POULTRY CAN BE THAWED SAFELY ON THE COUNTER AT AMBIENT TEMPERATURE

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Background

Raw poultry are contaminated with various spoilage and pathogenic bacteria (1). These bacteria do not multiply when frozen and may actually decrease in population. However, as soon as frozen raw poultry products begin to thaw, any bacteria that may have been present before freezing can begin to multiply again when the temperature increases to their growth range. The USDA, using the research of Klose et al. (4), allows poultry to be thawed at room temperature. The FDA Food Code (2) recommends that food be thawed in the refrigerator or in flowing water, but provides no research to show that these methods of thawing are required to insure safety. Thawing large poultry carcasses in the refrigerator can be inefficient and time-consuming, in addition to occupying refrigeration space required for other food items.

Objective

The purpose of this research was to study the population changes of spoilage bacteria in chicken, and of *Salmonella hadar* in inoculated chicken carcasses thawed on the counter at ambient temperature, in flowing water and in refrigeration.

Methods

Uninoculated chicken.

Three chicken carcasses, approximately 3 kg each, were obtained from a local commercial poultry processing plant. Within a few hours after slaughter and evisceration the carcasses were transported under refrigeration to the research laboratory. Three-10 g samples of skin from each chicken carcass were excised aseptically before the chicken carcasses were frozen and after the carcasses were thawed. Each of the 10 g samples was a composite of skin from 6 areas of the carcass (breast, leg, thigh, back, neck and wing). Each of the samples was homogenized in a 0.1% peptone/water solution with a Stomacher. Total viable organisms (PCA, 25°C 48 h), total Enterobacteriaceae (VRBD, 35°C 48 h) and pseudomonad counts (Cetrimide, 25 °C 48 h) were determined. Minimum confirmatory tests were also done. To isolate and confirm salmonellae, the ICMSF official method (3) was used.

Inoculated chicken

Three chicken carcasses, approximately 3 kg each, were obtained from a local commercial poultry processing plant. The chickens were then inoculated with *Salmonella hadar*. The *Salmonella hadar* strain was maintained in tryptic soy agar (TSA, Difco) at 5°C. Cultures were activated at 37°C for 24 h in tryptic soy broth (TSB, Difco) for 3 successive transfers. Then, they were diluted in 0.1 M potassium phosphate buffer (pH 7.0) to give a viable cell population of around 10^7 CFU/ml. By means of a sterile scalpel and a 100 cm^2 stainless steel frame, the area of the chicken to be inoculated was outlined. A 0.1 ml *Salmonella hadar* inoculum was successively added and spread over the defined area until 1 ml of the inoculum was applied. This procedure allowed the inoculation solution to dry on the skin of the chicken within the defined analysis zone. After inoculation, the chicken carcasses were placed in a laminar, sterile air-flow chamber for 30 minutes to allow the microorganisms time for attachment.

Recovery

Half of the inoculated chicken skin was removed to enumerate cells before freezing. The remaining half of the inoculated skin remained on the carcass for *Salmonella hadar* enumeration after thawing. The samples were individually placed in 90 ml of buffered 0.1% peptone water and shaken for 3 min. Decimal dilutions were performed serially. Aliquots of 0.1 ml were then plated onto Hecktoen agar and XLD (xylose lysine deoxicholate) agar (35°C, 24h). Presumptive positive colonies were selected, streaked, and stabbed into lysine iron, triple sugar iron and urea agar slants for serological confirmation (35°C, 24h).

Thermocouple placement and temperature measurement

A Dual Log R® Thermocouple Thermometer Model N° 600-1050 (Barnantt, Chicago, IL USA) recorded freezing and thawing temperature data. On each carcass, one thermocouple (T_1) was located 3.5 cm inside the breast, and the other thermocouple (T_2) was located just under the skin of the thigh. The carcasses were then frozen to -20°C within 10 h. At the start of freezing, the temperature in the breast (T_1) was approximately 6°C and under the skin in the thigh (T_2) was 17°C. Carcasses were thawed on the counter at ambient temperature, in flowing water, or in the refrigerator. Thawing was halted when a temperature of 4.4°C was reached in T_1.

Statistical analysis

Differences between in initial and final counts (in log) in bacterial populations were evaluated by a t-test analysis.

Results and discussions

Uninoculated chicken

Thawing chicken on the counter at ambient temperature (22 °C), in flowing potable water (21°C) or in the refrigerator (3.5 to 7.2°C) are shown in Fig.1. The time required for temperature to reach 4.4°C at T_1 was 9 h, 2.75 h and 55 h, respectively.

Data in Figure 2 show the changes in the bacterial population of the uninoculated chickens. The population change that occurred after thawing on the counter at ambient temperature was shown to be not statistically significant for aerobic plate counts but significant for Enterobacteriaceae ($P=0.050$) and pseudomonads ($P=0.087$)

When the chicken was thawed in flowing water, there was no statistically significant change in aerobic plate count and Enterobacteriaceae. However, the slight decrease in pseudomonad population ($P=0.049$) was found to be statistically significant.

