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Color, Metmyoglobin Reductase Activity, and Lipid Oxidation in Ground Beef Patties during Retail Display from Angus Steers Fed Endophyte-Infected Tall Fescue Seeds

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Objectives

Endophyte-infected tall fescue has toxic ergot alkaloids that can bind to serotonin receptors and cause vasoconstriction in cattle, which reduce animal's ability to dissipate heat. Heat stress has been shown to increase oxidative stress, i.e., an increase in reactive oxygen species in tissues. The objective of the current study was to determine the effects of feeding endophyte-infected tall fescue seeds to Angus steers on color, metmyoglobin reductase activity (MRA), and thiobarbituric reactive substances (TBARS) in ground beef patties.

Materials and Methods

Twelve Angus steers, blocked by initial BW, were randomly fed with either KY32 (E- or control; $n = 6$) or KY31 seeds (E+ or treatment; approximately 20 µg of ergovaline/kg BW; $n = 6$). Steers were fed individually using Calan gates during a 70-d feeding period in the summer of 2015, followed by a 149-d withdrawal period, and a 64-d feeding period in the winter of 2016. Following the second feeding period, steers received a dose of Ralgro, finished on summer perennial pastures for 66 d, and slaughtered at approximately 21 mon of age and 500 kg of BW. Lean and fat trimmings were collected at 72 h post-mortem, vacuumed packaged, and stored at –20°C until ground beef production. Two 3-oz patties were placed on black Styrofoam trays, overwrapped with PVC film, and placed under simulated retail display conditions (2°C, 900-lux, and 80% RH) for 7 d. The color was measured repeatedly on the same tray per animal every 24 h using a Hunter Lab MiniScan 4500L spectrophotometer (Hunter Associates Inc, Reston, VA) on the surface of the patties. For TBARS and MRA, one tray per animal was withdrawn at 0, 1, 3, 5, and 7 d. Thiobarbituric reactive substances were extracted in 10% trichloroacetic acid, reacted with 0.02 M TBA solution, and quantified at 532 nm (Spectra max plus 384; Molecular Devices, Sunnyvale, CA). Metmyoglobin reductase activity (µM of MMb reduced/min/g of muscle) was determined by extracting muscle reductases, reacting them with equine skeletal metmyoglobin, and measuring deoxymyoglobin at 580 nm (Spectra max plus 384; Molecular Devices, Sunnyvale, CA). Statistical analysis was performed by the GLIMMIX procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC) at 0.05 level of significance.

Results

Endophyte-infected tall fescue seeds did not impact lightness (L*), oxymyoglobin (OMb), and metmyoglobin (MMb; $P \geq 0.467$). However, deoxymyoglobin was 0.5% greater in E+ patties ($P = 0.017$). For redness (a*) there was a treatment × day interaction, in which a* between E- and E+ patties on d 0, 1, 3, and 4 was similar ($P \geq 0.166$), however, a* was greater in E+ patties on d 2 and 5 ($P \leq 0.027$). Feeding of endophyte-infected tall fescue seeds had no impact on TBARS or MRA ($P \geq 0.082$). As expected, TBARS were increased from 1.53 to 3.42 mg MDA/kg and MRA was decreased from 5.57 to 2.16 µM MMb reduced/min/g over 5 d of the retail display ($P < 0.001$).

Conclusion

Feeding endophyte-infected tall fescue seeds with long withdrawal periods did not have significant impacts on color, metmyoglobin reductase activity, and lipid oxidation in ground beef.

