

# Hot Water Rinses as a Bacteriological Intervention Strategy on Swine Carcasses

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### Summary and Implications

Hot water rinses were applied to the forelegs of hog carcasses intentionally contaminated with manure. The water temperature varied from ambient temperature (25°C) to 82°C. The hot water washes were followed by a 1.5% acetic acid rinse, and the carcasses were sampled before the hot water rinse, after the rinse, and after the acid rinse. The hot water rinses reduced the total aerobic population by approximately 2 log<sub>10</sub> cycles and the population of *Enterobacteriaceae* by approximately 2.5 log<sub>10</sub> cycles. The acid rinses reduced the total aerobic population by an additional 0.3 log<sub>10</sub> cycle (total of 2.3 log<sub>10</sub> cycles) and the population of *Enterobacteriaceae* to below detectable limits (total of 4 log<sub>10</sub> cycles).

### Introduction

Microbial contamination of animal carcasses during slaughtering is an unavoidable problem in the conversion of live animals to meat for consumption. Much of the initial contamination comes from the hide during removal. The exposed surface of the hide and the hair accumulates dust, dirt, and fecal material (3). It has been demonstrated that slaughter instruments could spread contamination into the internal organs of beef cattle. The workers in slaughter operations also can be a source of contamination, as *Salmonella* spp. and *Escherichia coli* have been isolated from the hands of workers even after thorough washing. A variety of methods has been developed to reduce the levels of contaminating bacteria on carcasses, although most of the current methods focus on washing and sanitizing procedures (4).

Decontamination of carcasses with hot water could have several advantages over the use of chemicals. Paterson (6) reported that beef carcasses treated with a steam and hot water spray (80°C–96°C) for 2 min contained significantly lower bacterial numbers than untreated carcasses. Even though some discoloration on the carcass surface occurred initially, the normal color returned after cooling for 24 hours (1). Hot water treatments have also resulted in significant reductions in bacterial populations on hog carcasses (5). Animal carcasses are known to be contaminated with a variety of pathogenic bacteria, including *Salmonella*, *Campylobacter*, *E. coli* and *Listeria*.

High-pressure washing with only water has been found to reduce the total aerobic and *Enterobacteriaceae* counts by 1 and 1.5 log cycles, respectively (2). Immersion in water at 80°C for 10 seconds of whole sheep carcasses taken off the end of the slaughter line in a commercial abattoir destroyed 99% of the contaminating coliform organisms and 96% of the total number of aerobic bacteria initially present on the surface tissues (7).

### Materials and Methods

Market weight hogs were intentionally contaminated with fresh manure on their forelegs. The forelegs were washed with water at temperatures ranging from ambient to 65°C. The water was applied with a low pressure applicator operating at 25 psi. Following the water rinse, the forelegs were sanitized with acetic acid (1.5% vol/vol), using a low pressure garden type sprayer.

Microbiological samples were taken by aseptically excising a 2 cm × 2 cm section of the skin to a depth of approximately 2 mm. The samples were homogenized in buffered peptone water and serially diluted in the same buffer. Total aerobic populations were enumerated by surface plating on tryptic soy agar incubated at 32°C for 48 hours. Total *Enterobacteriaceae* populations were enumerated by surface plating on violet red bile glucose agar incubated at 37°C for 24 hours.

### Results and Discussion

Table 1 shows the effects of hot water and acid rinses on the total aerobic populations (log<sub>10</sub> CFU/cm<sup>2</sup>). The ambient water rinse reduced the population by approximately 1 log<sub>10</sub> cycle. Raising the temperature to 65°C reduced the populations by an additional 1.5 log<sub>10</sub> cycles. The application of 1.5% acetic acid reduced the populations by an additional 1.25 (25°C) to 0.3 (65°C) log cycles. The initial contaminating population consisted of a significant portion of sporeformers, so the patterns of survivors were consistent with the presence of spores.

**Table 1. Populations of total aerobic bacteria on hog carcasses (CFU/cm<sup>2</sup>) after water and acetic acid rinses.**

Water Temp (°C).	Water Rinse	Acid Rinse
Control	4.5 (no trt)	(-)
25	3.49	2.25
55	2.64	2.25
65	2.06	1.76

Table 2 shows the effects of hot water and acetic acid rinses on the *Enterobacteriaceae* populations. The ambient

water rinse reduced the population by 1.3 log<sub>10</sub> cycles, and increasing the temperature resulted in an additional 1 log<sub>10</sub> reduction. Following the water rinse with an acid rinse reduced the populations to below detectable limits following a 65°C water rinse. It is suspected that the hot water rinse increased the permeability of the gram- negative cell wall that allows for a greater effect of the organic acid.

**Table 2. Populations of *Enterobacteriaceae* on hog carcasses (cfu/cm<sup>2</sup>) after water and acetic acid rinses.**

Water Temp. (°C).	Water Rinse	Acid Rinse
Control	4.1 (no trt.)	(-)
25	2.7	1.13
55	1.41	1.48
65	1.68	bdl

bdl, below detectable limits.

### References

1. Barkate, M.L., G.R. Acuff, L.M. Lucia and D.S. Hale. 1993. Hot water decontamination of beef carcasses for reduction of initial bacterial numbers. *Meat Sci.* 35: 397–401.
2. Dickson, J.S. 1988. Reduction of bacteria attached to meat surfaces by washing with selected compounds. *J. Food Prot.* 51: 869–873.
3. Dickson, J.S. and M.E. Anderson. 1991. Control of *Salmonella* on beef tissue surfaces in a model system by pre- and post-evisceration washing and sanitizing, with and without spray chilling. *J. Food Prot.* 54: 514–518.
4. Dickson, J.S. and M.E. Anderson. 1992. Microbiological decontamination of food animal carcasses by washing and sanitizing systems: A Review. *J. Food Prot.* 55: 133–140.
5. Eggenberger-Solorzano, L and J.S. Dickson. 1996. Hot water rinses as a bacteriological intervention strategy on swine. Proceedings of the Tri-State Food Safety Consortium Annual Meeting, Kansas City, MO. 20–22 Oct.
6. Patterson, J.J. 1968. Hygiene in meat processing plants. III. Methods of reducing carcass contamination. *Record of Agric. Res.*, Ministry of Agriculture, Northern Ireland 17(1):7-12.
7. Smith M.G. and A. Graham 1978. Destruction of *Escherichia coli* and salmonellae on mutton carcasses by treatment with hot water. *Meat Sci.* 2: 119–128.