	92
Ammonia-nitrogen	209	208	201
Urea-nitrogen	-78	-58	-55
Alpha-amino-nitrogen	111	102	87
Acetate	526	605	469
Propionate[a]	481	465	353
Butyrate	31	25	33
Isobutyrate[d]	10	12	8
2-methylbutyrate[c]	9	17	24
3-methylbutyrate	7	6	17
Valerate	16	19	14
Insulin µg/h	124	123	112

Linear effect (P<.10)[a]; (P<.05)[b]; (P<.01)[c].

Quadratic effect (P<.10)[d].