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Nutrient Differences of Beef from Steers with Different Genotypes for Myostatin

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Summary

Strip loins and eye of rounds from steers genotyped as having zero, one, or two copies of the inactive myostatin (IM) mutation were obtained. Steaks for nutrient analysis were cut and frozen and steaks for tenderness were aged for 14 days and cooked fresh, never frozen. Meat from cattle with one copy and two copies were more tender than zero copy cattle for eye of round steaks. Homozygous IM cattle had less overall fat content and calories than homozygous normal cattle.

Introduction

Myostatin is a negative regulator of skeletal muscle mass. In cattle, the inactive myostatin gene is responsible for double muscling which causes an increase in muscle fiber number (hyperplasia). (Kambadur et al., *Genome Research,* 1997). We hypothesized that meat from cattle with two copies of the inactive allele would be equivalent in tenderness to cattle containing zero and one copies even though the product is leaner. This study was conducted to determine tenderness and nutrient composition differences of steers from different genotypes (0, 1, or 2 copies of the inactive myostatin allele).

Procedure

Fifty- nine steers (n = 21, 22, and 16 carrying 0, 1, and 2-copies of the inactive myostatin allele) were individually fed the same diet for 182 days, and then finished for 50 days, for a total of 232 days on feed. At 3 days postmortem samples were collected from the carcasses. Samples for nutrient analysis (proximate, lipid, and mineral content) were drawn from 58 strip loins (*Longissimus lumborum;* n = 20, 22, and 16*)* and 59 eye of rounds (*semitendinosus;* n = 21, 22, and 16) for 0, 1, and 2-copy genotypes, respectively. Steaks for nutrient analysis were cut to 0.5-inch thickness and trimmed to .125-inch subcutaneous fat and frozen.

After aging 14 days, steaks for Warner-Bratzler Shear Force (WBSF) determination were cut to 1-inch thickness. Initial temperature and weight were recorded for each steak before being cooked on a Hamilton Beach Indoor/Outdoor grill. Steaks were cooked to an internal temperature of 95°F and were then turned and cooked on the other side until the internal temperature reached 160°F. After cooking steaks were reweighed for a final weight and recorded to determine cooking loss. Steaks were wrapped in oxygen permeable film and placed in a cooler for 24 hr at 39°F. After 24 hours six cores (0.5 inch in diameter) were taken from each steak parallel with the muscle fiber direction and sheared to determine WBSF.

Data was analyzed using a completely randomized design in SAS (Version 9.1) with the fixed effects being the different inactive myostatin mutations and random effect of the animal was used. Analysis of Variance (ANOVA) was performed using the Proc Mixed procedure with mean separation determined using LS MEANS and DIFF LINES options of SAS (SAS Inst. Inc., Cary, N.C.), with significance determined at $P \leq 0.05$.

Results

Fat content ($P < 0.01$) and total calories ($P < 0.10$) were lower (Table 1 and Table 2), while moisture ($P < 0.01$) and protein content

Table 1. Proximate, lipid, and mineral analysis of strip loin from cattle with 0, 1, or 2 copies of the inactive myostatin allele.

		Number of Inactive Myostatin Alleles				
Trait	Unit	0	1	2	SEM	*P*-value
Number of Samples		20	22	16		
Proximate Analysis						
Moisture	%	58.92^{c}	65.23^{b}	70.45^{a}	0.509	<.01
Protein	%	19.39^{c}	20.82^{b}	24.22^{a}	0.291	<.01
Fat	%	20.72^{a}	13.15^{b}	3.49^{c}	0.728	<.01
Ash	%	0.635^{c}	0.828^{b}	0.954^{a}	0.042	<.01
Carbohydrates	%	1.028	0.78	1.34	0.354	0.50
Calories	kCal	298.40^{a}	227.41^{b}	148.7^{c}	6.115	<.01
Lipid Analysis						
Cholesterol	mg/100g	43.35^{b}	43.18^{b}	48.31^{a}	1.003	0.04
Saturated Fatty Acids	% of fat	46.70^{b}	46.76^{b}	49.94^{a}	0.630	0.03
Monounsaturated Fatty Acids	% of fat	48.92^{a}	47.70^{a}	39.38^{b}	0.765	<.01
Polyunsaturated Fatty Acids	% of fat	3.40^{b}	4.32^{b}	9.11^{a}	0.521	<.01
Trans Fatty Acids	% of fat	0.99	1.19	1.57	0.067	<.01
Mineral Analysis						
Sodium	ppm	437.70^{ab}	419.80^{b}	443.52^{a}	7.401	0.039
Potassium	ppm	2800.85^{c}	3054.68^{b}	3305.19^{a}	47.470	<.01
Calcium	ppm	59.70^{b}	75.53^{a}	81.53^{a}	3.927	0.03
Iron	ppm	13.072	13.99	12.51	0.519	0.935

