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Abstract

Distillers grains are a by-product of ethanol production and have become increasingly available in recent years. Some research has revealed negative effects of distillers grains on quality and yield grades. Distillers grains contain substantial amounts of unsaturated fats and therefore could alter the ratios of saturated and unsaturated fats to achieve a more desirable composition in beef. Heterocyclic amines are the carcinogenic compounds released during high-temperature grilling of meat and would be increased if fat composition is changed. Our objectives were to evaluate effects of feeding distillers grains on carcass fatness, fatty acid profiles, and formation of heterocyclic amines.

Keywords

Cattlemen's Day, 2009; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1010; Kansas Agricultural Experiment Station contribution ; no. 09-168-S; Beef; Cattle; Distillers grains

Authors

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Distillers Grains Do Not Change Carcass Composition but Change Some Fatty Acids When Added to Finishing Diet[1]

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Introduction

Distillers grains are a by-product of ethanol production and have become increasingly available in recent years. Some research has revealed negative effects of distillers grains on quality and yield grades. Distillers grains contain substantial amounts of unsaturated fats and therefore could alter the ratios of saturated and unsaturated fats to achieve a more desirable composition in beef. Heterocyclic amines are the carcinogenic compounds released during high-temperature grilling of meat and would be increased if fat composition is changed. Our objectives were to evaluate effects of feeding distillers grains on carcass fatness, fatty acid profiles, and formation of heterocyclic amines.

Experimental Procedures

Crossbred yearling heifers (n = 689) were used in a finishing trial to evaluate the effects of feeding dry-rolled corn (DRC) and dried corn distillers grains with solubles (DDGS) in steam-flaked corn (SFC) diets. Diets consisted of SFC with 0 or 25% DDGS and 0 or 25% DRC (Table 1) in a 2 × 2 factorial arrangement of treatments. Heifers were blocked into light and heavy weight groups according to initial body weight and fed in 28 dirt-surfaced pens with 23 to 25 heifers per pen. Heifers in the heavy and light weight blocks were fed once daily for 137 and 157 days, respectively. Wholesale ribs were collected from one side of four randomly selected cattle in each of 24 pens after a 24-hour chill. Weights of the 9th-10th-11th rib section were taken; then the rib was separated into lean, fat, and bone portions. After the portions were weighed, they were ground twice and frozen with liquid nitrogen. The lean and fat portions were then used to evaluate fatty acid profiles in the triglyceride and phospholipid fractions. Ribeyes collected from the 6th-7th-8th rib section were analyzed for heterocyclic amine concentrations after high-temperature grilling of steaks.

Results and Discussion

We evaluated the actual separated components of the rib section as well as the carcass percentages of various components that were predicted using the regression equations. Overall, carcass fat was approximately 28.5% when averaged across treatments. There were no differences among treatments with respect to percentage of carcass lean, fat, and bone ($P>0.10$; Table 2). We view this as being positive because it indicates that DDGS

[1] This project was funded in part by beef and veal producers and importers through their $1-per-head checkoff and was produced for the Cattlemen's Beef Board and state beef councils by the National Cattlemen's Beef Association.

[2] Dakota Gold Research Association, Sioux Falls, SD

and DRC can substitute for steam-flaked corn with no detrimental effects on carcass composition (Table 3). Fatty acid profiles, expressed as a percentage of total fatty acid content, are shown in Tables 3 and 4. Feeding DRC resulted in small but measureable increases in C12:0 (lauric), C14:0 (myristic), and C21:0 (henicosanoic) and a compensatory decrease in C18:1n9 (oleic) from triglycerides. The magnitude of these changes was relatively modest. The increase in myristic acid (C14:0) generally is not positive because this is one of the key fatty acids associated with plaque formation in atherosclerosis. However, the change was relatively small and was apparent only in fat extracted from the separated lean. Feeding DDGS resulted in a number of changes in the proportions of fatty acids that appeared in the triglycerides extracted from the separated fat and lean portions of the rib. Generally, the C18:1 (oleic) fatty acids decreased in response to feeding DDGS, whereas the proportions of C18:0 (stearic) and C18:2 increased, including the trans-10, cis-12 isomer of conjugated linoleic acid. The proportion of C16:0 (palmitic) in fat extracted from the separated lean fraction also was significantly decreased, which generally is positive. Overall, changes in fatty acid profiles of steaks derived from cattle fed the different diets were, as expected, quite modest. We found no differences in the amount of heterocyclic amines in cooked steaks with addition of DRC or DDGS. This suggests that the industry can feed DDGS or DRC without increasing the amount of carcinogenic compounds that are formed when cooking beef at high temperatures.