The greatest change in population was noted in an increase of pseudomonads that occurred when the chicken was thawed in the refrigerator. In this case, pseudomonads grew almost a half log while in the other two methods of thawing the cell population of

pseudomonads decreased or showed little change in population. The increase of pseudomonads that occurred when the chicken was thawed in refrigerator was shown to be significant (P=0.048) The changes that occurred in the aerobic plate count and Enterobacteriaceae during thawing in the refrigerator were not statistically significant. No salmonellae were detected in any of the uninoculated chicken samples before freezing or after any method of thawing.

Salmonella inoculated chicken

Thawing the chicken inoculated with Salmonella on the counter at ambient temperature of 22°C, in flowing potable water (21°C) and in the refrigerator (3.5 to 7.2°) are shown in Fig.2. The time required for temperature to reach 4.4°C at T_1 was 13.75 h, 5 h and 33 h, respectively. Table 1 shows the changes (population decrease) in *Salmonella hadar*. In all the inoculated chicken samples there was approximately 1 log reduction in salmonellae population regardless of the thawing method.

Conclusions

It is apparent from the results of this study, that there is a slight reduction of the bacterial cell counts during freezing and thawing due to cell injury. During the extended period of time required to thaw the chicken in the refrigerator, pseudomonads (which multiply slowly at 0-2°C) increased slightly in population. Salmonella spp. do not multiply below 5°C.This is shown by the results of thawing inoculated chickens. Temperature and time during any of these thawing methods was not sufficient to allow the growth of *Salmonella hadar*.

This study has shown that thawing on the counter at room temperature (21-22°C) within 14 hours or less to an internal temperature of 4.4°C (3.5 cm within the breast) is a safe procedure. Thawing chicken in flowing water is a safe, rapid method. Thawing poultry in a standard refrigeration unit at a temperature of 3.5 to 7.2°C requires a longer thawing period at temperatures that encourage the growth of pseudomonas spoilage bacteria.

Pertinent Literature

1- CAST (Council for Agricultural Science and Technology) 1994. Foodborne pathogens: Risks and consequences. Task Force Report N°122. CAST, 4420 West Lincoln Way, Ames, IA.

2- FDA Food Code. 1999. U.S. Public Health Service, U.S. Dept. of Health and Human Services. Pub.N°.PB99-115925. Washington, D.C.

3- International Commission of Microbiological Specifications for Foods. 1978. Microorganisms in Foods1.Their Significance and Methods of Enumeration. 2nd edition. pp. 160-172. University of Toronto Press. Toronto, Canada.

4- Klose, A.A., H.Lineweaver, and H.H.Palmer. 1968. Thawing turkeys at ambient air temperature. Food Tech. 22: 1310-1314.

Figure 1. Temperature vs.time during thawing of uninoculated chicken

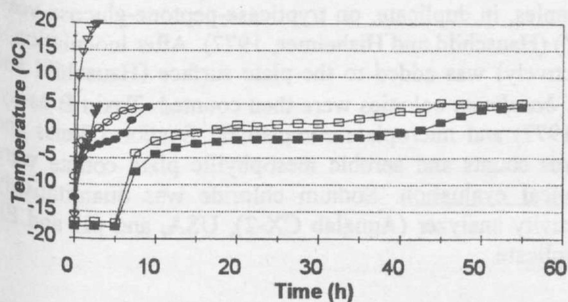

Figure 2. Temperature vs.time during thawing of inoculated chicken

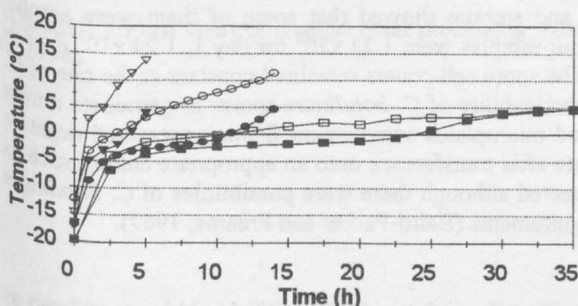

Figure 3. Bacterial population before freezing (Ni) and after thawing (Nf)

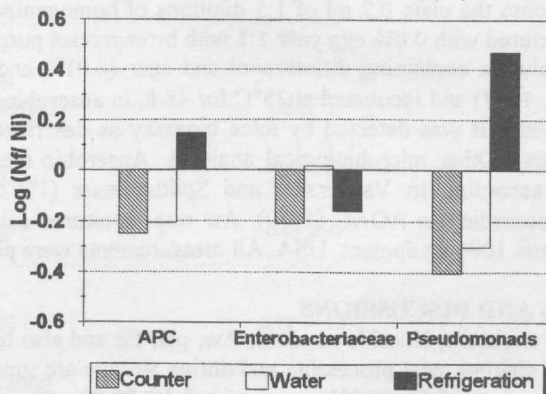

Table 1.Changes in Salmonela hadar population as affected by thawing method

Thawing Method	Salmonella hada Log (Nf/Ni)
On the counter	-0.915
Flowing, potable water	-1.061
In the refrigerator	-0.979

Nf = CFU/g after thawing
Ni = CFU/g before freezing