^{a,b,c}Means with different superscripts within the same row differ ($P \leq 0.05$)

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Table 2. Proximate, lipid, and mineral analysis of eye of round from cattle with 0, 1, or 2 copies of the inactive myostatin allele.

		Number of Inactive Myostatin Alleles				
Trait	Unit	0	1	2	SEM	*P*-value
Number of Samples		21	22	16		
Proximate Analysis						
Moisture	%	69.36[c]	72.67[b]	73.89[a]	0.306	<.01
Protein	%	21.51[c]	23.44[b]	24.25[a]	0.185	<.01
Fat	%	7.88[a]	3.51[b]	0.78[c]	0.418	<.01
Ash	%	0.92[b]	1.05[a]	0.93[b]	0.040	0.02
Carbohydrates	%	1.08	0.31	0.47	0.339	0.11
Calories	kCal	178.71	140.77	117.63	3.654	<.01
Lipid Analysis						
Cholesterol	mg/100g	47.29[b]	48.86[b]	53.75[a]	0.741	<.01
Saturated Fatty Acids	% of fat	45.28[a]	45.10[a]	42.96[b]	0.549	0.04
Monounsaturated Fatty Acids	% of fat	49.54[a]	46.09[b]	36.41[c]	0.899	<.01
Polyunsaturated Fatty Acids	% of fat	4.30[c]	7.83[b]	19.61a	0.778	<.01
Trans Fatty Acids	% of fat	0.88	0.99	1.09	0.076	0.11
Mineral Analysis						
Sodium	ppm	418.77[a]	399.87[b]	408.11[ab]	5.985	0.42
Potassium	ppm	3483.76[b]	3684.41[a]	3754.31[a]	36.109	<.01
Calcium	ppm	42.63	43.03	45.31	1.532	0.38
Iron	ppm	14.06[a]	13.10[a]	10.94[b]	0.413	<.01

[a,b,c]Means with different superscripts within the same row differ ($P \leq 0.05$).

Table 3. Tenderness (shear force) and cooking loss of strip and eye of round steaks from cattle with 0,1, or 2 copies of the inactive myostatin allele.

	Number of Inactive Myostatin Alleles				
Trait	0	1	2	SEM	*P*-value
Strip Steak Cooking Loss (%)	15.04	18.88	18.64	1.957	0.25
Strip Steak Shear Force (kg)	2.62	2.79	2.87	0.095	0.13
Eye of Round Cooking Loss (%)	19.83	21.61	22.74	1.585	0.36
Eye of Round Shear Force (kg)	3.60[a]	2.99[b]	3.10[b]	0.052	<.01

[a,b]Means with different superscripts within the same row differ ($P \leq 0.05$).

($P < 0.01$) were higher in meat from cattle with two copies compared to zero copies of the myostatin mutation. The two copy samples had a lower percentage of monounsaturated fatty acids than zero copy and one copy ($P < 0.01$). The zero and one copy samples had a lower percentage of polyunsaturated fatty acids ($P < 0.01$) and a lower level of cholesterol ($P < .01$) than two copy. Meat from cattle with two copies of the inactive myostatin allele tended to have less iron and more calcium compared to zero copy and one copy and was inconsistent in content of other minerals. The one and two copy steaks from the eye of round were lower in shear force ($P < 0.01$) than zero copy; there were no differences in shear force among genotypes for strip steaks.

In conclusion, meat from cattle with two copies of the inactive myostatin mutation had less fat content and calories than those with zero copy. As well, meat from cattle with one copy and two copies were more tender than zero copy for the eye of round.

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