SPOILAGE PSEUDOMONAS SURVIVE THERMAL PROCESSING AND GROW DURING VACUUM-PACKAGED STORAGE IN AN EMULSIFIED MEAT SYSTEM

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I. OBJECTIVES

Pseudomonas are considered the predominant microbial spoilers of aerobically stored raw meat products with minor roles in vacuum-packed product spoilage. However, recent findings have challenged this principle and opened new avenues for research on the role of *Pseudomonas* in the spoilage of thermally processed, vacuum-packaged meat. The natural food microbiome and contamination from the processing environment contribute to the *Pseudomonas* presence in vacuum-packed cooked product. Given the potential thermal resistance of *Pseudomonas*, residual post-process populations may also be responsible for product spoilage. Therefore, an experiment was conducted with the objectives of determining whether spoilage *Pseudomonas* can survive thermal processing and grow anaerobically through refrigerated storage in an emulsified model meat system.

II. MATERIALS AND METHODS

Three *Pseudomonas* isolates from spoiled meat were grown individually in Luria-Bertani broth and combined to create an inoculation cocktail. Two kilograms of coarse ground beef were inoculated to approximately 5 $\log_{10}$ of *Pseudomonas* and emulsified with ice, salt (2% meat block basis), sodium nitrite (156 ppm meat block basis), sodium erythorbate, black pepper, and garlic in a food processor (Hobart FP41; Hobart Corporation; Troy, OH). Batter samples (approximately 20 g, <1.5 cm thickness) were vacuum packaged individually and split into 3 treatments: 2 cooked treatments (71°C for 1 s or 54°C for 121 min) and 1 uncooked treatment. Samples were cooked in water baths using sous vide units to target temperatures and then chilled in an ice bath for 15 min. *Pseudomonas* concentrations were enumerated after inoculation, after chilling for cooked samples, and after emulsifying for uncooked samples, as well as at 14, 28, and 56 d of storage at 4°C and 10°C. At each sampling time, 10 g of an individually packed sample were stomached with 20 mL of buffered peptone water. Homogenates were serially diluted and plated onto *Pseudomonas* Agar Base plates supplemented with Cetrimide-Fucidin-Cephalosporin Selective Supplement. The experiment was conducted in 3 independent replications with duplicate samples. Data were reported as $\log_{10}$ CFU/g and analyzed using the GLIMMIX procedure with least significant difference means separation in SAS version 9.4 (SAS Institute Inc., Cary, NC).

III. RESULTS

Pseudomonas concentrations in uncooked treatments decreased by 1.66 $\log_{10}$ and 1.39 $\log_{10}$ ($P < 0.05$) after 56 d of storage for 10°C and 4°C storage, respectively. In both cooked treatments, concentrations were reduced below the detection limit (0.18 $\log_{10}$) immediately following cooking ($P < 0.05$). After 56 d of storage, *Pseudomonas* populations increased to

>0.5 $\log_{10}$ in both cooked treatments stored at 10°C and 4°C and were greater than concentrations from samples taken immediately after cooking ($P < 0.05$).

IV. CONCLUSION

Pseudomonas was recovered from all cooking and storage treatment combinations, indicating the ability to survive thermal processing. The increasing concentration of *Pseudomonas* during storage in intact vacuum packages warrants further investigation into the ability of *Pseudomonas* to recover and grow in anaerobic environments and cause spoilage.

Keywords: meat spoilage, *Pseudomonas*, thermal survival