RESEARCH REPORT
PORK SAFETY

Title: Validation of Temperature Parameters as CCPs During Pork Fabrication
NPB# 01-118

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Abstract:

Samples from chilled pork carcasses and subprimal cuts were taken in the university meat lab in pork fabrication areas where the carcasses were fabricated in both refrigerated and non-refrigerated areas. The presence of *Salmonella* and *Campylobacter* as well as the presence of indicator organisms was determined. Samples were collected at the beginning of the day, at mid-shift and at the end of the day. Ten carcasses/cuts per day in 3 separate sampling days during the spring, summer and fall were collected. The refrigerated meat lab area was maintained at a temperature of 50 F while non refrigerated areas were maintained at 70-75 F. Generally, in all processes, carcasses and cuts remained in the fabrication areas for less than 2 hour with most being in the area for less than 1 hour. In addition to carcass sampling, environmental samples were collected to determine if cross-contamination could occur. In the processing plant environments, there were no significant increases in indicator organisms or in pathogen loads during the processing day indicating that the environments were safe as long as the carcasses were fabricated quickly and returned to the cooler within 2 hours. There were no differences in seasonal data.

Because this information did not set a critical limit for processors with regard to processing room times/temperatures, further studies were conducted under more controlled settings in the lab environment. We determined that there were no significant increases in coliforms or total aerobic plate counts when the subprimal cuts were held in a non-refrigerated area for up to 4 hours. At 6 hours, we observed 1-2 log cycle increases on surfaces indicating that the critical limit in a non-refrigerated area should be set at 4 hours. In a HACCP plan, the critical limit when processors fabricate carcasses in non-refrigerated areas maintained at or below 75 G should be a time factor of less than 4 hours.

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Introduction

The implementation of HACCP plans to reduce hazards must be based on sound, scientific data. Small and very small processors are presented with limitations in facilities and refrigeration that require specialized management for HACCP and food safety (Boyle et.al, 1997; Brashears et. al. 2000). Additionally, past experience in working with small processors in has pointed out the need for scientific information to develop sound HACCP plans, especially in fresh meat processing environments. Most of the needs have focused on time and temperature parameters for fresh meat processing. The USDA Technical Services Center has listed temperature control during fresh meat processing as one of their most frequently addressed issues (USDA, 2000).

Specifically, there is little information available on the relationship of temperature change of meat as compared to environmental temperatures during processing. Increased product temperature is a significant issue when temperature is used as a critical limit for a critical control point (CCP) in fresh meat processing. Many small processors fabricate products in rooms at temperatures above 50^{o}C. They need simple, easy to understand guidelines to use in HACCP plans in order set critical limits and to monitor them to maximize product safety. This type of information will assist processors in refining HACCP plans for determining monitoring frequency and to avoid exceeding critical limits in the HACCP plans. Excessive monitoring frequency can increase the difficulty of HACCP plan management for small processors and exceeding critical limits could result in product and economic losses. Having defined time and temperature parameters will allow for science-based decisions by small processors.

Project Objectives:

The objective of this project was to determine safe critical limits and monitoring methods associated with a temperature CCP for small pork processors processing product in non-refrigerated areas. Data can be used to support HACCP plans and to justify their processing methods.

Methods:

The university meat laboratory was used as a processing control area where pork carcasses were fabricated at temperatures at or below 50°F. Additional data was collected in areas maintained at 70 F.

Sampling Methods

Chilled pork carcasses (24 hours after slaughter) were sampled using the USDA sponge sampling method (USDA, 1996) and the internal and surface temperature was determined immediately prior to fabrication. On each day of sampling 10 carcasses were sampled. After fabrication, 30 subprimal cuts from carcasses not previously sampled were sampled just prior to packaging and cold storage using the sponge method to determine if there is an increase in the microbial populations. The 30 subprimal cuts were collected throughout the process day, 10 samples immediately after start up, 10 samples at midshift, and 10 samples at the end of the shift. The surface temperature and the internal temperature were also noted. We noted the amount of time it took for carcasses to move throughout the process. The room temperature during fabrication was followed continuously with a temperature recorder. We sampled 2 times in the summer, fall and winter months to account for seasonal variation in incoming microbial populations and for fluctuating room temperatures.

Carcass data was supplemented with sponge samples taken from equipment work areas including tables, knives, and/or saws depending on the processing environment. This data is critical to determine if microorganisms transferred to equipment from carcasses grow during the process day.

Microbiological Parameters to be Examined:

We determined the total aerobic plate counts, coliform/generic *E. coli* counts, and presence of *Salmonella* and *Campylobacter* on each sample. The following microbial analyses are based on methods described in the USDA/FSIS Microbiology Laboratory Guidebook (USDA, 1998) and in the FDA Bacteriological Analytical Manual (USDA, 1995).

