



CARCASS WASH INFORMATION

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Carcass wash (90 to 105F, 300 psi). prior to any of the following pasteurization procedures (using a portable spray unit)

Followed by either **hot water pasteurization** - 165F for 5-10 sec. (160F, 10-20 sec)
or

Acid Rinse - 2% acetic acid or 2% lactic acid, at 110-130F (both acid treatments work best on warm carcasses)

Summary

The initial warm carcass wash is important to assist in removing as much organic matter (manure, hair, etc.) from the carcass as possible before continuing hot water or acid rinses. The warm 90-105F water temperature is also important to keep the carcass surface warm, in the event that acid rinse will follow. Research has shown that the higher the pressure that is used to spray warm water the better. While 300 psi might be difficult for some to obtain, the portable spray units that some small processors have, should reach that level of pressure. It is important that steps be taken to prevent this high pressure warm water treatment from blowing fecal contamination all over the slaughter floor. This would be prevented by proper training for those using the sprayer and/or the use of some type of panels or walls to surround the carcasses while being washed.

Hot water pasteurization has been shown to be an effective means to reduce E. coli levels on beef carcasses however, it may be difficult to use water of this temperature on carcasses in some plants. Perhaps the easiest method to reduce pathogens, after the carcass wash, would be the use of an organic acid rinse.

Acetic acid would be recommended over lactic acid at this time due to its availability and safety of its use. Initially, we would recommend that you use vinegar, from a grocery store (5-8% acetic acid), and dilute it to a 2% concentration. Use of chlorine is not recommended as the research is inconsistent in terms of its effect on pathogens. There is also very little research using 50 ppm chlorine solutions on carcasses. Also chlorine is very corrosive.

The following summaries of scientific publications supports the use of these E. coli intervention strategies, as well as other strategies that are not recommended.

Supporting Scientific Publications

Trimming

Trimming reduced *E. coli* O157:H7 population by 3.1 logs (5.14 logs initial), whereas, trimming combined with a warm water wash (35C/95F) reduced *E. coli* O157:H7 by 4.7 logs (5.19 logs initial). Phebus, et al, 1997, *J. Food Prot.* 60(5):476-484.

Acetic Acid

When 2% acetic acid was sprayed onto beef brisket fat for 12 sec., immediately after being inoculated with fecal matter, *E. coli* was reduced by 3.69 logs. When there was a 2 hr. delay between inoculation and application of 2% acetic acid solution, *E. coli* levels were reduced significantly less, at 2.5 logs (which was not significantly different from the use of 35C/95F water, but significantly less reduction than when 74C/165F water was used. Cabedo, Sofos and Smith. 1996. *J. Food Prot* 59(12):1284-1287.

Chlorine

50 ppm chlorine (at 25C/77F) sprayed on pork carcasses reduced *S. typhimurium* by 2.25 logs (equal to the reduction with a 2% lactic acid rinse). When hot water wash (10 sec) was applied after the chlorine rinse, *S. typhimurium* was reduced an additional 2.5 logs. N. Clayton, 2002. unpublished thesis from U. Kentucky.

Over all average: Reduced total aerobic counts on beef forequarters from 3,000/cm before wash, 100/cm² 45 min. after wash and 27/cm² 24 hrs after 200 ppm chlorinated (generated electrolytically) water wash. Increasing spray pressure from 4.2 kg/cm² to 246 kg/cm² caused significant reductions in counts, to levels comparable to low pressure, high temperature (51 .7C) wash. Kotula et al., 1974, *J. An. Sci.*39(4):674-679.

Strips of beef plates treated with 200-250 mg/L sodium hypochlorite (Chlorox) resulted in a mean decrease in counts of 0.43 logs, and counts increased over 48 hrs., showing no residual effect. The higher pressure treatment (14.0 kg/cm²) resulted in a larger reduction (0.47 logs) than the lower pressure treatment (3.5 kg/cm²). Unpublished data showed that significantly less growth occurred on hypochlorite treated carcasses that were not washed prior to the treatment, suggesting that the water wash hypochlorite reducing its effectiveness. Anderson, M. E. 1977. *J Food Sci.* 42(2):326-329.

80C (176F) water rinse was approx. equivalent to 95mg/L chlorine at 55C (131F) in reducing aerobic plate counts on lamb carcasses (> 1log reduction). Greater reductions were found at either 65 (149F) or 80C, using 30 mg/l chlorine. Kelly, et al. 1981. *J. Appl. Bacteriol.* 51:415-424.

