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Summary

A total of 128 steers were fed one of two finishing diets: 50% de-oiled dry distillers grains plus solubles (DDGS) or a corn-based control diet. Carcasses (n = 48) were selected to evaluate the effect of diet on the fatty acid profile of strip loin steaks. The C15:0, C16:1, C17:0, and C17:1 were greater for beef from steers finished on the corn-based control diet while the C18:1T, C18:2, C20:3ω6, total trans, ω6 and polyunsaturated fatty acids (PUFA) were greater in beef from cattle finished on 50% de-oiled DDGS. These findings confirm that feeding distillers grains plus solubles (be it wet or dry) increases the amount of PUFA's in meat.

Introduction

The constant evolution of the ethanol industry to maximize by-products results in numerous modified versions of distillers grains available for cattle that merit evaluation in terms of cattle performance and meat quality. Recently, ethanol plants have been extracting soluble fats found in distillers grains by centrifugation for other uses (2011 *Nebraska Beef Cattle Report*, pp. 96–99). Previous research evaluated the impact of feeding de-oiled wet distillers grains plus solubles (WDGS) vs. full-fat WDGS or a corn-based control diet and have determined that the reduction in soluble fat of the feed decreases the total polyunsaturated fatty acid content of beef compared to the full-fat WDGS (2014 *Nebraska Beef Cattle Report*, pp. 116–118). The objective of this study is to determine if there are any meaningful changes in beef fatty acid profiles associated with feeding de-oiled dry distillers grains compared to a corn-based control diet.

Procedure

A total of 128 crossbred steers were fed one of two dietary treatments with eight replications per treatment. Steers were sorted based on initial body weight and grouped eight to a pen. Steers received an initial implant with Ralgro® followed by a Revalor®200 implant. All diets were formulated on a dry matter basis using high-moisture corn (31.5%), alfalfa hay (5.5%), corn silage (4%), molasses (5%), and supplement (5%) containing Rumensin® (30 g/ton) and Tylan® (90 mg/steer/day). Feeding treatments were 50% dry-rolled corn or 50% de-oiled dry distillers grains plus solubles (DDGS; DM basis). After harvest, 24 USDA low Choice carcasses were selected within each treatment (n = 48) and strip loins were obtained. Vacuum sealed loins were transported on the day of collection (2 day post-mortem) to the Loeffel Meat Laboratory where ½-inch steaks were fabricated, immediately vacuum packed, and stored in an ultralow-freezer (−112°F) for fatty acid determination and proximate analysis.

Fatty acid profile

Frozen samples were diced into small pieces, with no subcutaneous fat, and flash frozen in liquid nitrogen. The frozen pieces were powdered in a metal cup blender and 1 g of powdered sample was weighed out to conduct fatty acid determination by gas chromatography. The chromatography was done using a Chromopack CP-Sil (0.25 mm × 100 m) column with an injector temperature of 518°F and a detector temperature of 572°F. The head pressure was set at 40 psi with a flow rate of 1.0 ml/min and a temperature programing system was used. The fatty acids were identified by their retention times in relation to known standards and the percent of fatty acid was determined by the peak area under the curve in the chromatograph.

Proximate analysis

Fat was extracted with ether following the Soxhlet extraction procedure. Moisture and ash were determined by using the LECO thermogravimetric analyzer. Fat, moisture and ash percentages were added and subtracted from 100% to determine the amount of protein by difference. Fat content determined with proximate analysis was used to convert fatty acid composition from a percentage basis to mg/100 g tissue for each individual sample.

Statistical analysis

Data were analyzed using the PROC GLIMMIX procedure in SAS (SAS Inst., Inc., Cary, N.C.) where the effect of dietary treatment was evaluated and mean separation was done with the LSMEANS statement with the LINES option and TUKEY adjustment with an alpha level of 0.05. Tendencies were considered with an alpha of 0.10.

Results

The proximate analysis data (not shown) reflected that there were no differences in moisture ($P = 0.78$), fat ($P = 0.34$), protein ($P = 0.10$), or ash ($P = 0.27$) content in the beef from the two dietary treatments. The overall averages for the nutritional constituents were: 72.08% moisture, 7.31% fat, 19.31% protein, and 1.31% ash.

Table 1 provides the fatty acid profiles of each dietary treatment. Differences ($P < 0.05$) were found in the C15:0, C16:1, C17:0, C17:1, C18:1T, C18:2, C20:3ω6, as well as total trans, ω6, and polyunsaturated fatty acids (PUFA).

No differences were seen in the amounts of monounsaturated fatty acids (MUFA), saturated fatty acids (SFA), unsaturated fatty acids (UFA), SFA:UFA relation, ω3, ω6:ω3 relation, or the total amount of fatty acids.