Samples were serial diluted and plated onto plate count agar incubating plates at 35°C for 48 h for determination of total counts. Generic *E. coli* and coliforms were enumerated by plating on violet red bile agar supplemented with 0.4 ug of 4 methyl umbelliferyl-beta-D-glucuronide (MUG) per ml and incubating at 37°C for 24 hours. Typical coliform colonies were counted and generic *E. coli* counts will be determined by examining plates with a longwave UV light. Supplemental MPN analysis was conducted when populations were low.

The presence of *Campylobacter* on the carcasses was determined by pre-enrichment in Hunt Enrichment Broth (HEB) in a Quik Seal Bag with microaerobic Campy gas mixture added. The bag was sealed and incubated at 37°C for 4 h in a shaking water bath. Sterile cefoperazone solution was added to yield a concentration of 30 mg/L. The enrichment was streaked onto Modified Campylobacter Charcoal Differential Agar (MCCDA) to obtain isolated colonies. MCCDA plates were incubated at 42°C for 24 in an anaerobic jar with a CampyPaK Plus (BBL) gas generating kit. Three typical colonies from the plates were transferred to brucella-FBP broth and incubated for 24-48 h at 42°C in an aerobic jar with microaerobic conditions. A wet

mount of broth cultures was examined for typical *Campylobacter* colony morphology and motility. Latex agglutenation tests were used to confirm identity.
The presence of *Salmonella* was determined by incubating in TT broth rappaport vassiliadis (RV) broth. Both was incubated at 42°C for 22-24 h. Broth cultures were streaked onto xylose lysine tergitol 4 agar (XLT4) and brilliant green sulfa agar (BGS). Plates were incubated at 35°C for 22-24 h. Typical colonies were streaked onto triple sugar iron (TSI) agar and Lysine Iron agar (LIA) slants were inoculated. Slants showing typical and/or suggestive *Salmonella* reactions were confirmed through biochemical reactions and serological testing. Positive and negative controls were included for both pathogens.

Results

During the processing day there were no significant increases ($P<.05$) in the numbers of coliforms, total aerobic organisms, Salmonella or Campylobacter. Additionally, there were no differences in the amount of organisms in processing areas maintained at 50 F vs those maintained at closer to room temperature (70-75 F). There were no significant differences in the surface or internal temperatures in the non-refrigerated areas or the refrigerated areas at any point during the processing day.

The total aerobic plate counts on carcasses were around 2.5 $\log_{10}$ cfu/cm^2 while those on subprimal cuts were around 2.5 $\log_{10}$ cfu/cm^2 (Figure 1). This did not represent a significant increase. Similarly, on product contact surfaces, there were no significant increases during the processing day with surfaces having around 0.5 $\log_{10}$ cfu/cm^2 at the beginning of the day and just over 1.0 $\log_{10}$ cfu/cm^2 at the end of the day. There were no seasonal effects so data were averaged over season.

Similar trends were observed for the coliform counts with the carcass and subprimal cuts containing around 1.0 $\log_{10}$ cfu/cm^2 during the entire processing day (Figure 3). Again, on processing surfaces, there were no significant increases with the coliforms being non-detectable at the beginning of the shift and then only increasing to less than 1 $\log_{10}$ cfu/cm^2 (Fig 4).

Less than 5% of the samples were positive for *Salmonella* and less than 3% were positive for *Campylobacter* and there were no significant increases during the processing day.

This part of the study indicated that products would remain safe in a processing area maintained at room temperature if they were in the area for less than 2 hours. However we wanted to determine how long it would take to reach significant growth at room temperature so a second study was conducted where we held subprimal cuts at room temperature until a significant amount of growth was observed. Significant growth of coliforms and total aerobic plate counts was observed at 4 hours (Figure 5). We are currently in the process of evaluating inoculated samples to determine growth patterns of *Salmonella* at various temperatures to determine pathogen behaviors on pork surfaces.

From this data we can conclude that a processor can fabricate pork carcasses in non-refrigerated areas for up to 4 hours without significant increases in microbial loads on the surfaces of the carcasses.

