

## 2018 Reciprocal Meat Conference – Undergraduate Research Competition

## Meat and Muscle Biology™



## Impact of Retail Display Case Lighting and Packaging Type on Microbial Growth and Beef Color

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### Objectives

The goal of this study was to evaluate the impact of 4 packaging types and 2 retail lighting systems on objective measures of microbial growth and muscle color of beef *Longissimus lumborum* steaks.

### Materials and Methods

Beef strip loins ( $n = 8$ ), USDA Choice, were collected and fabricated (7d postmortem) into seventeen 1.27-cm thick steaks. Steaks ( $n = 16$ ) were assigned into 4 packaging treatments: high oxygen MAP (80% O<sub>2</sub>, 20% CO<sub>2</sub>) (HIOX), overwrapped packages in a motherbag flushed with carbon monoxide (0.4% CO, 30% CO<sub>2</sub>, 69.6% N<sub>2</sub>) (CO), vacuum rollstock (VAC), and traditional overwrap (OW), which were held in vacuum packaging, then placed onto foam trays and sealed with polyvinyl chloride film immediately before display. Microbial sampling occurred for each treatment at 7d (packaging), 20d (before display), and 23d (post display) postmortem. Each package type was sorted into 3 lighting treatments: darkness (DARK) (put in a box and held in cold storage), or a refrigerated open multi-deck retail display case with either light emitting diode (LED) or fluorescent (FL) lighting for 72h. Instrumental color (L\* a\* b\*) was measured, and chroma calculated, at 0h and 72h of display using a Hunter Colorimeter. Aerobic Plate Counts (APC) and Psychrotrophic Plate Counts (PPC) were evaluated at packaging day, 0h and 72h retail display. Bacterial load was determined by swabbing a 50 cm<sup>2</sup> area of the steak. Serial dilutions were plated, in duplicate, onto APC petrifilm for mesophilic incubation, and standard methods agar plates for psychrotrophic incubation. Bacterial counts were reported as log<sub>10</sub> CFU/50 cm<sup>2</sup>. Microbial data were analyzed using the GLM procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC), and color analysis performed using the GLM procedure with repeated measures to ac-

count for beginning and end of retail display. Statistical significance was determined at  $P \leq 0.05$ .

### Results

There were no interactions between lighting and packaging type for APC or PPC ( $P > 0.05$ ). Mean APC differed by sampling time, from 0.77 log<sub>10</sub> CFU/50 cm<sup>2</sup> on packaging day to 3.79 log<sub>10</sub> CFU/50 cm<sup>2</sup> at the end of retail display ( $P < 0.0001$ ) across all packaging types. At the end of display, mean APC from OW were greater than HIOX packages, 3.83 and 3.05 log<sub>10</sub> CFU/50 cm<sup>2</sup> respectively ( $P < 0.05$ ). Lighting did not impact APC counts at the end of display across any packaging type ( $P = 0.84$ ). Lighting across all packaging types did not significantly ( $P = 0.07$ ) impact PPC. Psychrotrophic means differed among VAC, CO, OW and HIOX ( $P < 0.05$ ) ranging from 5.52 to 6.87 log<sub>10</sub> CFU/50 cm<sup>2</sup>, with HIOX and CO being the only 2 packaging types that were not different ( $P > 0.05$ .) At the end of display, across all packaging types, L\* values differed ( $P < 0.05$ ) between FL display (34.20) and DARK (36.69) packages. Calculated chroma, a\* and b\* did not vary ( $P > 0.05$ ) between lighting treatments across package types at the end of retail display.

### Conclusion

This study provides evidence that packaging type has more of an effect on bacteria than lighting conditions, and variability in the lighting conditions does not have an impact on calculated chroma, b\* or a\* values, but does affect brightness (L\*). Overall, OW packages had greater APC and PPC. These results imply packaging type may be used as a way to improve shelf life via control of spoilage bacteria. Moreover, this study indicates lighting systems may be used interchangeably when considering growth of spoilage organisms.