Grass Type, Grazing Supplementation, and Finishing Diets Affect Beef Fatty Acids

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Summary

Crossbred steers (n = 64) were grazed on warm- or cool-season grasses, without or with energy supplementation of wet distillers grains with solubles (WDGS), and were finished on a corn-based diet with or without 35% WDGS. Grass type was the major contributor in determining the fatty acid profile, especially in the neutral lipid layer. Warm-season grasses decreased concentrations of most fatty acids compared to cool-season grasses. The provision of WDGS as an energy supplement while grazing dissipated any differences caused by grass type.

Introduction

The diet of beef cattle has a large effect on the fatty acid (FA) profile of beef. Due to the use of corn for ethanol production, finishing cattle on wet distillers grains with solubles (WDGS), a byproduct of ethanol production, has increased in use. Several studies have shown that finishing cattle on WDGS drastically increases the content of polyunsaturated FA (PUFA) when compared to an all-corn finishing diet (*2011 Nebraska Beef Report*, pp. 96-99 and *2009 Nebraska Beef Report*, pp. 110-111).

Type of grass grazed also can have an effect on ultimate FA profiles. Jenschke et al. (*Journal of Animal Science*, 2008, 86:949-959) grazed cattle on different types of forages and found the FA profile to be drastically different. In addition, providing supplementation while grazing also has been found to cause changes in FA profiles (*Animal Industry Report*, 2011, 657:16; *Journal of Animal Science*, 1997, 75:910-919). Little research has been conducted examining the effects on diet from weaning to finish on the FA profile. The objective of this study was to investigate how fatty acids are affected in two different muscles from cattle fed two types of forages post-weaning, with or without supplemental energy, and finished on either a corn or WDGS diet.

Procedure

Crossbred steers (n = 64) were allowed to graze from April 17, 2012, until Oct. 10, 2012, (177 days) on warm-season grasses at the Barta Brothers Ranch in the Eastern Sandhills of Nebraska or on cool-season pastures near Ithaca, Neb., without or with energy supplementation of wet distillers grains with solubles WDGS (0.6% BW/ day). After the grazing period, cattle were finished on a corn-based diet with or without 35% WDGS for 119 days to an average live weight of 1,427 lb. Cattle were harvested at Greater Omaha Packing Co. in Omaha, Neb.

Six carcasses from each treatment (n = 48) that graded USDA Choice or Select were identified and *Longissimus dorsi (L. dorsi)* and *Biceps femoris* (*B. femoris*) muscles from each side of each carcass were collected and aged under vacuum for seven days. After aging, one steak was cut from each muscle and analyzed for fatty acids in the neutral and phospholipid layers.

Steaks were cut into cubes, flash frozen using liquid nitrogen, and powdered in a grinder to create a homogenous sample. Powdered meat samples were then analyzed for fatty acid analysis. Lipid layers were separated using thin layer chromatography. The neutral and phospholipid layers were identified, isolated, and the fatty acids were extracted. Gas chromatography was used to determine the fatty acid profile in each lipid layer. A Chrompack CP-Sil 88 (0.25 mm x 100 m) was used. Injector temperature was set at 518°F and the detector temperature was set at 572°F. The carrier gas was Helium with a flow rate of 1.1 mL/min.

Data were analyzed using the Mixed procedure in SAS (SAS Institute, Inc., Cary, N.C.) with differences determined at $P \leq 0.05$. Whenever there was a three- or four-way interaction, the LSmeans were reanalyzed using the GLIMMIX procedure with the slicediff option in order to more accurately study differences.

Results

In the neutral lipid layer of *L. dorsi* steaks, warm-season grass grazing without supplementation lowered total unsaturated FA(UFA) and total monounsaturated FA (MUFA) concentrations ($P = 0.04$) compared to cool-season grasses (Table 1). When supplementation was provided, there were no differences in UFA or MUFA between grass types. Within warm-season grasses, providing supplementation caused higher concentrations of total UFA and MUFA than when supplementation was not provided. A higher level of UFA and MUFA could lead to increased oxidation and decreased shelf-life. Clearly, warm-season grasses caused a shift to occur in FA profiles that can be altered by supplementation with WDGS.