Figure 1. Total Aerobic Plate Counts on Raw Pork Surfaces During Processing. There were no significant increases/differences during the processing day (P<.05)

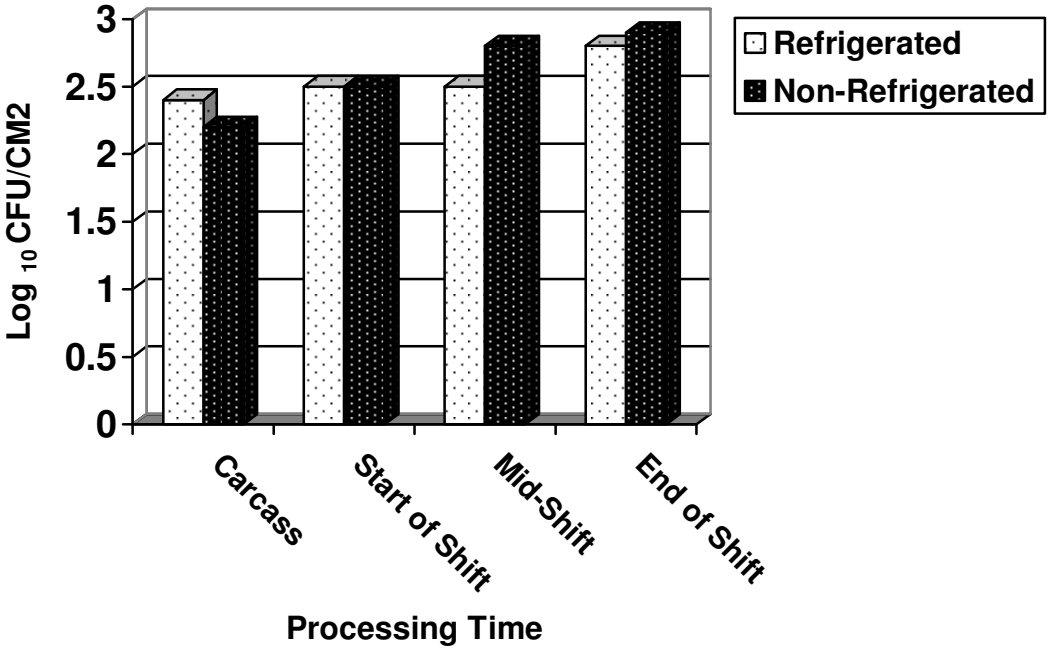


Figure 2. Total Aerobic Plate Counts on Environmental Surfaces During Processing of Pork Carcasses. There were no significant increases during the processing day (P<.05)

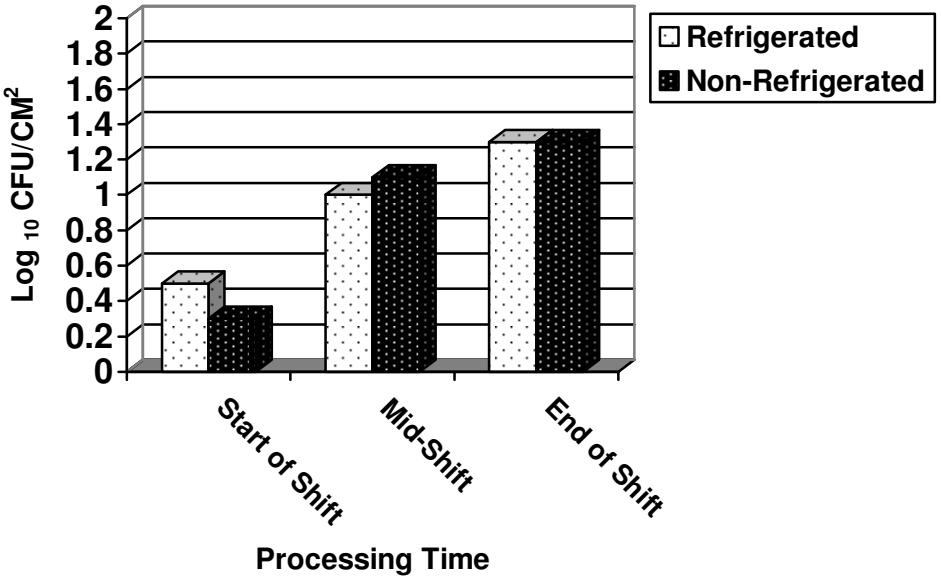


Figure 3. Coliform Counts on Raw Pork Surfaces During Processing. There were no significant increases/differences during the processing day (P<.05)

