Color, Marbling, and Firmness Characteristics of Pork Loins from Growing-Finishing Pigs Supplemented with Conjugated Linoleic Acid

B.R. Wiegand, graduate assistant;
F.C. Parrish, Jr., professor;
K. J. Franey, undergraduate assistant;
S. T. Larsen, undergraduate assistant;
J.C. Sparks, graduate assistant;
Department of Animal Science

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Summary and Implications

A study was initiated to research the efficacy of feeding conjugated linoleic acid (CLA) to market barrows to achieve improvements in growth, carcass, and pork quality characteristics. The feeding of CLA at a constant level (0.75%) from 40 kg to 115 kg of body weight resulted in a significant increase in subjective marbling scores and tended to increase subjective firmness scores of loins from CLA-treated pigs compared with loins from pigs on the control diet. No Hunter color differences were observed when day of shelflife was evaluated in the statistical model. Hunter color values were analyzed independent of day. No differences were observed for L* and a* values. A significant difference ($P < .05$), however, was observed for b* values indicating a more yellow product from CLA supplementation.

Introduction

Pork loin quality is one of the most important group of characteristics effecting the sale of pork loin products in the domestic and international market. Great strides have been taken to improve genetic potential in the U.S. swine herd. There is still room, however, for improvement of pork quality by means independent of genetics. Supplementation of conjugated linoleic acid (CLA), a naturally occurring isomer of linoleic acid, has been hypothesized to act as an antioxidant when fed in laboratory animal trials. We have hypothesized that an antioxidant effect would prolong pork loin color while in retail storage. Additionally, CLA has been shown to improve growth and performance characteristics of laboratory animals and finishing pigs. These findings prompted us to investigate the effect of CLA on subjective and objective measures of pork quality.

Materials and Methods

Ninety-six Yorkshire × Landrace × Duroc × Hampshire barrows were randomly assigned by litter to four treatment with five replications per treatment. Treatment groups were fed a constant (0.75%) level of CLA in the diet. Pigs were started on their respective diets at varying body weights in the growth phase. Control 40 kg (T1), CLA 90 kg (T2), CLA 65kg (T3), and CLA 40 kg (T4) were treatment groups. Pigs were slaughtered at an average weight of 115 kg at Hormel in Austin, MN. Two different groups were slaughtered approximately 30 days apart. Whole bone-in loins were removed from the left side of the carcass, packaged, and transported to the Iowa State University Meat Laboratory. At 48-hours postmortem, all loins were subjectively evaluated for color, marbling, and firmness according to the National Pork Producer Council's 5-point scale. All T1 and T4 loins were weighed, deboned, and cut into 2.54-cm-thick chops and vacuum-packaged. Two chops from each loin were placed in Viskase® vacuum packages for shelflife study. Chops were then evaluated for objective color characteristics at 1, 14, and 28 days of retail storage. Chops were held in vacuum packages until the appropriate day of shelflife where they were placed on 20s styrofoam trays with polyvinyl, oxygen permeable overwrap. Trays were placed in a cooler at 2°C under lighting conditions similar to retail sales coolers. This procedure was used to mimic the industry standard of shipping pork loins in vacuum packages to the retail outlet where they are subsequently placed in oxygen-permeable overwrap packaging. Chops were placed in the retail cooler for 24 hours after being overwrapped in trays. The L*, a*, and b* color values were measured with the Hunter laboratory system for color evaluation. Statistical analysis was performed using the GLM procedure of SAS. The model included fixed effects of treatment and replication for subjective quality score. An additional fixed effect of day was included in the model for objective color scores. Means were considered different at a preset P-value of 0.05 or less.

Results and Discussion

Data in Table 1 shows least squares means and standard errors for subjective measures of color, marbling, and firmness. No differences were observed ($P=0.95$) for subjective color at 48 hours postmortem. Marbling ($P<0.03$) and firmness ($P<0.07$) scores showed a linear effect with increasing time on CLA. Longer time on CLA corresponded to more marbling and a trend towards a firmer loin eye at the 10^{th} and 11^{th} rib junction. Least squares means and standard errors for Hunter L*, a*, and b* values taken at 24 hours on overwrap packages at 1, 14, and 28 days of retail storage are shown in Table 2. No statistical differences were observed for any of the Hunter color values for treatments compared at each day of retail storage. L* values tended to increase over time indicating a lighter product. A decreasing tendency also was observed for a* values that would indicate a trend for a less red product over time. Also, b* values trended higher, indicating a more yellow chop color over time. A more yellow product is a deviation from the normal gray that is considered ideal for pork chops. These observations were for all chops independent of treatment. Because day was not significant, Hunter color was analyzed independent of day (Table 3) and statistical differences were observed between treatments for b* values ($P < .05$) with CLA chops having a more yellow color compared with control chops. Although L* and a* values did not differ for treatment, CLA chops tended to be more red and had higher L* values suggesting a lighter product overall. This trend in lightness may be due to a significantly higher amount of marbling observed in the CLA chops.

Conclusions

Results from this phase of our research indicates that some measures, marbling, firmness, and b* (yellow/blue) color, were increased when CLA was fed at 0.75% of the diet from 40 kg to 115 kg of body weight. An increase in marbling could improve flavor and juiciness of pork chops from CLA-supplemented pigs. Additionally, the trend toward red color improvements could result potentially in increased consumer acceptability of pork chops due to a more eye-appealing product in the retail case. An increase in red color also may improve export (Japanese) sales of U.S. pork due to the preferences of some foreign consumers.

Additional work is underway at Iowa State University to examine more closely the measures of color, marbling, and firmness as they relate to pork quality.

Table 1. Least squares means and standard errors for subjective measures of color, marbling and firmness.

Trt[a]	Color	SE	Marb	SE	Firm	SE
1	2.43	.10	2.04b	.10	2.36	.06
2	2.31	.11	2.18c	.10	2.27	.07
3	2.47	.10	2.35d	.10	2.45	.06
4	2.38	.10	2.31d	.10	2.49	.06

[a] 1= control; 2= 90-kg body weight; 3 = 65-kg body weight; 4= 40-kg body weight.
Values within a column with different letters are significant at P<.05.

Table 2. Least squares means and standard errors for Hunter L*, a*, and b* values taken at 24 hr on overwrap packages.

Trt[a]	D[b]	L*	a*	b*
1	1	50.22	6.38	11.44
4	1	50.77	6.84	11.83
1	14	49.58	6.09	11.13
4	14	50.13	6.40	11.40
1	28	54.19	6.00	12.71
4	28	55.08	6.35	13.22
SEM		.58	.29	.16

[a] 1= control; 4= 40-kg body weight.
[b] 1, 14, 28 = days of retail storage.

Table 3. Least squares means for Hunter L*, a*, and b* values of overwrap chops at 24 hr independent of day.

Trt[a]	L*	SE	a*	SE	b*	SE
Control	51.53	0.34	6.16	0.17	11.76a	0.09
CLA	52.18	0.33	6.53	0.17	12.15b	0.09

[a] Con = control diet; CLA = longest time on CLA diet.
Values within columns with different letters significant at P<.05.