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Abstract

Eighty crossbred (PIC) gilts were used to determine the influence of feeding modified tall oil (MTO, 0 or .5% of diet), chromium nicotinate (0 or 50 ppb), and L-carnitine (0 or 50 ppm) on display color stability, Warner-Bratzler shear, and sensory panel traits of pork chops. Dietary additions of MTO, chromium nicotinate, and L-camitine to growing and finishing swine diets had minimal effects on quality characteristics and display color stability of pork chops. Therefore, producers probably can take advantage of any production or carcass cutability improvement from these feed supplements without affecting muscle quality of pork chops.; Swine Day, Manhattan, KS, November 18, 1999

Keywords

Swine day, 1999; Kansas Agricultural Experiment Station contribution; no. 00-103-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 841; Swine; Modified tall oil; Chromium nicotinate; L-carnitine; Pork chop

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INFLUENCE OF DIETARY SUPPLEMENTATION OF MODIFIED TALL OIL, CHROMIUM NICOTINATE, AND L-CARNITINE ON PORK CHOP DISPLAY COLOR STABILITY, WARNER-BRATZLER SHEAR, AND SENSORY PANEL TRAITS[1]

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Summary

Eighty crossbred (PIC) gilts were used to determine the influence of feeding modified tall oil (MTO, 0 or .5% of diet), chromium nicotinate (0 or 50 ppb), and L-carnitine (0 or 50 ppm) on display color stability, Warner-Bratzler shear, and sensory panel traits of pork chops. Dietary additions of MTO, chromium nicotinate, and L-carnitine to growing and finishing swine diets had minimal effects on quality characteristics and display color stability of pork chops. Therefore, producers probably can take advantage of any production or carcass cutability improvement from these feed supplements without affecting muscle quality of pork chops.

(Key Words: Modified Tall Oil, Chromium Nicotinate, L-Carnitine, Pork Chop.)

Introduction

Modified tall oil is a by-product of the pulp and paper industry and has a high content of conjugated linoleic acid (67.4%). Supplementation of swine diets with MTO has decreased backfat, increased lean percentage, and increased belly firmness. Chromium (Cr) is an essential trace element involved in metabolism. Swine diet supplementation of Cr has decreased backfat and increased loin eye area in pork carcasses. Carnitine is a naturally occurring B-vitamin-like compound involved in normal metabolism. Feeding pigs carnitine has resulted in larger loin eye areas and a greater percentage of muscle on pork carcasses.

Limited information is available on the influence of feeding dietary combinations of MTO, Cr nicotinate, and L-carnitine on pork chop quality. Therefore, this experiment was conducted to determine that influence.

Procedures

In a 2 × 2 × 2 factorial arrangement, 80 crossbred (PIC) gilts were blocked by initial BW (100 lb) and ancestry and randomly allotted to one of eight dietary treatments. Two pigs were fed in each pen with five replicate pens per treatment. The main effects were two levels of MTO (0 or .5% of the diet), two levels of Cr nicotinate (0 or 50 ppb), and two levels of L-carnitine (0 or 50 ppm). The basal growing diet was fed from 100 lb to 160 lb BW and consisted of 66.5% corn and 27.7% soybean meal formulated to contain 1.0% lysine. The basal finishing diet was fed from 160 lb to 235 lb BW and consisted of 76.9% corn and 18.5% soybean meal formulated to contain .75% lysine.

Pigs were harvested humanely using standard industry procedures approved by the Kansas State University Animal Care Committee. At 28 h postmortem, the right side of each carcass was fabricated into the wholesale cuts of ham, loin, belly, spareribs, and shoulder. From the wholesale loin, a 9-in. long boneless loin sample was removed from the tenth rib and posterior. The loin was

[1]Appreciation is expressed to Lonza Inc., Fair Lawn, NJ for assistance in this research project.
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[3]Lonza Inc., Fair Lawn, NJ.

vacuum packaged and aged for an additional 6 d at 34°F. At 7 d postmortem, each loin was faced at the tenth rib surface and cut into 1-in. chops. Cutting anterior to posterior, chops were assigned as follows: 1) display color, 2) 0 d thiobarbituric acid reacting substance (TBARS), 3) 5 d TBARS, 4) sensory panel, and 5) Warner-Bratzler shear force (WBS). Display color and 5 d TBARS chops were placed immediately in retail display cases. Chops for sensory panel, 0 d TBARS, and WBS were crust frozen for 30 min at -40°F, individually vacuum packaged, and stored at -40°F until analysis.