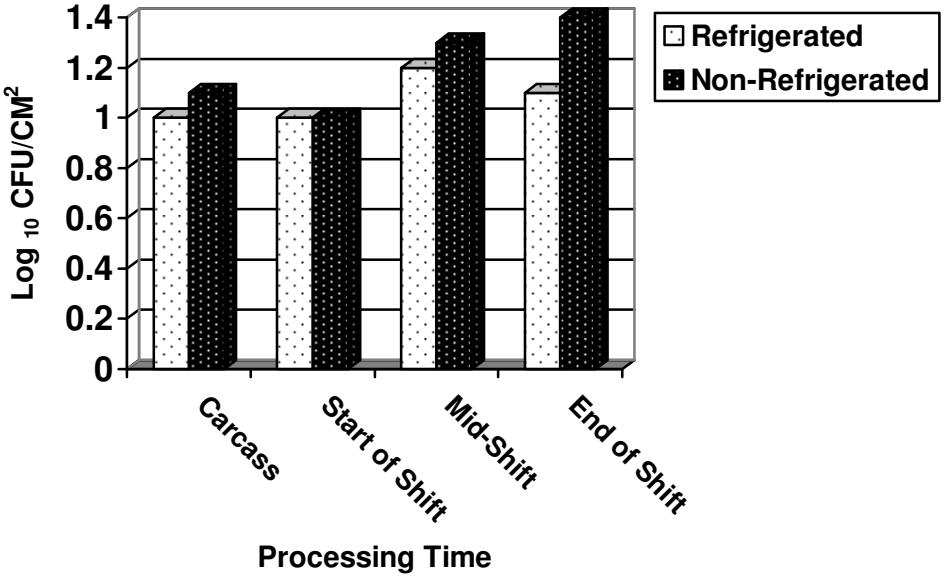


Figure 4. Coliform Counts on Environmental Surfaces During Processing. There were no significant increases/differences during the processing day (P<.05)

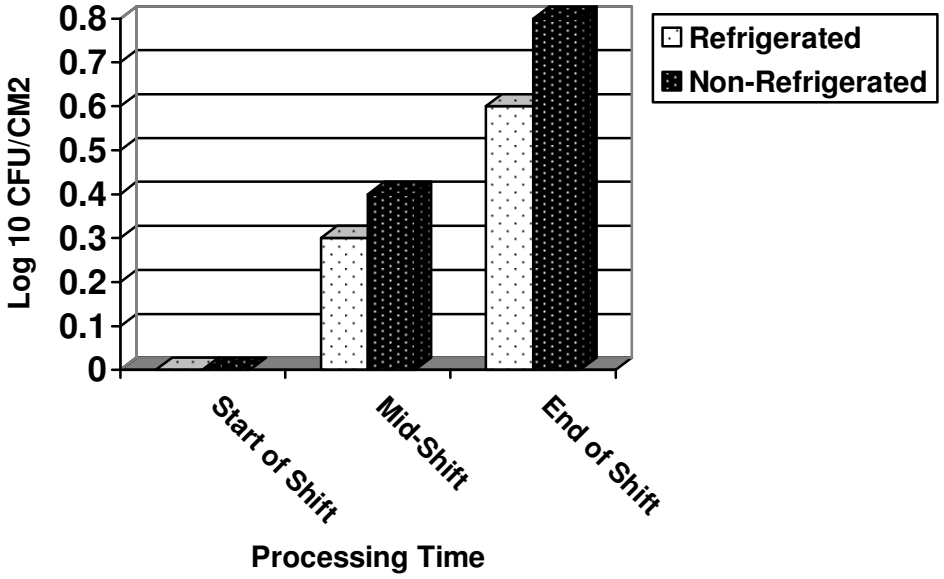
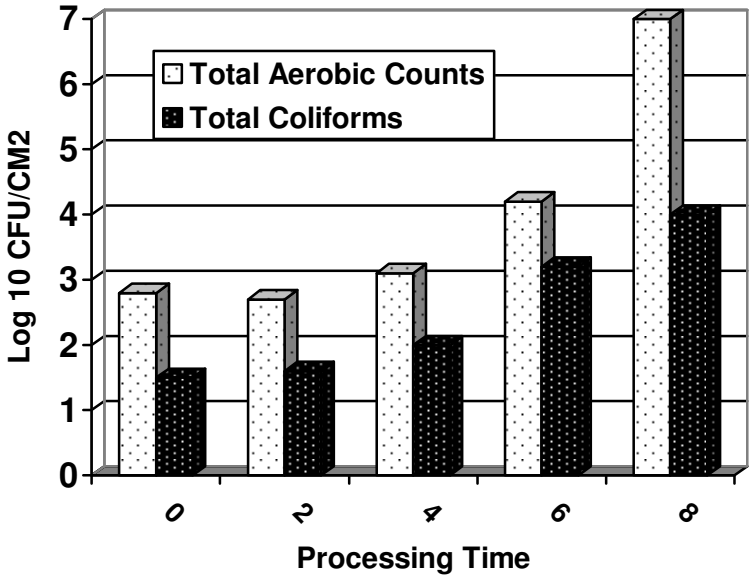


Figure 5. Total Aerobic Plate Counts and Coliform Counts on Raw Pork Surfaces held at 70 F for 8 hours. Significant increases occurred at 5 hours and continued to significantly increase at each subsequent sampling hour.



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