Use of Modified Tall Oil and Vitamin E to Improve Pork Longissimus Muscle Quality

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Background

Over the last few years, sources of conjugated linoleic acid (CLA) derived from sunflower oil have become commercially available. Conjugated linoleic acid enhances efficiency of gain and improves carcass leanness in swine (*Dugan et al., 1997; Ostrowska et al., 1999*) with no detriment on meat quality (*Dugan et al., 1999*). Pigs fed modified tall oil (MTO; a rich source of CLA) have enhanced growth performance compared to pigs fed CLA derived from sunflower oil (*O'Quinn et al., 2000*) but similar improvements in carcass leanness. Table 1 summarizes the results of seven trials conducted at Kansas State University with pigs fed MTO at 0.50% of the diet (approximately 0.35% total CLA isomers). Modified tall oil has been shown to alter the metabolism of ∝-tocopherol in rats and concentrate ∝-tocopherol in adipose tissue (*O'Quinn et al., 1999*).

Objectives

Based on the ability of MTO to improve growth performance and carcass characteristics in pigs and to alter metabolism and deposition of ∝-tocopherol in rats, the current study was conducted to evaluate the influence of supplemental vitamin E and MTO in swine diets on longissimus muscle quality characteristics.

Methods

In a 2 × 3 factorial arrangement of dietary treatments, 72 crossbred barrows (PIC; initially 45.5 kg BW) received meal diets containing 0 or 0.50% MTO and 0, 22, or 110 IU/kg supplemental vitamin E from dl-∝-tocopherol acetate. The corn-soybean meal diets were fed in two phases, did not contain any vitamin E in the premixes, and were formulated to be nutritionally adequate (*NRC, 1988*).

Upon termination of the growth trial (114.6 kg BW), all pigs were humanely slaughtered at the Kansas State University abattoir, and at 28 h postmortem, a 23-cm boneless loin was removed from the wholesale loin at the 10th rib and posterior. This section was vacuum packaged and aged for an additional six days at 4°C. At seven days postmortem, each loin was faced at the 10th rib surface and cut into 2.54-cm chops. Cutting anterior to posterior, chops were assigned as follows: 1) display color, 2) 0 d lipid oxidation, 3) 4 d lipid oxidation, 4) sensory panel, and 5) Warner-Bratzler shear.

Display chops were placed immediately on a soaker pad on a white 2S Styrofoam tray and overwrapped with oxygen permeable polyvinyl chloride film (21,700 cc O_2/m^2) and placed in an open-top display case. Chops were maintained at 2 ± 2°C under continuous lighting (1614 lux) and evaluated by a nine-member panel on a five-point scale where 1 = bright grayish-pink or reddish-pink and 5 = dark pink/red to brown. A score of 3.5 or above indicated a product with substantial visual color deterioration and product rejection. Sensory panel chops were crust frozen for 30 min at -40°C, individually vacuum packaged, and stored at -40°C until analyzed

Data were analyzed as a 2 × 3 factorial with main effects of MTO (0 or 0.50%) and vitamin E (0, 22, or 110 IU/kg) in a randomized complete block design using the GLM procedures of *SAS (1998)*. Pen was the experimental unit. For measurements over time, a split-plot analysis using the Mixed procedure of SAS was utilized.

Results and Discussion

No differences were observed ($P > 0.05$) for thawing or cooking losses, tenderness (Warner-Bratzler shear), or sensory panel attributes (tenderness, connective tissue amount, juiciness, flavor intensity, or off flavors). As expected, scores for visual panel evaluation, a*, and lipid oxidation deteriorated over time ($P < 0.001$). Figure 1 shows the display values of chops from selected dietary treatments of pigs fed no added MTO or vitamin E (NE), 110 IU/kg vitamin E (HE), and 0.50% MTO with 110 IU/kg vitamin E (MHE). Color display values for chops from pigs fed NE or HE remained similar ($P > 0.05$) throughout. By day 4 of display, chops from pigs fed MHE had less color deterioration ($P < 0.05$) than pigs fed only vitamin E. Supporting these findings are the numerically improved values for chops from pigs fed MTO and 110 IU/kg vitamin E for L* (Figure 2), a* (Figure 3), and lipid oxidation (TBARS; Figure 4). In agreement with *Ashgar et al. (1991)*, our data indicate that vitamin E alone may not guarantee improvements in fresh pork quality characteristics. *Nicolosi et al. (1997)* suggested that CLA was tocopherol sparing. *O'Quinn et al. (1999)* determined that MTO preferentially shifted the deposition of ∝-tocopherol to the adipose tissues. Thus, the improvements in fresh pork color display characteristics in this study may be due to the ability of MTO to redirect the absorption of tocopherol to the adipose tissue, stabilization of cell membranes, and(or) retardation of lipid oxidation as evidenced by lower lipid oxidation values.

Conclusions

The combination of vitamin E and MTO improves color display stability in pork longissimus muscle and extends display life approximately two days. The improvements in color stability may be associated with lowered intramuscular lipid oxidation. When feeding 110 IU/kg vitamin E, the incorporation of 0.50% MTO is needed to improve display color stability.

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Table 1. Summary of seven trials conducted feeding pigs 0.50% modified tall oil[a]

Item	Change from controls	Item	Change from controls
ADG, kg	+ 1%	LMA, cm^2	+ 3%
Gain:feed	+ 2%	Average backfat, cm	- 4%
Visual marbling	+ 6%	10th rib backfat, cm	- 8%
Belly firmness, cm	+ 15%	Lean percentage	+ 2%

[a]Values represent means of 572 mixed sex growing-finishing pigs with average initial and final body weights of 42.0 and 114.1 kg, respectively.