Hot Water

Beef brisket adipose tissue, inoculated with 6.3 log CFU of *E. coli* per cm² treated with 74C (165F) water wash, followed by a 16C (61F) water wash resulted in a 3 log reduction. However, if reversed in order (16C water wash, followed by 74C water wash), *E. coli* was reduced by only 2.6 logs. Gorman et al. 1995 *Food Prot.* 58:899-907

Sheep carcass surfaces submerged in 80C (176F) water for 10 s reduced *E. coli* by 3.3 log (6 log inoculation). Smith and Graham. 1978. *Meat Sci.* 2:119-128.

Log reductions of *E. coli* from beef sides (6.8 log inoculation) treated with hot water at 2 temperature and 2 splay times:

Temperatures: 66C (151F) 74.2C (166F) 83.5C (182.3F)
Time: 10sec 0.91 1.4 2.33 / 20 sec. 1.1 2.1 3.0

Davey, K.R. and M.G. Smith. 1989. *Int. J. Food Sci & Tech.* 24:305-316

Sequential water rinses resulted in the following reduction (from 6.8 log initial) of *E. coli*:

Pre-evisceration wash (tap water at 21-54C, 345 kPa, 5.6 sec) = 1.1 log reduction
Final wash (tap water at 21-54C, 2069 kPa, 20 sec) = 1.5 log reduction
Hot-water rinse (80C/176F), 207 kPa for 5.6 sec) = 1.8 log reduction
Final wash plus hot-water rinse (above) = 2.3 log reduction

Delmore-Graves, L.R, J. N Sofos, G. R. Schmidt and G. C. Smith. 1998. *J. Food Sci.* 63(5):890-893

After 24 hrs. 51.7C (125F) water reduced total aerobic counts by 3.2 logs, compared to 12.8C (55F) water reducing total aerobic counts by 2.3 logs., Kotula et al., 1974, *J. An. Sci.*39(4):674-679.

80C (176F) water on carcasses leaves a bleached, gray appearance which help determine if entire carcass has been treated, 7 strains of *E. coli* reduced >1 log with 60C (140F) water, for 10 sec, reduced 3 logs with 80C (176F) water for 10 sec., roughly the same response with the 20 sec. treatment, with the 80C (176F) water approaching 3.5 log reduction. Used meat pieces, not carcasses. Smith, M. G. (1992) *Epidemiol.Infect.*109:491

80C (176F) water poured on beef and mutton samples for 10 sec reduced 6.5 logs of *E. coli* by 99% Smith & Graham, 1978

A hot water wash (74/165F at 20.7 psi, followed by 30C/86F at 125 psi water), reduced *Listeria innocua* on beef carcasses by 2.5 logs. This same water wash treatment reduced *E. coli* MARC1-s by 2.6 logs. Dorsa, Cutter and Siragusa,

A hot water treatment (53C/127F) for 10 s resulted in the greater reduction of *S. typhimurium* on pork carcasses, than a 10 S flame singe, 50 ppm chlorine or 2% lactic acid, with a 3.7 log reduction. A second hot water rinse (53C/127F) further reduced *S. typhimurium* counts by additional 1 log. N. Clayton, 2002. unpublished thesis from U. Kentucky

Hot water (74C/165F, for 20s at 20.7 bar) was claimed to be more effective in reducing *E. coli* contamination (4.2 log reduction) than either organic acids or cooler water, however, the reduction was not significantly different ($P > 0.05$) than that for 35C water, 5% hydrogen peroxide, and 2% acetic acid. Cabedo et al., 1996. *J. Food Prot* 59(12)1284-1287.

Lactic Acid

A 2% lactic acid solution sprayed on pork carcasses reduced *S. typhimurium* by 2.25 logs (equal to the reduction by 50 ppm chlorine rinse). When a hot water wash (10 sec) was applied after the chlorine rinse, *S. typhimurium* was reduced an additional 2.2 logs. N. Clayton, 2002. unpublished thesis from U. Kentucky.

A water wash (hand held sprayer, 35C, 1.5 L, 10 psi, 90 sec, followed by a high pressure, 5 L, 250 psi for 5sec, and finally, 400 psi for 4 sec) followed by a 2% lactic acid spray (200 ml, 40 psi, 55C/131F) was the most effective antimicrobial treatment compared, with log reductions of E. coli O157:H7 ranging from 3.0 to 4.9, depending upon what carcass surface was sampled; water wash combined with 2% lactic acid was better at reducing E. coli O157:H7 than either trimming or water washing alone, and was significantly better at reducing E. coli O157:H7 than water wash combined with acetic acid. Hardin, M. D. et al., 1995. J. Food Prot. 58:368-373.

Singeing

Flame singeing of pork carcasses for 10 s, reduced *S. typhimurium* population by 2.2-3 logs, and for 20 s by 3.1 logs.. Beef carcass singeing research that includes E. coli O157:H7 is now being conducted. N. Clayton, 2002. Unpublished theses from U. Kentucky