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Crude glycerin improves feed efficiency in finishing heifers (2013)

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Crude Glycerin Improves Feed Efficiency in Finishing Heifers

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Introduction

Crude glycerin is the principal byproduct of biodiesel production. The raw feedstocks, animal fats and vegetable oils, yield approximately 90 lb of biodiesel and 10 lb of crude glycerin for each 100 lb of input. When ingested by cattle, glycerin has two major fates: (1) direct absorption by the rumen epithelium, and (2) fermentation by microorganisms within the rumen to generate volatile fatty acid, mainly propionate. Using glycerin in feedlot cattle diets has become common, particularly as a component of liquid feed supplements.

We have evaluated the use of crude glycerin in cattle diets in previous studies and generally have observed positive effects on dry matter intake and feed efficiency when fed up to 8% of the diet on a dry matter basis. Crude glycerin can be highly variable in its composition, however, containing varying proportions of residual alcohol, soaps, and salts. Our focus in the present experiment was on the sodium content of crude glycerin. We hypothesized that the high concentration of sodium in glycerin, when combined with salt that normally is incorporated into feedlot diets, would result in abnormally high levels of sodium that could have deleterious consequences for feed consumption.

The objective of this study was to evaluate feedlot performance and carcass characteristics of finishing heifers fed diets containing high levels of crude glycerin in the presence and absence of added salt.

Experimental Procedures

Three hundred seventy-five crossbred heifers (initial body weight 736 ± 38 lb) were assigned to a randomized complete block experiment to evaluate the effects of adding crude glycerin to finishing cattle diets, both in the presence and absence of supplemental salt. The experiment was carried out at Kansas State University Beef Cattle Research Center in Manhattan, KS. The adjustment period consisted of four step-up diets fed for 5 days each. Animals were fed diets containing (dry matter basis) 50%, 40%, 30%, and 20% corn silage for step-up diets 1, 2, 3, and 4, respectively. Finishing diets (100% dry matter basis; Table 1) consisted of the following 5 treatments: (1) Control with no glycerin and 0.3% salt, (2) 7.5% glycerin with 0.3% salt, (3) 7.5% glycerin with no added salt, (4) 15% glycerin with 0.3% salt, and (5) 15% glycerin with no added salt. Animals were fed their respective diets once daily for 125 days. Starting 23 days prior to harvest, Zilmax (Merck Animal Health, Summit, NJ) was included in the diet for 20 days, followed by a 3-day withdrawal period before harvest. At the end of the experimental period, heifers were weighed then transported to a commercial abattoir. Hot carcass weight and liver abscess scores were obtained on the day of harvest, and after 24 hours we measured 12th-rib fat thickness; ribeye area; percentage of kidney, pelvic

and heart fat; marbling score; USDA quality grade, and USDA yield grade. Statistical analyses were performed using the MIXED procedure of SAS (SAS Institute; Cary, NC). Treatment was included in the model as the fixed effect, block was the random effect, and the experimental unit was pen. Contrasts were performed to test the linear and quadratic effects of crude glycerin and the effect of addition of salt to the glycerin-containing diets.

Results and Discussion

Incorporating glycerin into finishing diets had no effect on average daily gain of heifers (Table 2; $P \geq 0.29$), but feed intake decreased in proportion to the amount of glycerin added (linear effect; $P \leq 0.01$); consequently, we observed an improvement ($P \leq 0.01$) in feed efficiency in heifers fed glycerin.

Dressing percentage, ribeye area, and percentage of kidney, pelvic and heart fat were unaffected by our diets ($P \geq 0.10$; Table 3). Feeding glycerin tended to decrease carcass weight ($P = 0.11$), and generally speaking, cattle fed glycerin deposited less fat in the carcass compared with cattle fed the control treatment, as evidenced by decreased12th-rib fat thickness (linear effect of glycerin, $P \leq 0.01$). USDA yield grades followed a similar trend (linear effect of glycerin, $P < 0.01$) and decreased with increasing levels of glycerin in the diet. Marbling also decreased when glycerin was incorporated into the diet, but the magnitude of this change was similar for heifers fed 7.5 and 15% glycerin (linear and quadratic effects of glycerin, $P \leq 0.05$). Similarly, feeding glycerin had a negative impact on quality grade, decreasing the percentage of carcasses classified as Premium Choice ($P < 0.03$).

Removing salt from glycerin-based diets had no impact on gain, feed intake, or feed efficiency. Likewise, carcass characteristics were largely unaffected by the presence or absence of salt ($P \geq 0.10$).

Implications

Including up to 15% crude glycerin in byproduct-based diets improved feed efficiency of finishing heifers by decreasing feed intake but also depressed marbling score and yield and quality grades. Removing supplemental salt from diets containing crude glycerin had no impact on performance or carcass characteristics.