Display chops were packaged in PVC film and displayed at 36°F under continuous lighting of 1614 lux from Philips Deluxe Warm White (40 watt) fluorescent lights. Visual display color was evaluated to the nearest .5 by eight display color panelists. The 5-point color scale used consisted of 1 = bright grayish-pink or reddish-pink, 2 = grayish-pink or reddish-pink, 3 = slightly dark pink/red to brown, 4 = moderately dark pink/red to brown, and 5 = dark pink/red to brown. A score of 3.5 indicated when the product had sufficient visual color deterioration to be discounted or unsaleable. Spectral data for ratio of reflectance %R630 nm /%R580 nm and CIE L*a*b* values were measured using a Hunter LabScan Spectrocolorimeter (Illuminant C). Three surface readings per sample were taken and averaged. Color was evaluated on 0, 1, 3, 5, and 7 d of display.

The extent of lipid oxidation was measured as TBARS at 0 and 5 d of display. The 0-d TBARS chops were cut, immediately packaged, crust frozen at -40°F for 30 min, vacuum packaged, and stored at -40°F. The 5-d TBARS chops were displayed in the cases for 5 d as previously described and then frozen and stored at -40°F. Values for duplicate samples from each chop were averaged and expressed as mg malonaldehyde/kg dry matter.

The chops were weighed and cooked to an internal temperature of 160°F in a Blodgett dual-air-flow oven. Chops were cooled at room temperature (70°F) for 1 h, reweighed, and subsequently chilled for 24 h at 36°F before six .5-in.-diameter cores were removed parallel to the muscle fibers and sheared perpendicular to the muscle fibers using a WBS attachment on an Instron Universal Testing Machine. Percentages of thawing and cooking losses were calculated.

The chops for sensory evaluation were thawed and cooked to an internal temperature of 160°F. Chops were removed from the oven and immediately cut into cubes of .5 in. × .5 in. × cooked chop thickness. A trained seven-member descriptive attribute sensory analysis panel received two warm samples from each chop. Six sensory traits of myofibrillar tenderness, connective tissue amount, overall tenderness, juiciness, flavor intensity, and off-flavor were evaluated on an 8-point scale to nearest .5. Myofibrillar tenderness and overall tenderness were evaluated on a scale from 1 = extremely tough to 8 = extremely tender. Connective tissue was ranked on a scale from 1 = abundant to 8 = none. Juiciness was scored on a scale from 1 = extremely dry to 8 = extremely juicy. Flavor intensity was evaluated on a scale from 1 = extremely bland to 8 = extremely intense. Off-flavor intensity was ranked from 1 = extremely intense to 8 = none.

The experimental design was a 2 × 2 × 2 factorial in a randomized complete block design using initial weight and ancestry to establish blocks. Statistical analyses were performed with the GLM procedure of SAS using the pen mean as the experimental unit. For comparisons pertaining to measurements over time, a split-plot analysis using the Mixed procedure of SAS was conducted to account for repeated measurements that included the fixed effects of treatment and display days. All main effect and interaction means were separated ($P<.05$) using the Least Significant Difference procedure when the respective F-tests were significant ($P<.05$).

Results and Discussion

Visual color panel and instrumental display data of pork chops are presented as MTO, Cr, and L-carnitine main effect means

in Table 1. Panel scores for visual display color were similar (P>.10) for all treatments. As expected, display time influenced (P<.001) visual scores, as well as CIE L*a*b*, and ratio of reflectance values (Table 2). Visual color scores dramatically declined over the 7 d of display. Scores were consistently lower (P<.05) at each evaluation period.

No treatment differences (P>.10) were observed for display CIE L*, CIE a*, or ratio of reflectance values (Table 1). Chops at 0, 1, and 3 d of display had lower (P<.05) L* values (darker color) than chops at 5 and 7 d of display (Table 2). In addition, chops at 5 d of display had lower (P<.05) CIE L* values than chops at 7 d of display. The highest (P<.05) a* value was observed at 1 d of display, and values decreased (P<.05) at 1 and 3 d of display. The lowest a* values were detected (P<.05) at 5 and 7 d of display. Chops from pigs fed MTO had higher (P<.05) b* values (an indicator of yellowness) than chops from pigs fed no MTO. Chops had the highest (P<.05) b* values at 0 d of display and the lowest (P<.05) b* values at 7 d of display. In addition, chops at 1 and 3 d of display had higher (P<.05) b* values than chops at 5 d of display. The ratio of reflectance %R630/%R580, which is an indicator of the amount of oxymyoglobin present, was consistently lower (P<.05) at each successive evaluation period during display.

