

2017 Reciprocal Meat Conference – Undergraduate Research Competition

Meat and Muscle Biology™



Effects of Extended Retail Display on Metmyoglobin Reducing Activity in Ground Beef Model

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Keywords: ground beef, meat color, metmyoglobin reducing activity, retail display
Meat and Muscle Biology 1(3):162

doi:10.221751/rmc2017.157

Objectives

The objective of this study was to evaluate the effects of extended retail display on metmyoglobin reducing activity in ground beef model.

Materials and Methods

Two retail display trials were conducted using 2 ground beef batches with 91 and 93% lean. Thirty-six 454-g ground beef loaves per trial were produced, placed on black Styrofoam trays, overwrapped with PVC film (O_2 permeability of 1.21 mL/cm²/d and water vapor permeability of 0.022 g/cm²/d; LINPAC Packaging-Filmco Inc., Aurora, OH), and displayed at 2°C under fluorescent light (900 lux) for up to 0, 4, 8, 12, 24, 36, 48, 72, 96, 120, 144, 168, 192, 216, 240, 264, 288, and 312 h ($n = 4$ per time point). Two randomly selected loaves per time point per trial were withdrawn for further analysis. The pH value was determined by placing 1 g of meat in 10 mL of D-water (Accumet AE150 pH Benchtop Meter; Fisher Scientific, Waltham, MA). Aerobic Plate Count (APC, log CFU/g) was determined using 3M APC Petrifilm (3M Corporation, St. Paul, MN). Lean redness and reflectance spectra (400 to 700 nm) were recorded with illuminant A at 10° angle (MiniScan EZ 4500L, Hunter Associates Laboratory, Inc., Reston, VA). Metmyoglobin reducing activity (MRA) was measured by reacting extracted reductases with horse skeletal met-

myoglobin and measuring absorbance by deoxymyoglobin at 580 nm (Spectramax Plus 384; Molecular Devices, Sunnyvale, CA). Statistical analysis was performed by using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC) at 0.05 level of significance.

Results

The APC was increased by 0.7 log CFU/g from 0 to 168 h ($P = 0.022$), which coincided with an increase in pH from 5.61 to 5.88 ($P < 0.001$). As expected, redness was decreased from 30.83 (0 h) to 13.48 (96 h; $P < 0.001$), which coincided with 10.56% decrease in surface oxymyoglobin ($P = 0.001$). However, lean redness and surface oxymyoglobin was increased after 120 h up to 216 h ($P < 0.001$). Although MRA remained constant from 0 to 120 h of retail display (7.03 to 8.58 $\mu\text{M}/\text{min}/\text{g}$; $P \geq 0.220$), it was increased up to 16.01 $\mu\text{M}/\text{min}/\text{g}$ by 288 h ($P \leq 0.004$), following a quadratic relationship that could be fit as $\text{MRA} = 7.68 + 0.0001 \times \text{time}^2$ ($R^2 = 0.67$; $P < 0.001$).

Conclusion

These findings were in contrast with the conventional wisdom that beef color continues to deteriorate as retail display progresses. The current study indicated that microorganisms in meat might contribute to the increase in metmyoglobin reducing activity, which may be used as novel technology to maintain meat color stability.