Implications

Replacing a portion of steam-flaked corn with either DRC or DDGS resulted in similar carcass composition but some small unfavorable changes in fatty acid profile.

Table 1. Composition of finishing diets containing steam-flaked corn (SFC) with or without dried corn distillers grains with solubles (DDGS) and/or dry-rolled corn (DRC)

	SFC		SFC + 25% DRC	
Ingredient, %	0% DDGS	25% DDGS	0% DDGS	25% DDGS
SFC	82.1	58.2	56.8	33.1
DDGS	–	25.4	–	25.3
DRC	–	–	25.5	25.3
Alfalfa hay	5.9	5.9	5.9	5.8
Corn steep liquor	6.5	6.4	6.4	6.4
Supplement[1,2]	2.8	2.5	2.7	2.5
Limestone	1.5	1.6	1.5	1.6
Urea	1.2	–	1.2	–

[1] Formulated to meet or exceed nutritional requirements and provide 300 mg monensin, 90 mg tylosin, and 0.5 mg melengestrol acetate per animal daily.
[2] Optaflexx was included at 200 mg/animal for the final 42 days on feed.

Table 2. 9th-10th-11th rib separation values, actual and calculated, from cattle fed steam-flaked corn (SFC) diets containing 0 or 25% dry-rolled corn (DRC) and/or 0 or 25% dried distillers grains with solubles (DDGS)

	SFC		SFC + 25% DRC			P-values		
Item	0% DDGS	25% DDGS	0% DDGS	25% DDGS	SEM	DRC	DDGS	DRC*DDGS
Bone, % of dressed carcass	15.3	16.2	15.5	15.5	0.31	0.44	0.11	0.10
Lean, % of dressed carcass	56.1	54.0	55.4	55.6	0.84	0.56	0.23	0.18
Fat, % of dressed carcass	28.4	28.7	28.5	28.4	1.06	0.96	0.92	0.82
Lean , % of edible portion[1]	62.6	61.1	62.0	62.2	1.40	0.85	0.64	0.56
Fat, % of edible portion[1]	37.4	38.9	38.0	37.8	1.40	0.85	0.64	0.56

[1] Edible portion is the sum of lean and adipose tissues.

Table 3. Fatty acid profile of phospholipids extracted from the separated lean portion of the 9th-10th-11th rib section, reported as percentage of total fatty acids from phospholipids in sample

	SFC[1]		SFC + 25% DRC[1]			P-values		
Fatty acid[2]	0% DDGS	25% DDGS	0% DDGS	25% DDGS	SEM	DRC	DDGS	DRC*DDGS
Total phospholipids in sample	0.074	0.075	0.073	0.072	0.004	0.58	0.95	0.71
C14:0	0.27	0.36	0.35	0.35	0.04	0.38	0.29	0.32
C16:0	9.81	10.07	9.57	10.56	0.44	0.76	0.15	0.40
C18:0	12.60	13.17	13.03	13.21	0.24	0.31	0.11	0.40
C18:1n9c	12.59	10.35	12.52	10.63	0.63	0.86	0.01	0.78
C18:2n6c	21.37	23.71	20.75	24.06	0.78	0.86	0.01	0.53
C18:3n3	0.48	0.37	0.49	0.40	0.04	0.54	0.01	0.83
C20:3n6	3.46	3.17	3.40	3.24	0.10	0.93	0.02	0.52
C20:4n6	16.02	15.35	16.58	16.06	0.67	0.33	0.36	0.90
C20:5n3	1.48	1.41	1.63	1.27	0.12	0.97	0.09	0.23
C22:5n3	4.46	3.93	4.44	3.76	0.24	0.69	0.01	0.75
C22:6n3	0.58	0.57	0.68	0.50	0.05	0.82	0.06	0.09

1 SFC = Steam-flaked corn; DRC = dry-rolled corn; DDGS = Dried corn distillers grains with solubles.
2 Fatty acids are represented as number of carbon atoms:number of carbon double bonds. The "n" in fatty acid notation followed by a number denotes the location of the first C=C double bond, counting from the methyl end of the chain. The notations "c" and "t" characterize the double bond as cis or trans isomeric forms.