For total PUFA, grazing warm-season grasses lowered concentrations ($P = 0.006$) compared to cool-season grasses while finishing on WDGS caused higher concentrations of PUFA ($P = 0.002$) compared to diets without WDGS (Table 2). It is well known that WDGS causes increased concentrations of total PUFA due to the composition of the grains. Increased concentrations of PUFA are also commonly associated with changes in oxidation, discoloration, and flavor.

Table 1. The effects of the interaction between grass type and supplementation on the LS means of fatty acids in the neutral lipid layers in *L. dorsi* steaks.

	Warm-Season Grass		Cool-Season Grass			
	No Supplementation	Supplementation	No Supplementation	Supplementation	SEM	*P*-value
Neutral Lipids, mg/100 g of meat						
Total SFA[1]	854.90	1250.75	1304.72	1281.18	138.88	0.13
Total UFA	1045.30[b]	1584.17[a]	1607.48[a]	1489.49[a]	159.18	0.04
Total MUFA	1013.53[b]	1531.32[a]	1545.75[a]	1428.78[ab]	153.35	0.04
Total PUFA	31.78	52.85	61.73	60.71	6.73	0.10

[1]SFA = saturated fatty acids, UFA = unsaturated fatty acids, MUFA = monounsaturated fatty acids, and PUFA = polyunsaturated fatty acids.
[ab]Means within the same row with different superscripts are different ($P \leq 0.05$).

Table 2. The effect of grass type and finishing diet on the LS means scores of fatty acids in the neutral and phospholipid layers of *L. dorsi* and *B. femoris* steaks.

	Grass Type				Finishing Diet			
	Warm-Season	Cool-Season	SEM	*P*-value	Corn	WDGS[1]	SEM	*P*-value
L. dorsi Neutral Lipids, mg/100 g of meat								
Total SFA[2]	1052.82	1292.95	95.95	0.08	1141.14	1204.63	95.95	0.64
Total UFA	1314.74	1548.48	109.97	0.14	1389.51	1473.72	109.97	0.59
Total MUFA	1272.43	1487.27	105.95	0.15	1348.84	1410.85	105.95	0.68
Total PUFA	42.31[b]	61.22[a]	4.65	0.006	40.67[b]	62.86[a]	4.65	0.002
L. dorsi Phospholipids, mg/100 g of meat								
Total SFA	308.84	348.42	24.85	0.26	336.44	320.82	24.85	0.66
Total UFA	551.33	614.09	38.12	0.25	584.18	581.24	38.12	0.96
Total MUFA	202.20	215.91	19.41	0.62	229.80	188.32	19.41	0.13
Total PUFA	349.13	398.18	22.76	0.13	354.38	392.93	22.76	0.23
B. femoris Neutral Lipids, mg/100 g of meat								
Total SFA	1089.11	1047.88	63.00	0.65	1126.86	1010.13	63.00	0.20
Total UFA	1587.68	1486.36	87.15	0.42	1602.98	1471.07	87.15	0.29
Total MUFA	1540.56	1433.86	84.17	0.38	1557.17	1417.24	84.17	0.25
Total PUFA	47.13	52.50	3.64	0.30	45.81	53.82	3.64	0.62
B. femoris Phospholipids, mg/100 g of meat								
Total SFA	324.44	340.03	15.03	0.47	332.94	331.53	15.03	0.95
Total UFA	630.04	664.00	30.14	0.43	644.39	649.65	30.14	0.90
Total MUFA	208.51	209.69	13.40	0.95	233.07[a]	185.12[b]	13.40	0.02
Total PUFA	421.53	454.32	21.62	0.29	411.31	464.54	21.62	0.09

[1]WDGS = Wet distillers grains with solubles.
[2]SFA = saturated fatty acids, UFA = unsaturated fatty acids, MUFA = monounsaturated fatty acids, and PUFA = polyunsaturated fatty acids.
[ab]Means within the same treatment and the same row with different superscripts are different ($P \leq 0.05$)

The FA profile of the phospholipid layer was unaffected by diet. The lack of differences could be due to the fact that phospholipids have a faster turnover rate than the neutral lipid layer. Since the phospholipids have a faster turnover rate, any changes in composition due to diet, especially grass type and supplementation, which were fed at a young age, could have been negated by the end of the finishing period.

