SUPPLEMENTAL GLUCOSE IN FEED OR DRINKING WATER FOR STEERS FED A HIGH CONCENTRATE DIET

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Story in Brief

The impact of glucose supplemented by two different routes (feed versus drinking water) on feed intake and performance of 12 finishing beef steers was measured. Animals were individually fed an 80% concentrate diet. Feed and water intake were recorded daily during the 56 day study. Treatments consisted of daily additions of glucose (200 g/animal) either in the feed or in the drinking water. Route of administration did not influence voluntary feed (9.4 versus 8.8 kg/day) or water (26.0 versus 25 liters/day) intake although both tended to be higher for glucose in feed. However, daily gain (2.3 versus 1.7 kg/day) and feed efficiency (4.0 versus 6.6) tended to be greater with glucose added to the feed. Plasma glucose concentration was slightly higher (87.1 vs 86.3 mg/dl) in those steers receiving glucose in the drinking water. Improved feed efficiency of steers receiving glucose in the feed rather than in the water may be a result of improved energy use. Dietary glucose should have increased microbial protein production whereas glucose in drinking water, if bypassing the rumen may have depressed intake as has been shown with propionate-infused cattle fed concentrate diets.

(Key Words: Beef Cattle, Glucose, Feed, Drinking Water.)

Introduction

Ruminal degradation of specific essential nutrients (proteins, B-vitamins, glucose fats, etc.) may be detrimental to ruminant performance. Hence methods to deliver nutrients of high nutritive value post-ruminally need to be evaluated. Garza and Owens (1989); suggested that drinking water may be an ideal vehicle to divert nutrients to the small intestine. Fenn and Leng (1989) reported that methionine supplementation via drinking water increased methionine absorption, and increased wool growth in sheep fed roughage based diets. Recently, Schutte et al. (1990) indicated that

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addition of casein (a natural protein) in the drinking water of steers increased nitrogen retention. This study compared the effect of two routes (feed or drinking water) of glucose supplementation on voluntary intake of feed and water, plasma glucose and urea-nitrogen levels, and performance of finishing beef steers fed a high concentrate diet.

Materials and Methods

Twelve crossbred steers (361 $\pm$ 20 kg body weight) were individually weighed, implanted with a commercial ear implant, and assigned to individual slatted-floor pens in a crossover design. Animals were adapted to an 80% concentrate diet (Table 1) in 20 days. During each 28 day experimental period, steers had free choice access to feed with fresh feed provided once daily. Each received either 200 g of glucose per day top dressed in the feed, or 200 g of glucose mixed in the drinking water. Individual feed and water intake were recorded daily. Initially and on the last two days (day 27 and 28) of each experimental period steers were weighed previous to being fed. Weight was calculated as the average of 2 day consecutive weights. On day 28 after body weight was recorded, jugular blood samples were withdrawn for plasma glucose and urea-nitrogen determinations. Daily weight gain and feed efficiency were calculated using final weight and mean dry matter intake.

Table 1. Composition of concentrate (dry matter basis)[a].

Ingredient	Percent
Corn, dry rolled	63.25
Cottonseed hulls	14.10
Soybean meal	10.05
Alfalfa pellets dehydrated	6.00
Cane molasses	5.00
Salt	.50
Ground limestone	.50
Dicalcium phosphate	.50
Urea, 45% N	.10
Monensin	.33

[a] 12.7% of DM was crude protein (Kjeldahl analysis); NEm 1.92 Mcal/kg; NEg 1.18 Mcal/kg (calculated).

The difference between the two methods of glucose administration on performance measurements was tested using a general linear models procedure (GLM), including animal, period and treatment as classes in the statistical model. Means were compared using the least squares procedure.

Results and Discussion

Daily dry matter intake (9.44 vs 8.76 kg/day) and water consumption (26.0 vs 25 liters/day) tended to be greater for the steers receiving glucose in the feed (Table 2). Daily gain (2.3 vs 1.7 kg/day) and feed efficiency (4.0 vs 6.6) also tended to be superior ($P<.06$) for steers receiving glucose in the ration (Table 2). Plasma glucose levels were only slightly higher (86.3 vs 87.1 mg/dl) for the animals given glucose in the drinking water. If glucose did bypass the rumen and was absorbed in the small intestine, blood glucose should have been elevated. However, if glucose is metabolized to lipid by the intestine, as suggested by Rust (1983), an increase would not be expected.

Plasma urea-nitrogen was not altered by route of glucose administration (17.2 vs 17.1 mg/dl; Table 2).

Superior performance of steers receiving glucose in the feed vs the water, suggests that either dietary glucose was beneficial or that glucose in water was detrimental. Glucose fermentation in the rumen presumably

Table 2. Influence of two methods of glucose administration on intake and performance of steers fed a high concentrate diet.

	Glucose		
	Feed	Drinking water	SE
Intake:			
Feed, kg DM/day	9.4	8.8	.27
Water, liters/day	26.0	24.7	.61
Weight:			
Total gain,kg	64.4	46.8	6.8
Daily gain, kg	2.3^a	1.7^b	.21
Feed/gain	4.0^a	6.7^b	.89
Plasma:			
Glucose, mg/dl	86.3	87.7	2.03
Urea-N, mg/dl			

^{a,b} Means in the same row with different supperscript differ ($P<.06$).

increased ammonia utilization and bacterial growth and protein synthesis. Studies with ruminal glucose infusions in dairy cattle (Rooke et al., 1987) fed grass-silage detected, decreased ruminal ammonia-nitrogen concentrations and increased supply of non-ammmonia nitrogen and bacterial protein reaching the small intestine.

We hypothesized that glucose should supply 10 to 30% of the energy if absorbed intact than if fermented in the rumen. In contrast, glucose in drinking water tended to reduce animal performance. Lack of response to glucose mixed with the drinking water, indicates that supply of absorbed glucose was not the first factor limiting production. The lower feed intake with glucose supplemented in the water suggests that a high proportion of glucose evaded ruminal fermentation and reached the small intestine. Otherwise, treatments should not have resulted in different performance levels.

Abomasal infusions of glucose or starch have reduced feed intake and daily gains in sheep fed low quality hay. Further addition of casein to these infusates reversed these responses, suggesting that supply of amino acids from casein was critical for these responses. Similarly, blood propionate infusions have depressed feed intake of concentrate-fed steers (Theurer, 1986).

The fact that small amounts of specific nutrients at the intestines can alter intake and performance suggests that intake control is a complex, and quite subject to nutritional control and regulation.

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