EFFECTS OF FEEDING ETHANOL ON PERFORMANCE AND CARCASS TRAITS OF FEEDLOT STEERS

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Story in Brief

Two experiments were conducted to examine the effects of ethanol on performance and carcass characteristics of beef cattle. In the initial study, ethanol was supplemented as 0, (control), 2, 4, or 6% of the diet dry matter. Yearling crossbred steers were limit fed (22 lb/day) a 91 % concentrate ration in two meals daily for a 42 day period. Daily gain, feed efficiency and carcass parameters were not altered by feeding ethanol; however numerically fewer of the ethanol fed cattle exhibited the minimum degree of marbling to attain the U.S. Choice quality grade. A second study was conducted to evaluate whether duration of ethanol feeding affects animal performance and carcass traits. Medium frame, yearling, crossbred steers were fed a high energy ration containing 4% ethanol. Ethanol was supplemented for 0 (control), 17, 24, 38, 66 or 122 days prior to slaughter. Feedlot performance was not altered by ethanol supplementation and cattle receiving ethanol for various time periods had comparable yield grades, marbling scores and liver abscess incidence. In summary, supplementing 4% of the diet with ethanol neither depressed nor augmented feedlot performance or carcass traits.

(Key Words: Steers, Ethanol, Feedlot Performance, Carcass Traits.)

Introduction

The improvement of meat quality is a key issue affecting the beef cattle industry today. As competition for the consumer's food dollar continues to escalate, a priority to those involved in the cattle industry is to identify a "formula" that provides consistent and predictable beef to the meat buyer's plate. The predictability of eating quality is highly dependent on tenderness, for it is this attribute that varies more widely than flavor and juiciness.

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The focus of this research is the application of recent evidence suggesting that alcohol induces several cellular changes to striated muscle in a dose dependent fashion (Rubin, 1979). Most notably, it has been reported that acute alcohol consumption interferes with the proper ionic milieu and association event of contractile proteins during muscle shortening. As first described by Locker and Hagyard (1963), pre-rigor beef muscles that are removed from their skeletal attachments shorten up to 60% of their initial length if cooled at 36^{0} F before entering the rapid phase of rigor onset. The length change associated with pre-rigor beef muscle is accompanied by a several fold toughening (Marsh and Leet, 1966). Therefore by interfering with the complex series of events that initiate muscle shortening, it is conceivable that meat tenderness could be enhanced by feeding ethanol. This study was designed to assess the effects of dietary ethanol on animal performance and carcass characteristics.

Materials and Methods

Trial One

Twenty-four crossbred steers nearing market weight (1040 lb) were individually weighed, identified and randomly assigned to one of four diets for 42 days. One pen (six steers) was fed each diet. Diets consisted of ethanol being supplemented as 0 (control), 2, 4, or 6% of diet dry matter. Ethanol (90% pure) was substituted for molasses on a dry matter basis (Table 1). The ethanol:molasses mixture was prepared at feeding and mixed thoroughly into the feed provided at every meal. Steers were limit fed (22 lb/day) a 91% concentrate ration in two meals daily for the 42 day trial. Initial weights obtained as cattle were unloaded from the truck were considered to be shrunk weights. Gains and feed efficiency were calculated based on shrunk weights (96% of full weight) to account for gut fill. One steer was removed from the 2% ethanol treatment for reasons not associated with dietary treatments. At the conclusion of the feeding trial, cattle were slaughtered at the Oklahoma State University Meat Laboratory. Carcasses were not subjected to electrical stimulation at time of slaughter. Livers were examined for the presence and severity of liver abscesses. Approximately 24 hours postmortem, complete yield and quality grade data (USDA, 1989) were recorded.

