



## Effects of Packaging and Temperature on Metmyoglobin Reducing Activity of Cooked Ground Beef Patties

B. Allahodjibeye Djimsa, A. Abraham\*, G. Mafi, D. VanOverbeke, and R. Ramanathan

Animal Science, Oklahoma State University, Stillwater, OK, USA

**Keywords:** metmyoglobin reducing activity, packaging, premature browning  
Meat and Muscle Biology 1(2):158

doi:10.221751/rmc2016.151

### Objectives

Approximately 47% of ground beef purchased at local stores is susceptible to premature browning (PMB). Premature browning is a condition in which cooked ground beef patties will have a well-done appearance at temperatures insufficient to render ground beef patties safe. Various studies have shown that the form of myoglobin present in the interior of patties at the time of cooking can affect cooked color. However, limited studies have determined the role of metmyoglobin reducing activity (MRA) in cooked patties on cooked color.

Therefore, the objective of this study was to determine the role of MRA in cooked color development and premature browning.

### Materials and Methods

Fresh coarse ground beef chubs (85% lean,  $n = 6$ ) were obtained from a local purveyor on the day of preparation. Coarse ground beef was fine ground using a LEM meat grinder. Patties (1 cm thickness  $\times$  10.5 cm diameter; 113 g) were prepared using a patty press. Patties were randomly allotted to vacuum (VP) or high-oxygen modified atmospheric package (HiOx-MAP, 80% oxygen and 20% carbon dioxide). High-oxygen modified atmospheric package patties were placed in Rock-Tenn DuraFresh rigid trays with absorbent pads and sealed with a clear, multi-layer barrier film using a semi-automatic Mondini tray-sealing machine and certified gas blends. Packaged patties were stored in the dark at  $0 \pm 2^\circ\text{C}$  for 48 h. At the conclusion of storage, two patties from each packaging were cooked to either 65 or 71°C using a George Foreman. One patty from each packaging was utilized for lipid oxidation and raw MRA. Two extra patties were

utilized to characterize d 0 (no packaging and storage) pH analysis, lipid oxidation, and MRA. Surface color ( $a^*$ ) and MRA of raw and cooked ground beef patties were measured. Nitric oxide metmyoglobin reduction method was used to determine the reducing activity of both raw and cooked patties. Surface color was determined daily using a HunterLab spectrophotometer. The experiment was repeated six times and the data were analyzed using the Mixed Procedure of SAS (SAS Inst. Inc., Cary, NC). The PDIF option for protected F-test was utilized to separate least squares means ( $P < 0.05$ ).

### Results

The average pH of ground beef was  $5.73 \pm 0.01$ . There was a significant packaging by temperature interaction for raw surface color and metmyoglobin reducing activity. High-oxygen modified atmospheric package patties had lower ( $P < 0.0001$ ) cooked internal  $a^*$  values and MRA compared with VP patties regardless of temperature. There was no difference in cooked patties MRA for HiOx-MAP between 65 and 71°C ( $P > 0.12$ ). Cooked patty MRA decreased as temperature increased for VP patties ( $P < 0.041$ ). There was a significant packaging  $\times$  time interaction observed for lipid oxidation. HiOx-MAP patties had greater ( $P < 0.0001$ ) lipid oxidation compared with VP patties after 48 h storage and d 0 patties. Storage did not affect lipid oxidation in VP ( $P > 0.40$ ).

### Conclusion

Metmyoglobin reducing activity in cooked patty suggests that enzymes involved in metmyoglobin reduction retain partial activity at greater temperatures. Developing strategies to increase reducing activity in ground beef has the potential to limit the incidence of premature browning.