The shorter carbon chain fatty acids (C15:0, C16:1, C17:0, and C17:1) were

Table 1. Fatty acid[a] composition of beef from cattle finished on de-oiled DDGS vs. a corn-based control diet (L. dorsi)

Fatty acid	De-oiled DDGS	Corn Control	*SEM*	*P*-value
C4:0	4.59	25.41	20.78	0.3551
C10:0	5.53	4.79	0.73	0.3273
C12:0	5.28	4.93	0.69	0.6221
C14:0	179.94	187.25	12.93	0.5751
C14:1	45.24	46.01	3.84	0.8425
C15:0	30.58[c]	37.68[b]	2.48	0.0066
C15:1	37.96	38.55	2.31	0.8006
C16:0	1736.43	1841.70	103.22	0.3139
C16:1T	22.54	22.87	1.86	0.8574
C16:1	175.89[c]	216.31[b]	13.01	0.0035
C17:0	83.12[c]	116.92[b]	8.36	0.0002
C17:1	56.57[c]	90.51[b]	5.47	< 0.0001
C18:0	1044.80	1033.62	72.97	0.8790
C18:1T	191.80[b]	128.91[c]	18.03	0.0012
C18:1	2647.65	2920.66	145.55	0.0680
C18:1V	514.33	452.46	38.91	0.1197
C18:2TT	12.28	11.56	3.6962	0.8488
C19:0	9.08	9.12	1.2582	0.9730
C18:2	389.39[b]	194.79[c]	14.74	< 0.0001
C18:3ω6	7.87	6.31	0.75	0.0538
C18:3ω3	30.75	26.12	4.23	0.2811
C20:1	15.09	17.48	3.71	0.5273
C20:3ω6	18.77[b]	15.48[c]	1.14	0.0064
C20:4ω6	55.15	50.76	3.62	0.2317
C22:4	10.86	11.17	0.82	0.7067
C22:5	9.84	10.79	1.11	0.4055
Total	**7281.87**	**7461.55**	**358.63**	**0.6191**
Other	66.04	67.03	6.36	0.8768
SFA	3081.63	3231.64	185.24	0.4228
UFA	4200.25	4229.91	192.46	0.8783
SFA:UFA	0.73	0.76	0.03	0.2282
MUFA	3676.23	3904.54	178.11	0.2073
PUFA	509.37[b]	304.57[c]	21.49	< 0.0001
Trans	210.13[b]	152.86[c]	20.26	0.0073
ω6	77.07[b]	67.70[c]	4.59	0.0480
ω3	30.75	26.12	4.23	0.2811
ω6:ω3	3.00	3.97	0.82	0.2431

[a]Amount (mg/100g tissue) of fatty acid in powdered loin sample determined by gas chromatography
[bc]Means in the same row with different superscripts are different ($P < 0.05$)

found to be greater for beef from steers finished on the corn-based control diet in comparison to those finished with 50% de-oiled DDGS. A previous study evaluating de-oiled wet distillers grains plus solubles (WDGS) vs. a corn-based control diet also observed greater C16:1 content in the corn-based control diet; however, no differences in C15:0, C17:0, and C 17:1 had been noted due to the feeding of de-oiled WDGS.

Longer chain fatty acids on the other hand (C18:1T, C18:2, C20:3ω6), were found to be in greater amounts in beef from cattle finished on 50% de-oiled DDGS. The most notable difference was seen with C18:2 where beef from cattle finished on 50% de-oiled DDGS had double the amount of C18:2 than the cattle on the control diet (389.39 mg/100 g tissue vs. 194.79 mg/100 g tissue, respectively). The increase in C18:1T and C18:2 had also been reported previously with finishing diets containing 50 and 65% de-oiled WDGS.

Additionally, beef from cattle finished with de-oiled DDGS also presented greater total trans (210.13 mg/100 g tissue vs. 152.86 mg/100 g tissue), ω6 (77.07 mg/100 g tissue vs. 67.70 mg/100 g tissue) and PUFA (509.37 mg/100 g tissue vs. 304.57 mg/100 g tissue) content in comparison to the control diet.

Although not statistically significant, C18:1 tended ($P = 0.0680$) to be greater for the control fed cattle (2920.66 mg/100g tissue vs. 2647.65 mg/100 g tissue) while C18:3ω6 tended ($P = 0.0538$) to be greater for the cattle finished on DDGS (7.87 mg/100 g tissue vs. 6.31 mg/100 g tissue).

These findings confirm that feeding distillers grains plus solubles, be it wet or dry, increase the amount of PUFA's in meat. Even considering the fact that de-oiled distillers grains are effective at reducing the PUFA content of muscle in relation or full-fat distillers grains, the increase in PUFA content associated with the use of distillers grains supports the use of pre or post-mortem antioxidants to counteract potential detrimental effects of lipid oxidation on beef shelf-life.

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