2009

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Summary

Yearling steers (n=268) were fed 0%, 10%, 20%, 30%, 40% or 50 % modified wet distillers grains with solubles (MWDGS; DM basis). Marbling attributes, intramuscular fat content and fatty acid profile of beef were analyzed. Treatments did not alter marbling score, marbling distribution or fat content. Slight differences were identified for marbling texture of Choice carcasses. Values of polyunsaturated, Omega 6 and trans fatty acids linearly increased as levels of modified wet distillers grains increased. Feeding this byproduct increases polyunsaturated, trans and Omega 6 fatty acids in beef.

Introduction

Modified wet distillers grains with solubles (MWDGS) are ethanol byproducts that usually contain 45-50% DM, whereas wet distillers grains with solubles are 35% DM. A study conducted by de Mello Jr. et al. (*2008 Nebraska Beef Report,* pp. 124-125) showed that levels up to 30% of WDGS may be added into finishing diets without detriment to the relationship between marbling and intramuscular fat. De Mello Jr. et al. (*2008 Nebraska Beef Report,* pp. 120-121) reported elevated values of polyunsaturated fatty acids (PUFA), conjugated linoleic acid (CLA), linoleic isomer 18:2 and total trans fatty acids in beef from animals finished with diets containing 30% WDGS. Also, Gill et al. (2008, *Journal of Animal Science 86*: 923-935) showed that feeding dry distillers grains increased concentrations of Omega 6 fatty acids and Omega 6:Omega 3 ratio in beef when compared to steam-flaked corn. The aim of the current study was to verify the effects of high levels of MWDGS on marbling attributes, intramuscular fat content and fatty acid profile of beef.

Procedure

Two-hundred sixty-eight yearling, crossbred steers were allocated to six treatments (0%, 10%, 20%, 30%, 40% or 50% MWDGS DM basis) and fed for 176 days. Marbling score, texture and distribution were called by a USDA grading supervisor at 48 hours postmortem. After grading, a 0.25 - in thick ribeye slice (m. *Longissimus thoracis*) was excised from each carcass and transferred under refrigeration to the Loeffel Meat Laboratory at the University of Nebraska–Lincoln. The slices were pulverized using liquid nitrogen and stored at -112°F until analyzed. Total lipid was determined by ether extraction using the Soxhlet procedure. For fatty acid analysis, total lipid was extracted with a chloroform:methanol mixture. The lipid extract was converted into fatty acid methyl esters to be separated by gas chromatography (GC). A capillary column (0.25 mm x 100 mm) was set in the GC oven initially programmed at 284°F. Oven temperature increased to 428°F at a rate of 3.6°F/minute, and the injector and detector were programmed to work at 518°F and 572°F, respectively. During the GC analysis, samples were carried by helium and each fatty acid was identified based upon the retention time of known standards. The analysis of the data was conducted using SAS (Version 9.1, Cary, N.C., 2002). An analysis of variance (ANOVA) using the GLIMMIX procedure was conducted with an alpha level of 0.05. Means were separated using the LSMEANS and identified using DIFF and LINES. Linear and quadratic relationships were verified using the MIXED procedure. The feeding performance data have been reported by Huls et al. (*2008 Nebraska Beef Report*, pp. 36-38).

Table 1. MWDGS finishing diets on marbling score, marbling distribution and intramuscular fat content.

	Dietary treatments[1]								
Attributes	0%	10%	20%	30%	40%	50%	*P*-value	Linear[3]	Quadratic[3]
Score	Slight^{93}	Slight^{93}	Small^{02}	Small^{01}	Slight^{95}	Slight^{93}	0.76	0.13	0.14
Distribution[2]	1.12	1.20	1.13	1.17	1.22	1.21	0.71	0.12	0.83
Fat, %	7.43	7.95	8.68	8.61	8.11	8.03	0.18	0.67	0.02

[1]Modified wet distillers grains plus solubles (DM basis).
[2]Even = 1, Uneven = 2.
[3]Linear and quadratic response to MWDGS level.

Table 2. MWDGS finishing diets on marbling texture.[1]

	Dietary treatments[2]								
USDA Grade	0%	10%	20%	30%	40%	50%	*P*-value	Linear[3]	Quadratic[3]
Choice	1.74^{Aa}	1.65^{Aa}	1.67^{Aa}	1.42^{B}	1.91^{Aa}	1.44^{Ba}	0.02	0.41	0.91
Select	1.11^{b}	1.23^{b}	1.18^{b}	1.24	1.08^{b}	1.15^{b}	0.02	0.75	0.37

[1]Fine = 1, Medium = 2, Coarse = 3.
[2]Modified wet distillers grains plus solubles (DM basis).
[3]Linear and quadratic response to MWDGS level.
^{A,B}Means in the same row having different superscripts are significant at $P \leq 0.05$ level.
^{a,b}Means in the same column having different superscripts are significant at $P \leq 0.05$ level.

Table 3. Weight percentage of fatty acids[1] of ribeye slices (m. *Longissimus thoracis*) from steers fed MWDGS finishing diets.

