Published April 25, 2019

2018 Reciprocal Meat Conference – Environment, Production Systems

Meat and Muscle Biology™

Cyclic Heat Stress and Supplementation of Zinc at a High or Low Level from Inorganic and Organic Sources Minimally Impact Display Shelf-Life of Fresh and Processed Pork

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Keywords: heat stress, lipid oxidation, pork color, shelf-life, zinc
Meat and Muscle Biology 2(2):18–19 **doi:10.221751/rmc2018.016**

Objectives

Heat stress (HS) induces metabolic changes associated with physiologic adaptation to stress and pigs exposed to acute heat experience musculoskeletal oxidative stress. Zinc may be particularly beneficial to HS animals due to its involvement in nutrient and insulin mediated metabolism. Thus, our objective was to determine the effects of Zn supplementation on color and oxidative stability of fresh and processed pork products from pigs subjected to a summer HS.

Materials and Methods

Commercial crossbred pigs (initially 72.0 kg) were housed 5 pigs/pen under thermoneutral (TN; 18.9 to 16.7°C) or cycling HS conditions simulating chronic summer heat (30°C/26.7°C for 12 h:12 h on d 24 to 63) with acute heat waves (32 to 33°C/29 to 30°C for 12 h:12 h on d 21 to 24, 42 to 45, & 63 to 65). Core body temperatures were recorded to validate HS. Pens (experimental units) were randomly allotted to eight treatments arranged as a 2 × 2 × 2 factorial with main effects of environment (ENV; TN vs. HS), supplemented Zn level (LEV; 50 vs. 130 mg/kg available Zn), and Zn source (SRC; inorganic from ZnO vs. organic/inorganic-blend). One pig per pen ($n = 80$) was slaughtered on d 65, and at 1 d postmortem chops were fabricated from the 4th-10th rib portion of the loin (*M. longissimus dorsi*). Dissected lean and fat from the picnic shoulder of each carcass was combined as a 70/30 lean:fat blend with a nitrate-free sausage seasoning blend and formed into 2.54 cm thick patties. Chops and patties were packaged on styrofoam trays with PVC film overwrap and stored at 4°C under 40-W fluorescent light for 0, 3, 7, or 10 d. At each display endpoint, assessment was made of CIE L*a*b* color attributes on all products with a Hunter MiniScan colorimeter (D65 illuminant/10°) and of lipid oxidation via 2-thiobarbituric acid reactive substances (TBARS) assay on all patties and a subset of chops ($n = 48$). Data were analyzed as a RCBD in SAS 9.4 (SAS Inst. Inc., Cary, NC) using preplanned contrasts.

Results

Color and oxidative changes occurred over time in all products but no interactions ($P > 0.10$) between display day and treatment were observed. For chops, d 3 L* was less when Zn was fed at the 50 mg/kg level from organic source, but less at the 130 mg/kg level from inorganic source (LEV × SOR, $P = 0.014$). Inorganic Zn increased d 10 a* (6.16 vs. 5.83, $P = 0.008$) and decreased discoloration (hue angle, $P = 0.004$) compared to organic Zn. Day 3 b* was less for 50 mg/kg vs. 130 mg/kg ($P = 0.048$) and ENV×SOR interactions ($P < 0.05$) were observed for d 3 discoloration, d 7 b*, and d 10 b* and chroma. For sausage patties, d 3 L* was decreased at the 50 mg/kg Zn level relative to 130 mg/kg. No differences were observed in sausage a* but HS decreased ($P < 0.01$) d 0 and d 10 b* and d 10 chroma compared to TN. Initially, sausage derived from HS animals tended (d 0, $P = 0.071$) to have less lipid oxidation than TN but within each subsequent display day, no lipid oxidation differences ($P > 0.05$) due to treatment were observed in either loin chops or sausage.

Conclusion

In conclusion, the HS model did not appear to reduce display shelf-life of fresh and minimally processed pork as indicated by lack of differences in lipid oxidation and color stability. The effects of Zn source on chop color differed by environment and Zn level but greater amounts of Zn failed to impart any benefit to oxidative stability and color.