Table 4. Fatty acid concentrations of triglycerides extracted from separated lean portion of the 9th-10th-11th rib section, reported as percentage of total fatty acids from triglyceride in sample

	SFC[1]		SFC + 25% DRC[1]			P-values		
Fatty acid[2]	0% DDGS	25% DDGS	0% DDGS	25% DDGS	SEM	DRC	DDGS	DRC*DDGS
Total triglycerides in sample	8.33	8.02	7.95	8.07	0.60	0.79	0.88	0.72
C14:0	3.66	3.64	3.92	4.00	0.10	0.01	0.76	0.60
C16:0	3.78	3.38	3.75	3.59	0.10	0.38	0.01	0.23
C18:0	15.53	16.72	15.79	16.33	0.36	0.85	0.01	0.34
C18:1n9c	39.20	38.23	38.26	37.37	0.46	0.04	0.04	0.93
C18:2n6c	2.58	3.37	2.69	3.42	0.18	0.64	<0.0001	0.88
C18:3n3	0.19	0.21	0.20	0.22	0.007	0.21	0.01	0.77
C20:3n6	0.054	0.061	0.056	0.061	0.0041	0.82	0.14	0.71
C20:4n6	0.034	0.040	0.033	0.043	0.0049	0.85	0.09	0.65
C20:5n3	0.0009	0.0043	0.0005	0.0023	0.00204	0.54	0.19	0.69
C22:5n3	0.0217	0.0228	0.0246	0.0241	0.0019	0.24	0.84	0.66
C22:6n3	0.00003	0.00159	0	0.00088	0.00065	0.55	0.05	0.58

1 SFC = Steam-flaked corn; DRC = dry-rolled corn; DDGS = Dried corn distillers grains with solubles.
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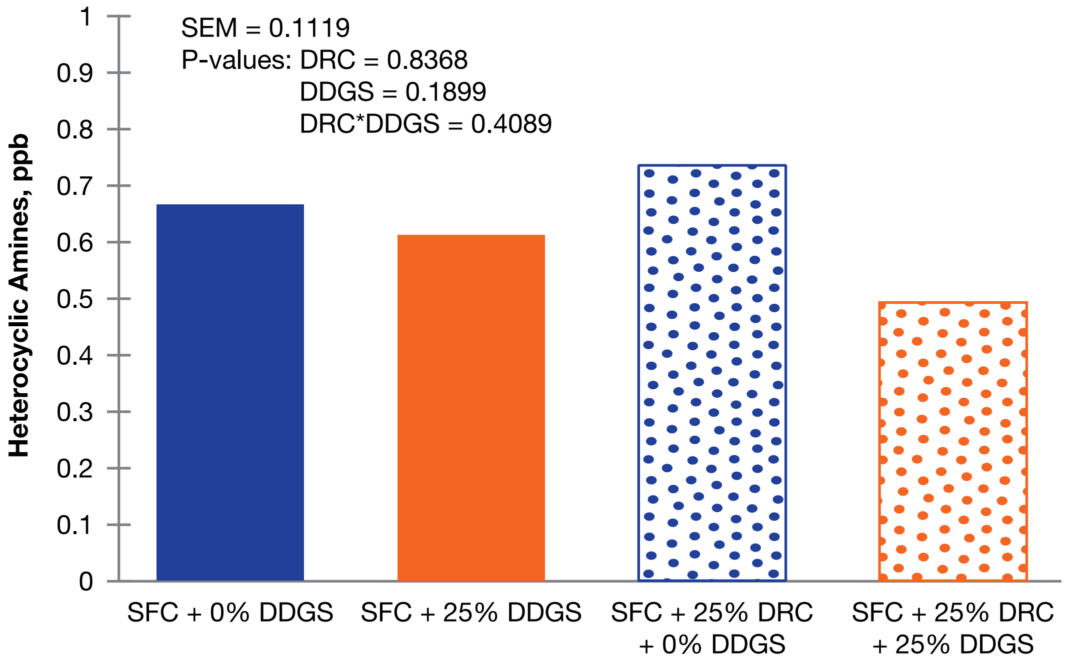

Figure 1. Concentrations of heterocyclic amines in steaks derived from cattle fed steam-flaked corn (SFC) diets containing 0 or 25% dry-rolled corn (DRC) and/or 0 or 25% dried distillers grains with solubles (DDGS).