Table 1. Influence of Modified Tall Oil, Chromium Nicotinate, and L-Carnitine Supplementation on Display Visual Color, Instrumental Color, and TBARS[a] Values of Pork Loin Chops

	Treatment						
	Modified Tall Oil, %		Chromium Nicotinate, ppb		L-Carnitine, ppm		
Item	0	.5	0	50	0	50	SE
Visual Color[b]	3.03	3.02	2.99	3.06	3.06	2.99	.12
Instrumental Color[c]							
L*	56.52	57.57	56.51	57.58	57.02	57.07	.58
a*	6.18	6.003	6.25	5.96	6.03	6.18	.20
b*	20.21[d]	20.55[e]	20.51	20.24	20.46	20.30	.17
%R630/%R580	2.05	2.08	2.09	2.04	2.05	2.08	.05
TBARS[a]	.74	.59	.69	.64	.63	.70	.08

[a]Thiobarbituric acid reacting substance, mg malonaldehyde/kg dry matter.
[b]Scores 1 to 5: 3 = slightly dark pink/red to brown.
[c]Measure of lightness (L*), redness (a*), yellowness (b*), or indicator of the amount of oxymyoglobin present (ratio of reflectance %R630/%R580).
[d,e]Means within modified tall oil and the same row with a different superscript differ (P<.05).

Thiobarbituric acid reacting substance values were not affected (P>.10) by dietary treatment (Table 1). As expected, the day of display influenced (P<.001) TBARS values (Table 2). The TBARS measurements of chops at 0 d were lower (P<.05) than those of chops displayed for 5 d.

The WBS and sensory panel main effect means for chops are presented in Table 3. The connective tissue amount, juiciness, flavor intensity, and off-flavor attributes were similar (P>.05) among treatments (Table 3). Myofibrillar and overall tenderness scores for chops from pigs fed no MTO

were higher (P<.05; less tough) than the sensory scores from pigs fed MTO. However, this difference was not supported by WBS values.

Previous research has indicated that CLA, Cr, and L-carnitine can improve feed efficiency and the proportion of lean to fat in swine. However, dietary additions of MTO, Cr, and L-carnitine to swine diets had minimal effect on display color and quality characteristics of pork chops. Therefore, producers probably can take advantage of any production or carcass cutability improvement from these feed supplements without effect on loin chop quality.

Table 2. Influence of Day of Display on Visual Color, Instrumental Color, and TBARS[c] Measurements of Pork Loin Chops

	Day					
Item	0	1	3	5	7	SE
Visual Color[a]	1.97[d]	2.51[e]	3.00[f]	3.57[g]	4.10[h]	.11
Instrumental Color[b]						
L*	56.28[d]	56.52[d]	56.68[d]	57.60[e]	58.14[f]	.45
a*	7.07[f]	7.62[g]	6.12[e]	5.01[d]	4.70[d]	.28
b*	21.34[g]	20.96[f]	20.61[f]	19.89[e]	19.09[d]	.19
%R630/%R580	2.56[h]	2.34[g]	2.06[f]	1.80[e]	1.55[d]	.05
TBARSc	.48[d]	--	--	.85[e]	--	.08

[a]Scores 1 to 5: 2 = grayish-pink or reddish-pink; 3 = slightly dark pink/red to brown; 4 = moderately dark/pink red to brown.
[b]Measure of lightness (L*), redness (a*), yellowness (b*), or indicator of the amount of oxymyoglobin present (ratio of reflectance %R630/%R580).
[c]Thiobarbituric acid reacting substance, mg malonaldehyde/kg dry matter.
[d,e,f,g,h]Means in the same row with a different superscript letter differ (P<.05).

Table 3. Influence of Modified Tall Oil, Chromium Nicotinate, and L-carnitine Supplementation on Warner-Bratzler Shear and Sensory Panel Traits

	Treatment						
	Modified Tall Oil, %		Chromium Nicotinate, ppb		L-Carnitine, ppm		
Item	0	.5	0	50	0	50	SE
Thawing loss, %	1.6	1.78	1.85	1.59	1.78	1.66	.24
Cooking loss, %	27.97	27.10	27.63	27.44	27.43	27.64	.60
Shear force, kg	3.05	3.14	3.00	3.18	2.98	3.20	.13
Sensory Evaluation[a]							
Myofibrillar tenderness	6.18[c]	5.86[b]	6.06	5.99	6.08	5.96	.10
Connective tissue	7.21	7.07	7.19	7.09	7.16	7.11	.06
Overall tenderness	6.25[c]	5.92[b]	6.14	6.04	6.16	6.01	.10
Juiciness	5.38	5.30	5.41	5.27	5.30	5.38	.07
Flavor intensity	5.69	5.62	5.70	5.61	5.65	5.66	.05
Off-flavor	7.92	7.86	7.88	7.91	7.89	7.90	.30

[a]Scores of 1 to 8: myofibrillar tenderness (5 = slightly tender and 6 = moderately tender); connective tissue (6 = traces and 7 = practically none); overall tenderness (5 = slightly tender and 6 = moderately tender); juiciness (4 = slightly dry and 5 = slightly juicy); off flavor (7 = practically none and 8 = none).
[b,c]Means within modified tall oil and the same row with a different superscript letter differ (P<.05).