Trial Two

One hundred twenty-six yearling crossbred steers were utilized to determine whether the number of days that ethanol is fed affects animal performance and carcass characteristics. Processing consisted of IBR-PI3-Lepto, 4-way clostridial vaccination, deworming with Ivermectin and

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

	Trial 1				Trial 2	
	Ethanol (%)					
Ingredient, %	0	2	4	6	0	4
Corn, rolled	78.65	78.31	77.98	77.65	79.27	75.98
Alfalfa hay, pellet	4.06	4.05	4.03	4.01	4.00	3.83
Cottonseed hulls	5.06	5.04	5.02	5.00	4.98	4.78
Supplement, pellet[a]	7.19	7.16	7.13	7.10	7.47	7.16
Molasses, cane	5.03	3.41	1.80	.20	4.27	4.09
Ethanol	0	2.03	4.04	6.04	0	4.15
Calculated Composition:						
NEm, Mcal/cwt[b]	93.89	95.71	97.52	99.34	93.89	97.07
NEg, Mcal/cwt[b]	59.87	61.24	62.56	64.41	59.87	62.60
Crude protein, %	12.08	11.93	11.77	11.62	12.25	11.72
K, %	0.73	0.66	0.60	0.53	0.70	0.67
Ca, %	0.52	0.50	0.48	0.47	0.55	0.52
P, %	0.33	0.33	0.32	0.32	0.34	0.32

[a] Supplement composition (%): Cottonseed meal, 75.92; calcium carbonate, 12.05; urea, 5.69; salt, 4.23; dicalcium phosphate, 1.18; Rumensin®, 0.27; vitamin E, 0.21; Tylan®, 0.17; vitamin A, 0.15; and trace mineral pre-mix, 0.13.

[b] Assuming ethanol provides 2.41 kcal NEm/lb and 1.79 kcal NEg/lb.

implanting with Compudose-200® at the beginning of the study. Cattle were individually weighed (initial weight = 628 lb) and subdivided into three weight blocks of 42 steers each. Within each weight block, one pen of cattle was assigned at random to one of six treatments for a total of 3 pens (21 steers) per treatment. These treatments consisted of ethanol being fed as 4% of the diet dry matter for 0 (control) 17, 24, 38, 66 and 122 days prior to slaughter. Cattle were given ad libitum access to feed with ethanol and fresh feed added twice daily. Diet compositions are shown in Table 1. Initial shrunk weights were obtained as steers were unloaded off the truck; period weights were taken with

all cattle being full. Gain and feed efficiency were calculated as in the first trial. The cattle were transported to a commercial packing plant for slaughter. Approximately 20 minutes after exsanguination, carcasses were subjected to high voltage electrical stimulation. Quality and yield grade data were obtained 24 hours postmortem.

In the first trial, data were analyzed on a individual animal basis (because only one pen was fed each diet) using a linear model that included the main effect of ethanol. Least square means are reported to account for unequal number of steers between treatments. The data of the second trial were analyzed on a pen basis using a linear model that included the main effects of ethanol and weight block.

Results and Discussion

Two preliminary concerns were the palatability or acceptability of ethanol by cattle and evaporative loss of ethanol from the feed. Prior to starting the trial, test batches of feed were prepared and weighed every five minutes for the first hour, and every hour for a twelve hour period. Because the evaporative loss was the same across dietary treatments, we concluded that our method of ethanol addition was acceptable. Ethanol was not detrimental to ration palatability to limit-fed steers; bunks were empty after each feeding and mean consumption time for all pens ranged from 20 to 40 minutes. Although not experimentally measured, steers receiving ethanol appeared more docile and seemed easier to handle.

Effects of ethanol supplementation on cattle performance are reported in Tables 2 and 3. In trial one, daily gains and feed efficiency were improved

Table 2. Feedlot performance of steers fed ethanol; Trial 1[a].

	Ethanol (%)				
	0	2	4	6	SEM
Number of steers	6	5	6	6	
Initial weight, lb	1031	1050	1047	1049	26.7
Final weight, lb	1139	1176	1179	1199	41.3
Daily gain, lb	2.93[b]	3.61[bc]	3.81[bc]	4.00[c]	0.47
Feed Intake, lb	22.0	22.0	22.0	22.0	
Feed/Gain	8.22[b]	6.53[bc]	5.86[bc]	5.70[c]	1.51

[a] Least squares means.

[bc] Means in a row with different superscript differ (P<0.10).

Table 3. Feedlot performance of steers fed ethanol; Trial 2[a].