	Dietary treatments[2]								
Fatty acids	0%	10%	20%	30%	40%	50%	*P*-value	Linear[3]	Quadratic[3]
Iso 16:0	0.54^{ab}	0.55^{a}	0.42^{c}	0.44^{bc}	0.43^{c}	0.49^{abc}	0.04	0.22	0.09
16:0	26.00^{a}	25.46^{b}	25.15^{b}	24.38^{c}	24.39^{c}	24.45^{c}	< 0.01	< 0.01	0.02
16:1(n-7)	3.37^{a}	3.12^{b}	2.82^{c}	2.76^{cd}	2.56^{de}	2.45^{e}	< 0.01	< 0.01	0.06
17:1(n-7)	1.16^{a}	1.10^{a}	0.98^{b}	0.89^{c}	0.82^{dc}	0.78^{d}	< 0.01	< 0.01	0.28
18:0	12.55^{d}	13.44^{c}	13.92^{cb}	14.21^{b}	14.34^{b}	15.10^{a}	< 0.01	< 0.01	0.31
18:1*t*	3.85^{d}	4.31^{d}	5.51^{c}	5.81^{c}	7.49^{a}	6.71^{b}	< 0.01	< 0.01	0.07
18:1(n-9)	36.45^{a}	35.76^{ab}	34.15^{bc}	34.01^{c}	32.76^{c}	32.86^{c}	< 0.01	<0.01	0.25
18:1 (n-7)	2.33^{a}	1.95^{b}	1.76^{bc}	1.59^{c}	1.59^{c}	1.33^{d}	< 0.01	< 0.01	0.12
18:1Δ13*t*	0.18^{e}	0.33^{d}	0.45^{c}	0.51^{bc}	0.65^{a}	0.55^{b}	< 0.01	< 0.01	< 0.01
18:1Δ14*t*	0.39^{a}	0.31^{b}	0.29^{bc}	0.27^{bc}	0.24^{cd}	0.21^{d}	< 0.01	< 0.01	0.22
18:2T	0.06^{c}	0.07^{bc}	0.10^{a}	0.11^{a}	0.12^{a}	0.09^{ab}	< 0.01	< 0.01	0.01
18:3(n-3)	0.17^{b}	0.19^{ab}	0.20^{a}	0.20^{a}	0.21^{a}	0.22^{a}	0.02	< 0.01	0.51
18:2(n-6)	3.13^{d}	3.92^{c}	4.29^{c}	4.85^{b}	5.07^{b}	5.64^{a}	< 0.01	< 0.01	0.28
20:0	0.02^{b}	0.04^{ab}	0.06^{a}	0.05^{ab}	0.06^{a}	0.06^{a}	0.02	0.02	0.07
20:1	0.50^{a}	0.44^{b}	0.50^{a}	0.52^{a}	0.51^{a}	0.48^{ab}	0.05	0.62	0.36
Omega 6	3.80^{d}	4.65^{c}	4.90^{c}	5.50^{b}	5.72^{b}	6.37^{a}	< 0.01	< 0.01	0.55
Total trans	6.82^{c}	6.98^{c}	8.13^{b}	8.31^{b}	8.90^{b}	10.12^{a}	< 0.01	< 0.01	0.46
PUFA	4.08^{d}	4.95^{c}	5.24^{c}	5.85^{b}	6.08^{b}	6.71^{a}	< 0.01	< 0.01	0.46

[1]Weight percentage values are relative proportions of all peaks observed by GC.
[2]Modified wet distillers grains plus solubles (MWDGS).
[3]Linear and quadratic response to MWDGS level.
[a,b,c,d]Means in the same row having different superscripts are significant at $P \leq 0.05$.

Results

Except for 20% MWDGS ($P = 0.11$), all treatments showed linear relationships between marbling score and fat content ($P \leq 0.05$). The test of common slopes revealed that all of them were statistically similar ($P = 0.45$). Feeding MWDGS did not alter the relationship between marbling and intramuscular fat. Dietary treatments did not significantly alter marbling score or marbling distribution (Table 1). However, a quadratic effect on fat content was observed where the highest values were obtained by feeding 20% to 30% MWDGS. For marbling texture, there was a small significant interaction between treatments and USDA grade ($P = 0.02$). Choice carcasses from treatments 0%, 10%, 20% and 40% MWDGS had higher values of coarser texture than those from treatments of 30% and 50% MWDGS (Table 2). Although a statistical difference was observed, there was no consistent pattern to indicate an optimum level of MWDGS for marbling texture.

Values of PUFA linearly increased as levels of MWDGS increased (Table 3). Those fatty acids are more easily oxidized when compared with saturated fatty acids (SFA) (2007, *Journal of the American Leather Chemists Association 102*:99-105). Higher levels of oxidation may compromise dependent attributes such as color and flavor (2000, *Meat Science 54*:49-57). Values of Omega 6 fatty acids were elevated as levels of MWDGS increased. Similar results were presented by de Mello Jr. (*2008 Nebraska Beef Report,* pp. 120-121) when levels of WDGS were increased in finishing diets. The major component of the Omega 6 fatty acid and PUFA is the linoleic isomer 18:2 (n-6). Therefore, this fatty acid showed response similar to Omega 6 and PUFA. Values of monounsaturated fatty acids such as palmitoleic (16:1 n-7) and 10-heptadecenoic (17:1 n-7) were lower when higher levels of MWDGS were added into the diets. Similar tendencies were observed for oleic (18:1 n-9) and cis vaccenic (18:1, n-7) acids. Oleic isomers 18:1Δ13*t* and 18:1Δ14*t* responded directly (quadratically) and inversely (linearly) to higher levels of MWDGS, respectively. Trans fatty acids were higher in beef from steers fed 40% MWDGS. Lower values were observed in beef from animals fed 0% or 10%. The major component of this group is the oleic isomer 18:1*t*. This fatty acid also showed higher values in beef from animals fed 40%.

In conclusion, finishing diets containing MWDGS did not affect marbling score, marbling distribution and intramuscular fat content of beef. Minimal effects were found for marbling texture. However, significant linear effects on fatty acid profile, such as increased PUFA, were observed.

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[2]This project was funded in part by the Beef Checkoff and the Nebraska Beef Council.