

SALMONELLA MIGRATION INTO MARINATED TURKEY BREAST AFTER CONTAMINATION DURING THREE STEPS OF THE MARINATION PROCESS

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Introduction

Consumer trends show an increasing demand for ready-to-eat (RTE) products, which include marinated whole-muscle products (Russell, 2002). Many meat and poultry products sold in retail markets are value-added by means of marination and mechanical tenderisation. It is often assumed that the interior of intact, undamaged whole-muscle is sterile (Elmossalami and Wassef, 1971). However, several studies have demonstrated that the inner portion of whole-muscle can be contaminated during processing. Warsaw *et al.*, (2002) evaluated the potential for *Salmonella* migration into intact, whole-muscle turkey breasts during marination. *Salmonella* counts increased with the application of vacuum to the process and decreased with depth below the inoculated surface. Migration is affected by several factors, including bacterial motility (Thomas *et al.*, 1987), proteolytic activity (Gill and Penney, 1982, Gupta *et al.*, 1983), water availability within the tissue, and fibre orientation (Maxcy, 1981). Tumbling is a process that increases uptake of marinade ingredients and promotes tenderisation (Xiong and Kupski, 1999), while vacuum is often applied to improve marinade penetration into the product. If a product surface and/or marinade were contaminated with a pathogenic microorganism, tumbling, vacuum and/or marinade composition could increase the potential for bacterial migration into the whole-muscle raw product. The objective was to study *Salmonella* migration into marinated turkey breast meat after contamination during three steps of the marination process.

Materials and Methods

This study focused on three different treatments: "pre-", "during", and "post-marination", depending on the time period at which the contamination occurred. For "pre-marination", 20 mL of *Salmonella* (8 strains)-inoculated marinade (10^8 CFU/mL) was added drop wise onto a sterile tray. An irradiated whole-muscle turkey breast was tossed over on the contaminated tray, then placed into a sterile bag before subjecting to 20 min vacuum tumbling marination. Turkey breast muscle for "post-marination" treatment was tumbled with sterile marinade for 20 min before turning over on the contaminated tray. For the "during marination" sample, whole-muscle turkey breast was tumbled with *Salmonella*-inoculated marinade.

After marination, three 1 cm-thick slices (cranial, middle, and caudal) were removed from the turkey breast longitudinal to the muscle fibre (Figure 1a). The middle slice was taken from the thickest part of the breast muscle. Cranial and caudal slices were sectioned at ~5 and 10 cm, respectively, measuring from both ends. Within these three slices, 1 cm³ cubes were excised along the axis of the muscle fibre (Figure 1b) and enumerated for surviving *Salmonella*. All of the dissection was done using a self-cauterizing electrosurgical unit.

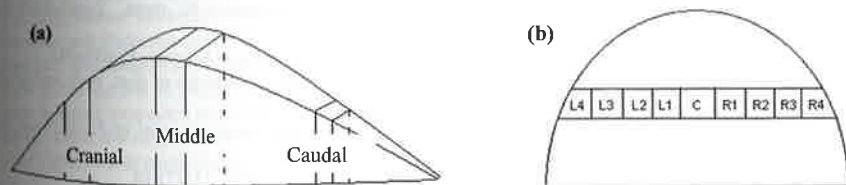


Figure 1: Sampling diagram (a) 3 slices excised from marinated whole-muscle turkey breast (b) 1-cm³ segments dissected from cranial, middle, and caudal slices. Segments labeled R1, R3, L1, and L3 were dissected from cranial and caudal slices and segments labeled C, R2, R4, L2, and L4 were dissected from middle slice.

Results and Discussion

The results suggest that penetration of *Salmonella* into whole-muscle turkey breasts does not follow a random pattern. *Salmonella* counts decreased as the depth below the inoculated surface from four directions (right, left, top, and bottom) increased. The highest counts were observed in the pieces next to the inoculated surface. The center segment (C) from the middle slice for all treatments showed the lowest *Salmonella* migration among all segments. *Salmonella* plate counts at the center (C) from the middle slice for "during marination" treatment was 3.43 Log CFU/mL (Figure 2b), which was higher ($P < 0.05$) than those of "pre-" and "post-marination" treatments (Figures 2a and 2c, respectively). This means

Salmonella penetrated more when turkey meat was tumbled with a contaminated marinade solution. There was a slight difference in *Salmonella* distribution for the cranial and caudal slices, as compared to the middle slice. This may be due to the actual structure of turkey breast muscle.

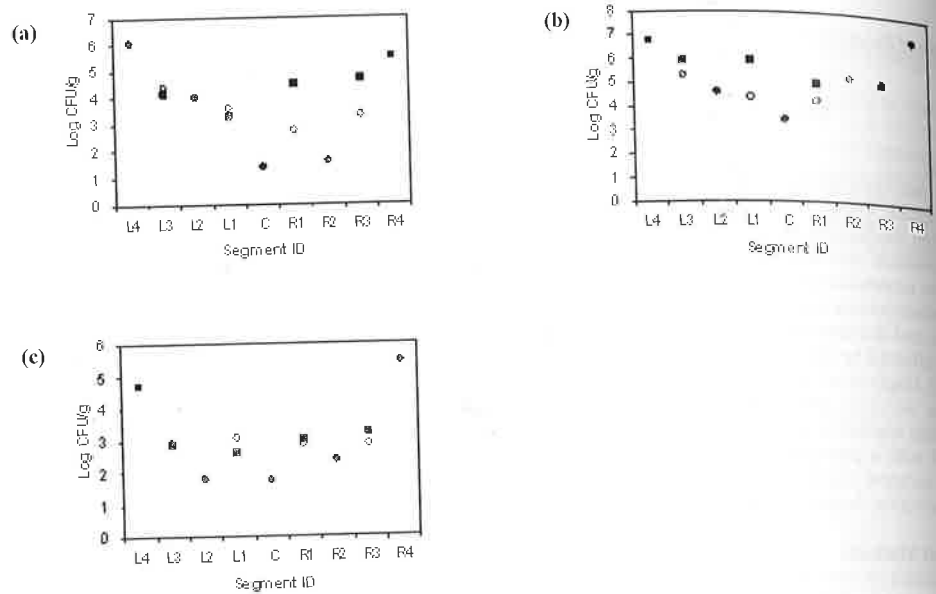


Figure 2: *Salmonella* migration pattern for (a) pre-marination (b) during marination and (c) post-marination. (Open circles, solid circles, and solid squares represent sample cubes from cranial, middle, and caudal slices, respectively).

Conclusions

These results suggest that *Salmonella* can enter and survive in value-added or marinated turkey products. Our results provide important information for product and process safety, which is necessary to develop a quantitative model for pathogen migration into whole-muscle poultry products during the marination process. In addition, our research provides preliminary information and feasibility in developing 3-D profiles of bacterial penetration into whole-muscle products during the marination process.

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