	Days fed ethanol						
	0	17	24	38	66	122	SEM
Number of steers	21	21	21	21	21	21	
Live weight, lb							
Initial	628	629	628	630	628	631	1.45
Final	1156	1144	1172	1154	1134	1164	17.8
Daily gain, lb							
Live	3.26	3.17	3.36	3.23	3.12	3.29	0.12
Carcass[b]	3.35	3.21	3.31	3.27	3.20	3.37	0.12
Feed Intake, lb	20.0	19.6	19.9	19.7	19.3	19.0	0.31
Feed/Gain	5.97	6.12	6.03	6.04	6.05	5.68	0.18

[a] Least squares means.
[b] Calculated on a carcass adjusted basis.

when ethanol was substituted for molasses in the diet. Average daily gains (live weight basis) were 36% greater (P<.08) when ethanol comprised 6% of the ration dry matter. In addition, feed/gain also was improved (5.7 vs 8.2) when ethanol was supplemented at the 6% level. However, due to the manner in which ethanol was supplemented for molasses, the ethanol diets contained more metabolizable and net energy. These higher energy levels may account partially for the improvement in feedlot performance. Burroughs et al., (1958) reported that ethanol supplementation improved feedlot performance. In the second study, with growing cattle given ad libitum access to feed, cattle on all treatments performed similarly.

Carcass traits are presented in Tables 4 and 5. Dressing percentage, ribeye area, percentage kidney, heart and pelvic fat, adjusted fat thickness and marbling score were not affected (P>.05) regardless of dietary level or length of ethanol addition. The percentage of carcasses attaining the U.S. Choice quality grade appeared to decrease linearly with increasing ethanol supplementation in the initial study. Although not statistically different, (controls versus 6% ethanol; P>.24), the magnitude of this difference may have a practical significance depending on how the cattle are marketed. In the second study, short term addition of ethanol appeared to increase the number of cattle reaching the Choice quality grade while supplementation past 24 days tended to decrease the percent Choice. Several researchers have suggested that prolonged ethanol ingestion affects lipid deposition and lipid composition. Whether or not intramuscular lipid deposition is influenced by ethanol consumption is currently unknown. Additionally, chronic ethanol consumption

Table 4. Carcass characteristics of steers fed ethanol; Trial 1[a].

	Ethanol (%)				
	0	2	4	6	SEM
Number of steers	6	5	6	6	
Carcass weight, lb	736	760	740	774	24.4
Dressing percent[b]	64.7	64.6	62.7	64.9	1.14
Ribeye area, sq. in.	13.4	13.9	13.0	14.4	0.80
Fat thickness, in.	0.64	0.49	0.69	0.53	0.08
Marbling Score[c]	482	454	468	423	50.8
Choice, %	83.3	80.0	66.7	50.0	21.7
USDA Yield Grade	3.08	2.75	3.37	2.65	0.40
Condemned liver, %	0	0	0	0	

Table 5. Carcass characteristics of steers fed ethanol; Trial 2[a].

	Days fed alcohol						
	0	17	24	38	66	122	SEM
Number of steers	21	21	21	21	21	21	
Carcass Weight, lb	724	711	720	717	708	728	11.21
Dressing percent[b]	62.6	62.2	61.5	62.1	62.4	62.5	0.49
Ribeye area, sq. in.	12.9	12.2	12.8	12.5	12.3	12.8	0.29
Fat thickness, in.	0.40	0.52	0.43	0.41	0.47	0.44	0.05
Marbling Score[c]	430	451	434	399	425	422	23.3
Choice, %	61.9	80.9	66.7	57.1	57.1	57.1	11.8
USDA Yield Grade	2.59	3.02	2.61	2.72	2.86	2.76	0.18
Condemned liver, %	0	0	0	4.8	14.3	4.8	0.21

[a] Least squares means.
[b] Calculated by dividing shrunk final live weight by carcass weight.
[c] 300 to 399 = slight; 400 to 499 = small.

affects liver function which may ultimately result in scar tissue and abscess formation. In these trials, the combination of a high concentrate ration and ethanol did not affect the incidence of liver condemnation at slaughter. The addition of ethanol to beef cattle finishing rations increases the energy content of the diet; however, ethanol had no consistent effect on performance or carcass traits.

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