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Evaluation of Changes in Microbiological and Biochemical Properties, And Color of Ground Beef During Aerobic Storage

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Objectives

Ground beef shelf-life is influenced by numerous microbiological, biochemical, and physical properties. The complex relationship of these variables has direct impacts on color. It is imperative to understand the relationship between microbial and chemical changes in ground beef and the subsequent changes to color occurring to develop solutions to extend shelf life. In that regard, a shelf-life study was conducted to evaluate microbiological and biochemical deterioration of ground beef and the concurrent impacts on color.

Materials and Methods

Three separate lots of finely ground beef (80% lean, 20% fat) were procured from 2 ground beef processing facilities in the Midwestern and Western United States, and were treated as 3 separate replicates. The lots of ground beef were stored at 2°C without exposure to light, at Colorado State University (Fort Collins, CO) for both a storage period of 16/17 d (Storage period 1- SP1) and 23/24 d (Storage period 2- SP2) post-processing. After the storage period, the ground beef chubs were finely ground, again, and portioned onto rigid trays overwrapped with polyvinyl chloride film before placement into a retail case with fluorescent lighting (Hussman, Model M3X8GEP) for 5 d. Objective color was evaluated every 12 h during the retail display period, while microbial populations (lactic acid bacteria [LAB], psychrotrophic bacteria, *Enterobacteriaceae* [EB], and *Pseudomonas* spp.), pH, and lipid oxidation were evaluated every 24 h for the duration of retail display. Bacterial populations, pH, instrument color, and

lipid oxidation indicators were analyzed in R (version 3.4.3) using the lme4, lmerTest, and lsmeans packages as a split-plot design. Objective color values were also analyzed in R using the nlme, plyr, and lsmeans packages as a repeated measures design. Data are reported as least squares means and are separated using an α of 0.05.

Results

As expected, microbial populations changed over retail display, but trends differed between the 2 storage periods. Populations of *Pseudomonas* increased ($P < 0.05$) by almost 2 log CFU/g during retail display for product stored for 16/17 d, while a less than 0.35 log CFU/g increase in *Pseudomonas* populations was observed in product stored for 23/24 d. Similarly, populations of psychrotrophic bacteria, *Enterobacteriaceae*, and LAB increased ($P < 0.05$) during retail display of both dark storage periods. Likewise, lipid oxidation increased ($P < 0.05$) during retail display. Instrument color assessments indicated that product became less red (decreased a^* values; $P < 0.05$).

Conclusion

This research displays the complex biochemical and microbiological changes that occur during storage and retail display of ground beef. These results suggest that the changes and their impacts on sensory properties, namely color, are not consistent among dark storage lengths. Further exploration of the changes in microbial communities and biochemical properties, and their impact on organoleptic properties, should continue.