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Abstract
Plant oils contain large amounts of triglycerides that will react to a catalyst, such as methanol. The transesterification reaction between the oil and alcohol will produce approximately 10% crude glycerin and 90% biodiesel. Crude glycerin is distilled for use in human products such as soaps, cosmetics, and moisturizers, but the usefulness of glycerin as a feed source for livestock is unclear. Rapid expansion of the biodiesel industry has created excess supplies of crude glycerin. It is thought that glycerin can be used in ruminant diets to decrease feed costs, but crude glycerin from biodiesel production can contain various levels of methanol, which can be toxic to livestock at increased levels. The purpose of this experiment was to determine the effects of feeding crude glycerin derived from soybean oil in steam-flaked corn finishing diets fed to beef cattle.

Keywords
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CRUDE GLYCERIN IN STEAM-FLAKED CORN-BASED DIETS FOR BEEF CATTLE

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Introduction

Plant oils contain large amounts of triglycerides that will react to a catalyst, such as methanol. The transesterification reaction between the oil and alcohol will produce approximately 10% crude glycerin and 90% biodiesel. Crude glycerin is distilled for use in human products such as soaps, cosmetics, and moisturizers, but the usefulness of glycerin as a feed source for livestock is unclear. Rapid expansion of the biodiesel industry has created excess supplies of crude glycerin. It is thought that glycerin can be used in ruminant diets to decrease feed costs, but crude glycerin from biodiesel production can contain various levels of methanol, which can be toxic to livestock at increased levels. The purpose of this experiment was to determine the effects of feeding crude glycerin derived from soybean oil in steam-flaked corn finishing diets fed to beef cattle.

Experimental Procedures

In March 2007, 375 crossbred yearling heifers (929.5 ± 63 lbs) were used in a finishing trial. Upon arrival, all cattle were offered *ad libitum* access to alfalfa hay and water before processing. Within 24 hours of arrival, cattle received injections of Bovishield[1] 4 and Ultrabac[1] 7 vaccines and were treated with internal and external parasiticide. Cattle were implanted with Revalor[2]-200 and gradually adapted to a 94% concentrate diet with 6% alfalfa hay (Table 1). Dietary treatments consisted of 0, 2, 4, 8, 12, or 16% crude glycerin (dry matter basis). Cattle were transitioned from the control diet to diets containing increasing proportions of glycerin over a 10-day period. Cattle were blocked by initial weight and randomly assigned within block to each of the six treatments. Three weight blocks were used with six to seven animals per pen and nine pens per treatment. Cattle were housed in 54 concrete-surfaced pens (392.9 ft^2) with roofs covering feed bunks and half the pen. Cattle were fed free choice once daily.

On day 85, pens were weighed using a platform scale and shipped to a commercial abattoir in Emporia, KS. At slaughter, hot carcass weight and incidence and severity of liver abscesses were measured. After a 24-hour chill period, USDA yield grade; USDA quality; marbling score; 12th-rib fat thickness; kidney, pelvic, and heart fat; and ribeye area were measured.

Results and Discussion

Glycerin increased average daily gain when added at levels less than 8% of the dry matter diet. Reductions in dry matter intake were observed when glycerin levels increased above 8%. Feeding glycerin at 2, 4, 8, and 12

[1]Bovishield and Ultrabac are registered trademarks of Pfizer Animal Health.
[2]Revalor is a registered trademark of Intervet, Inc.

% of the diet increased feed efficiency by 10.8, 10.0, 7.2, and 3.1%, respectively. Final body weights increased by 28.0, 17.8, and 11.7 pounds when glycerin was added at 2, 4, and 8% of the diet, respectively, but reductions in final body weight occurred when glycerin was fed at the 12 and 16% levels.

Hot carcass weights increased by 17.8, 11.3, and 7.3 pounds when glycerin was fed at 2, 4, and 8% levels, respectively, but were reduced at levels 12% and greater. *Longissimus* muscle area decreased when glycerin was added to the diet. Feeding glycerin caused reduced subcutaneous fat over the 12th-rib and lower marbling scores. Lower marbling scores resulted in a 1.3 to 16.4% reduction in the percentage of glycerin-fed cattle grading UDSA Choice. The percentage of glycerin-fed cattle grading USDA Select increased between 0 and 14.8%. Treatment had no effect on percentage of kidney, pelvic, and heart fat or the percentage of liver abscesses.

Implications

Adding glycerin at 2 to 8% of the steam-flaked, corn-based finishing diet improved weight gains and efficiency, but higher levels appear detrimental.

