Wet Distillers Grains Plus Solubles Do Not Increase Liver-like Off-Flavors in Cooked Beef.

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Summary

Crossbred steers fed with varying levels of wet distillers grains to test the incidence of liver-like off-flavors. USDA Choice steaks, when compared to USDA Select, had significantly higher trained sensory muscle fiber tenderness scores, less detectable connective tissue, higher juiciness scores, and more intense off-flavor ratings. USDA Choice steaks had a higher percentage of panelists denote liver-like and metallic off-flavors. Wet distillers grains did not significantly influence off-flavor indicating these by-products can be used to finish cattle without causing detrimental effects on the sensory profile.

Introduction

Recently, purveyors, retailers, and consumers have reported a liver-like off-flavor in beef cuts. Previous research indicates cuts cooked to higher degree of doneness, cuts with higher levels of myoglobin, and cuts with greater degrees of lipid oxidation typically express a liver-like off-flavor. More specifically, recent research has identified thirteen compounds that were higher in samples with liver-like off-flavor when compared to samples without liver-like flavors. Of these by-products, six were aldehydes formed from the oxidation of oleic and linoleic acid.

Distillers grains supplementation increases unsaturated fat content of the diet which may subsequently escape rumen biohydrogenation and become incorporated into the phospholipid fraction of muscle tissue, thus increasing the possibilities of lipid oxidation and subsequent off-flavors. Our objectives were to determine if feeding wet distillers grains plus solubles (WDGS) increases liver-like off-flavors in beef, and to determine the sensory attributes of cattle finished with WDGS.

Procedure

Two hundred eighty-eight crossbred yearling steers were randomly assigned to a dietary treatment containing 0, 10, 20, 30, 40, and 50% (DM basis) WDGS, where WDGS replaced a high-moisture/dry-rolled corn mixture (1:1 DM basis). Steers were implanted on day 28 with Revalor-S7, fed for 125 days and harvested at a commercial processing facility. At harvest, university personnel randomly selected 15 Choice and 15 Select carcasses from each treatment group (n=180). Carcass data (hot carcass weight, fat thickness, and ribeye area) were collected by university personnel while USDA marbling score and yield grade were determined by a USDA grader. Following grading, the knuckles (IMPS #167) (n=180) were removed from the carcasses, vacuum-packaged, and shipped to the Loeffel Meat Laboratory at the University of Nebraska.

Following a total aging period of 7 days at 34°F , the *M. rectus femoris* (knuckle centers) were isolated and cut into 1-inch steaks, freezer wrapped, and frozen (3°F) until sensory analysis was conducted. Steaks were allowed to thaw in a cooler at 34°F for 1 day prior to cooking for sensory evaluation.

Sensory Evaluation

Steaks were cooked to an internal temperature of 158°F on an electric broiler. Internal temperature was monitored with a digital thermometer with a type T thermocouple. When the internal temperature reached 95°F, the steak was turned once until the final temperature was reached. The steak was cut into 0.5 x 0.5 x 1- inch cubes and served warm to the panelists, approximately five minutes post cooking.

In order to prevent bias, panelists were seated in individual booths equipped with red fluorescent lights and partitioned to reduce collaboration between panelists and eliminate visual differences. Each panelist was served distilled water and unsalted, saltine crackers and given three minutes between samples to cleanse their palates. Six samples, identified using three-digit codes, were served on each day. Eight-point descriptive attribute scales (Muscle fiber tenderness: 1=extremely tough, 8=extremely tender; Connective tissue: 1=abundant, 8=none; Juiciness: 1=extremely dry, 8=extremely juicy; Off-flavor intensity: 1=extreme off-flavor, 8=no off-flavor) were used. Panelists were trained to identify the specific off-flavors (liver-like, metallic, sour, charred, oxidized, rancid, or other) contributing to the off-flavor score for the steak.

Statistical Analysis

Data were analyzed as a randomized complete block design by analysis of variance (ANOVA) using the MIXED procedure of SAS with a predetermined significance level of $P \leq 0.05$. Carcass served as the experimental unit and was considered a random effect. Main effects of treatment, grade, and their two-way interaction were included in the model. Since the treatment x grade interaction was not significant for any attribute, least square means were not reported. The Kenward-Roger option was used to determine denominator degrees of freedom. When significance was indicated by ANOVA, means separations were performed using the LSMEANS and PDIFF function of SAS.

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Results

Carcass Data

For this experiment, a subset of 180 animals was used. Treatment had an effect on hot carcass weight and USDA yield grade ($P = 0.0001$ and 0.036, respectively). Cattle finished on the 0%, 10%, and 50% diets had similar hot carcass weights, which were lighter than those from cattle fed 20%, 30%, and 40% diets (Table 1). Adjusted fat thickness, ribeye area, and USDA marbling score were not ($P = 0.37$, 0.08, and 0.31, respectively) different in the present study. Distillers grains have higher fat content than corn, which may contribute to higher yield grades.

Grade effects for hot carcass weight ($P = 0.72$), adjusted fat thickness ($P = 0.24$), ribeye area ($P = 0.95$) and USDA yield grade ($P = 0.10$) were not significant, but USDA marbling score, as expected, was highly significant ($P = 0.0001$).

Treatment had no effect on the sensory attributes muscle fiber tenderness, connective tissue amount, juiciness, and off-flavor intensity (Table 1). USDA Choice steaks were more tender, had lower amounts of detectable connective tissue, were juicer, and had a greater off-flavor intensity when compared to Select steaks.