Table 1. Composition of experimental diets (dry matter basis)

		7.5% glycerin		15% glycerin	
Ingredient, % of dry matter	Control	Salt	No salt	Salt	No salt
Corn silage	10.00	10.00	10.00	10.00	10.00
Dry-rolled corn	31.00	21.94	22.30	12.90	13.26
Corn gluten feed	35.00	35.00	35.00	35.00	35.00
Soybean hulls	20.00	20.00	20.00	20.00	20.00
Supplement[1,2,3]	3.70	5.26	5.20	6.80	6.74
Crude glycerin	0.00	7.50	7.50	15.00	15.00
Salt (NaCl)	0.30	0.30	0.00	0.30	0.00
Nutrient analyses, %					
Dry matter	65.7	65.7	65.7	65.7	65.7
Crude protein	14.5	14.5	14.5	14.5	14.5
Neutral detergent fiber	37.2	36.5	36.6	35.9	35.9
Ether extract	3.03	2.66	2.67	2.28	2.30
Calcium	0.70	0.70	0.70	0.70	0.70
Phosphorus	0.53	0.52	0.52	0.50	0.50
Potassium	0.70	0.70	0.70	0.70	0.70

[1] Formulated to provide 0.1 ppm cobalt, 1.0 ppm copper, 0.6 ppm iodine, 60 ppm manganese, 0.25 ppm selenium, 60 ppm zinc, 1,000 IU/lb vitamin A, and 10 IU/lb vitamin E in the total diet on a 100% dry matter basis.

[2] Formulated to provide 300 mg Rumensin, 90 mg Tylan, and 0.5 mg Heifermaxx (Elanco Animal Health; Greenfild, IN) per heifer daily.

[3] Zilmax (Merck Animal Health, Millsboro, DE) was fed for 20 days followed by a 3-day withdrawal before harvest.

Table 2. Feedlot performance of heifers fed crude glycerin with or without added salt

		Treatments							
		7.5% glycerin		15% glycerin				*P*-value[1]	
Item	Control	Salt	No salt	Salt	No salt	SEM	Linear	Quadratic	Salt
No. of cattle	73	73	75	71	73	-	-	-	-
Initial weight, lb	734	736	737	735	735	37.9	0.74	0.50	0.66
Final weight, lb	1333	1307	1336	1323	1308	44.1	0.35	0.15	0.90
Average daily gain, lb	4.03	3.80	4.06	3.98	3.86	0.09	0.29	0.53	0.42
Dry matter intake, lb/day	27.3	26.1	26.0	25.2	24.8	0.75	<0.01	0.83	0.70
Feed:gain, lb/lb	6.76	6.86	6.39	6.29	6.41	0.168	0.03	0.62	0.25

[1] Linear and quadratic refer to linear and quadratic effects of glycerin; salt = contrast between 0 and 0.3% salt in diets that contain crude glycerin.

Table 3. Carcass characteristics of heifers fed crude glycerin with or without added salt

		Treatments							
		7.5% glycerin		15% glycerin				*P*-value[1]	
Item	Control	Salt	No salt	Salt	No salt	SEM	Linear	Quadratic	Salt
Hot carcass weight, lb	814	803	816	803	798	27.7	0.11	0.76	0.57
Dressed yield, %	61.07	61.44	61.06	60.72	61.06	2.10	0.76	0.58	0.48
Ribeye area, sq. in.	14.5	14.5	14.5	14.5	14.8	0.29	0.46	0.76	0.44
Kidney, pelvic and heart fat,%	3.23	3.24	3.19	3.26	3.11	0.05	0.46	0.87	0.07
12th-rib fat thickness, in.	0.86	0.82	0.84	0.81	0.71	0.03	<0.01	0.48	0.25
Liver abscesses, %	10.7	17.3	13.2	16.0	17.6	4.10	0.23	0.69	0.75
USDA yield grade	2.63	2.49	2.56	2.36	2.35	0.11	0.01	0.64	0.73
Marbling[2]	512	485	458	476	474	13	<0.01	0.02	0.16
USDA quality grades									
Prime, %	2.7	4.0	0	0	0	1.32	0.09	0.59	0.13
Premium Choice, %	34.7	20.0	21.1	28.0	25.7	5.07	0.21	0.03	0.89
Choice, %	82.7	82.7	78.9	88.0	87.8	4.26	0.31	0.26	0.65
Select, %	14.7	13.3	19.7	12.0	10.8	4.03	0.51	0.35	0.52

[1] Linear and quadratic refer to linear and quadratic effects of glycerin; salt = contrast between 0 and 0.3% salt in diets that contain crude glycerin.
[2] Marbling scores determined by USDA graders; slight = 300–399, small = 400–499, and modest = 500–599.