Table 1. Experimental Diets and Calculated Dietary Nutrients for Cross-bred Heifers Fed Diets Containing 0, 2, 4, 8, 12, and 16% Crude Glycerin

	% Crude Glycerin, dry matter basis					
Ingredient, %	0	2	4	8	12	16
Steam-flaked corn	82.6	80.2	77.8	73.0	68.2	63.4
Corn steep liquor	5.7	5.7	5.7	5.7	5.7	5.7
Alfalfa hay	5.9	5.9	5.9	5.9	5.9	5.9
Glycerin[1]	0.0	2.0	4.0	8.0	12.0	16.0
Protein/mineral premix[2]	3.6	4.1	4.5	5.2	6.0	6.8
Feed additive premix[3]	2.2	2.2	2.2	2.2	2.2	2.2
Nutrients						
Dry matter, %	81.0	81.2	81.3	81.5	81.7	82.0
CP	14.9	14.9	14.8	14.7	14.6	14.5
Ca	0.7	0.7	0.7	0.7	0.7	0.7
P	0.3	0.3	0.3	0.3	0.3	0.3

[1]Methanol content of glycerin, <0.01%
[2]Formulated to provide 0.1 ppm Co; 10 ppm Cu; 0.6 ppm I; 60 ppm Mn; 0.25 ppm Se; 60 ppm Zn; 1.0% K; 2,640 IU/kg vitamin A.
[3]Feed additive premix was formulated to provide 300 mg monensin, 90 mg tylosin, and 0.5 mg melengestrol acetate per heifer daily using ground corn as the carrier.

Table 2. Feedlot Performance of Heifers Fed 0, 2, 4, 8, 12, 16% Crude Glycerin for Final 85 Days on Feed

	% Crude Glycerin (dry matter basis)							Contrasts		
Item	0	2	4	8	12	16	SEM	Linear	Quadratic	Cubic
Number of heifers	62	62	61	63	63	62	-	-	-	-
Initial weight, lbs	929.6	929.5	929.0	929.8	929.9	929.4	8.95	-	-	-
Final weight[1], lbs	1153	1181	1171	1165	1149	1122	11.4	*	*	-
Dry matter intake, lbs	19.5	19.6	19.1	19.0	18.5	17.2	0.29	*	*	-
Average daily gains, lbs	2.63	2.96	2.85	2.76	2.58	2.26	0.20	*	*	-
Feed:Gain	7.41	6.61	6.67	6.88	7.18	7.61	0.02	-	*	-

[1]Calculated by dividing HCW by a common dressing percentage of 63.5%.
* = P<0.05, † = P<0.10

Table 3. Carcass Characteristics of Heifers Fed 0, 2, 4, 8, 12, or 16% Crude Glycerin

	% Crude Glycerin (Dry matter basis)							Contrasts			
Item	0	2	4	8	12	16	SEM	Linear	Quadratic	Cubic	0 vs Glycerin
Hot carcass weight, lbs	732.2	746.0	743.5	739.5	729.5	712.2	10.24	*	*	-	-
Rib-eye area, in[2]	12.88	13.38	13.02	12.82	12.66	12.62	0.24	*	-	-	-
USDA Yield Grade											
Yield grade 1,%	11.4	16.1	13.2	11.1	12.7	15.9	4.03	-	-	-	-
Yield grade 2,%	32.0	32.8	31.2	33.3	28.6	40.5	6.51	-	-	-	-
Yield grade 3,%	51.9	51.1	47.6	44.5	50.8	42.1	6.6	-	-	-	-
Yield grade 4 & 5,%	4.8	0.0	7.9	11.1	6.4	1.6	2.61	-	†	*	-
Average yield grade	2.5	2.35	2.52	2.55	2.54	2.29	0.09	-	-	*	-
USDA Quality Grade											
Prime, %	3.2	0.0	1.6	0.0	0.0	1.6	1.28	-	-	-	†
Choice, %	53.7	50.3	57.4	42.9	52.4	37.3	6.11	†	-	-	-
Select, %	43.1	46.6	37.8	53.9	46.0	57.9	5.6	†	-	-	-
No Roll, %	0	3.2	3.2	3.2	1.6	3.2	1.7	-	-	-	-
Marbling[1]	435	405	416	398	410	397	9.67	*	-	-	*
Kidney, pelvic, and heart fat, %	2.24	2.21	2.19	2.24	2.2	2.19	0.04	-	-	-	-
12th-rib fat thickness, in	0.48	0.43	0.46	0.46	0.46	0.40	0.02	*	-	*	†
Liver abscess, %	11.1	6.6	17.7	9.5	4.7	17.7	4.11	-	-	-	-

[1]Marbling scores were obtained by a commercial abattoir; Slight =3 00-399, Small = 400-499, Modest = 500-599.
* = P<0.05, † = P<0.10.