Treatment did not significantly influence off-flavor intensity (Table 2), although the frequency of liver-like off-flavor notes was approaching significance ($P = 0.07$). The liver-like off-flavor occurred most frequently in the 0% and 10% WDGS diets (14.44 and 19.63, respectively) while steaks from animals fed the 30% and 50% WDGS diet had the lowest incidence of liver-like off-flavor (7.41 and 8.52, respectively). Liver-like and metallic off-flavors were more frequent in Select carcasses ($P = 0.02$ and $P = 0.0002$, respectively). Although oxidative rancidity was not measured in our study, we hypothesize that the

Table 1. Least squares means for main effects for hot carcass weight, adjusted fat thickness, yield grade, and marbling score for sub sampled carcasses.

Effect	Hot Carcass Weight,lb	Adjusted Fat Thickness,in	Ribeye Area,in^2	USDA Yield Grade	USDA Marbling Score[a]
Treatment[b]					
0	784[c]	0.44	12.8	2.4[c]	503
10	806[cd]	0.52	12.7	2.7[d]	521
20	817[de]	0.50	12.7	2.7[d]	494
30	832[e]	0.48	12.7	2.7[d]	508
40	839[e]	0.47	12.1	2.9[d]	504
50	794[cd]	0.49	12.2	2.7[d]	503
SEM[f]	8.65	0.02	0.2	0.11	8.10
P-value	0.0001	0.37	0.08	0.036	0.31
Quality Grade					
Choice	813	0.50	12.5	2.76	564[d]
Select	811	0.47	12.5	2.61	465[c]
SEM[f]	5.00	0.01	0.1	0.06	4.68
P-value	0.72	0.24	0.95	0.10	0.0001

[a]400= Slight^{00} and 500= Small^{00}.
[b]Treatments: Percentage of wet distillers grains plus solubles included in diet.
[cde]Mean values within a column and followed by the same letter are not significantly different ($P>0.05$).
[f] Standard error of the mean.

Table 2. Least squares means for main effects for muscle fiber tenderness, connective tissue amount, juiciness, and off-flavor intensity.

Effect	Muscle Fiber Tenderness[a]	Connective Tissue Amount[b]	Juiciness[c]	Off-Flavor Intensity[d]
Treatment[e]				
0	5.80	4.86	5.18	5.72
10	5.62	4.73	5.04	5.49
20	5.82	4.91	5.24	5.69
30	5.51	4.65	4.90	5.74
40	5.53	4.67	4.96	5.54
50	5.60	4.73	5.05	5.73
SEM[f]	0.13	0.14	0.13	0.11
P-value	0.37	0.72	0.46	0.47
Quality Grade				
Choice	5.90[h]	5.01[h]	5.24[h]	5.51[g]
Select	5.39[g]	4.51[g]	4.87[g]	5.80[h]
SEM[f]	0.07	0.08	0.08	0.07
P-value	0.0001	0.0001	0.0009	0.0020

[a]Muscle fiber tenderness: 1= Extremely Tough; 8= Extremely Tender.
[b]Connective tissue amount: 1= Abundant Amount; 8=No Connective Tissue.
[C]Juiciness: 1= Extremely Dry; 8= Extremely Juicy.
[d]Off-flavor intensity: 1=Extreme Off-Flavor; 8= No Off-Flavor.
[e]Treatments: Percentage of wet distillers grains plus solubles included in diet.
[f]Standard error of the mean.
[gh]Mean values within a column and followed by the same letter are not significantly different ($P>0.05$).

Table 3. Least squares means for main effects for livery-like, metallic, sour, oxidized, rancid, and other off-flavors.

Effect	Liver-like[a]	Metallic[a]	Sour[a]	Charred[a]	Oxidized[a]	Rancid[a]	Other[a]
Treatment[b]							
0	14.44	34.07	48.89	7.41	10.37	12.22	2.96
10	19.63	27.41	50.37	8.52	11.85	8.52	0.74
20	11.85	31.85	50.74	5.56	18.52	11.11	3.33
30	7.41	31.85	55.19	4.44	11.48	10.74	3.33
40	12.22	34.81	49.63	8.89	16.67	11.11	2.59
50	8.52	36.30	50.37	5.56	10.37	11.36	4.82
SEM[c]	0.03	0.04	0.03	0.02	0.03	0.02	0.01
P-value	0.07	0.73	0.82	0.37	0.21	0.75	0.10
QG[d]							
Choice	15.19[f]	39.26[f]	51.48	7.78	11.98	11.36	3.58
Select	9.51[e]	26.17[e]	50.25	5.68	14.44	9.38	2.35
SEM[c]	0.02	0.02	0.02	0.01	0.02	0.01	0.01
P-value	0.02	0.0002	0.65	0.14	0.30	0.24	0.12

[a]Off-flavors are expressed as a percentage of panelists that identified the off-flavor.
[b]Treatments: Percentage of wet distillers grains plus solubles included in diet.
[c]Standard error of the mean.
[d]Quality grade.
[ef]Mean values within a column and followed by the same letter are not significantly different ($P>0.05$).

increase in off-flavor intensity, liver-like, and metallic off-flavors may be due to lipid oxidation. A greater percentage of panelists detected the liver-like off-flavor (15.19 vs. 9.51) and the metallic off-flavor (39.26 vs. 26.17) in USDA Choice steaks when compared to USDA Select steaks. All other off-flavor notes were not significant in terms of quality grade.

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