The fatty acids in the neutral lipids layer of *B. femoris* steaks were affected by a three-way interaction between grass-type, supplementation, and finishing diet (Table 3). Grazing on warm-season grasses without supplementation and finishing on corn without WDGS decreased concentrations ($P \leq 0.03$) of total saturated FA (SFA), total UFA, and total MUFA compared to not supplementing and finishing on WDGS. When supplementation was provided, there were no differences in concentrations of total SFA, total UFA, or total MUFA among finishing diets. The lack of differences could be because WDGS were used for supplementation.

In contrast, when cattle were grazed on cool-season grasses there were no differences in concentrations of total SFA, total UFA, or total MUFA regardless of supplementation or finishing diet. The differences in FA composition when cattle are grazed on warm-season grasses compared to the lack of differences seen with cool-season grass grazing indicates that grass type causes the FA changes. The amount of time the cattle were in the finishing lot was not enough to overcome the effects of the grass type, but supplementing while grazing helped to prevent the change in FA composition of the phospholipid layer due to grass type.

Similar to *L. dorsi* steaks, few dietary components had an effect on FA in the phospholipid layer. Finishing diet had the greatest effect with an all-corn diet causing an increased ($P \leq 0.02$) concentration of

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total MUFA over finishing on WDGS. There was also a tendency ($P = 0.09$) for WDGS to cause higher concentration of total PUFA compared to finishing on corn (464.54 vs. 411.31).

In conclusion, FA in neutral lipids are more easily altered by diet than those in the phospholipid layer. Grass type had the biggest effect on the fatty acid profile with warm-season grasses causing decreased concentrations in a majority of the FA, especially in the neutral lipid layer. Even though grass type had such a major effect, the provision of WDGS as a supplemental energy source was able to minimize, if not deter, a majority of the changes. This would mean that if a producer concerned about the effect of grass type on their cattle, they could provide an energy supplementation to their cattle and effectively negate any effects.

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Table 3. The effect of grass type, supplementation, and finishing diet on the LS means of fatty acid concentrations in the neutral lipid layer when separated by grass type for *B. femoris* steaks

	No Supplementation		Supplementation			
	Corn	WDGS[1]	Corn	WDGS	SEM	*P*-value
Warm-season Grass, mg/100 g of meat						
Total SFA[2]	1375.10[a]	857.17[b]	1026.02[ab]	1098.15[ab]	125.99	0.02
Total UFA	1952.46[a]	1330.93[b]	1496.66[ab]	1570.67[ab]	174.30	0.03
Total MUFA	1905.19[a]	1285.39[b]	1455.10[ab]	1516.54[ab]	168.35	0.03
Total PUFA	47.27	45.55	41.56	54.13	7.27	0.20
Cool-season Grass, mg/100 g of meat						
Total SFA	947.37[a]	1073.76[a]	1158.95[a]	1011.42[a]	125.99	0.02
Total UFA	1375.74[a]	1584.63[a]	1587.05[a]	1398.04[a]	174.30	0.03
Total MUFA	1334.67[a]	1526.77[a]	1533.73[a]	1340.28[a]	168.35	0.03
Total PUFA	41.07	57.85	53.32	57.76	7.27	0.20

[1]WDGS = Wet distillers grains with solubles.
[2]SFA = saturated fatty acids, UFA = unsaturated fatty acids, MUFA = monounsaturated fatty acids, and PUFA = polyunsaturated fatty acids.
[ab]Means within the same treatment and the same row with different superscripts are different ($P \leq 0.05$).