



EFFECTS OF HOT WATER AND LACTIC ACID TREATMENT OF PORK CARCASS PRIOR TO COOLING ON MICROBIAL AND ULTIMATE PORK QUALITY

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Background

Prevention of microbial contamination during slaughtering and processing is one of the most critical safety issues of pork. Although the process carried out under ideal conditions, the pork from normal and healthy pigs could present opportunities for contamination with a variety of bacteria including some pathogens. Several intervention strategies have been developed to reduce bacterial numbers on pork carcass surface such as washing with hot water, chlorinated water, organic acids, alone and in combination. The combination of hot water and lactic acid treatment seemed to be the most effective for reducing microbial of beef (Gill and Landers, 2003), pork (Gordon and Bryan, 1995), chicken (Moon et al., 2004) and lamb (James et al., 2000). However, despite the effects of hot temperature organic acids on reducing pathogens, it would be expected to have some deleterious effects on meat quality. Especially pork quality could be affected by hot temperature treatment sensitively, but the information is limited.

Objectives

The effects of hot water and lactic acid treatment on microbial counts of eviscerated pig carcasses prior to cooling and ultimate pork quality at postmortem 24 hrs were investigated.

Materials and methods

Twenty pigs were slaughtered and split. Hot carcasses sides were inoculated with bacterial cocktail by pouring 500 ml of a peptone saline containing *E. coli*, *Salmonella* and *Listeria*. Inoculums were prepared from frozen (-20°C) stock cultures of *Escherichia coli* (ATCC #25922), *Salmonella typhimurium* (ATCC #14028) and *Listeria monocytogenes* (KCTC # 3569). Frozen cultures of *E. coli*, *S. typhimurium* and *L. monocytogenes* were thawed, and bacteria suspension was inoculated into separate of TSB. After 16 h of incubation at 37°C, suspended in the same volume of 1ml and then pooled together (1,000 ml of *E. coli*, 1,000 ml of *S. typhimurium* and 1,000ml of *L. monocytogenes*) to make a bacterial cocktail. The cocktail (For each specie in 3,000ml, 10⁵ or 10⁶ CFU/ml) was cooled to 4°C and used to pour upon carcasses. Carcasses were spray washed with hot water and 2% lactic acid at 80°C from a spray nozzle for 10, 20, 30 s, while for the cold spray treatment, the temperature was 15°C and the exposure time 30 s. After spray washing, sampling of the outside of carcasses for bacteriological examination was carried out by swab method. The swab sampling included four sites of the abdominal cavity and three sites of the back. After cooling of the carcasses for 24 hrs at cold room, pork loins were sampled to measure meat color and water-holding capacity. Meat color was measured by using a Minolta Chromameter CR-301, and water holding capacity was calculated by % drip loss (Joo et al., 1999). The data were analysed using statistical analysis systems (SAS, 1999). To evaluate the differences among treatments, data were analysed by analysis of variance and Duncan's multiple range test.

Results and discussion

As expected, total bacterial numbers were significantly reduced by spraying with hot water and 2% lactic acid, but not effectively reduced with spraying of cold lactic acid for 30 s (Table 1). Total plate count (TPC) showed about a 2.79 log unit reduction as a result of hot water spray while about a 1.57 log unit reduction was observed with spraying of cold lactic acid. TPC of pork carcass surface was completely removed by spray washing with 2% lactic acid at 80°C for 30 s. Moreover only 20 s treatment of 2% lactic acid at 80°C also effectively reduced all pathogens. This could be achieved by treatment with hot water for 30 s too. However, spray washing of 2% lactic acid at 15°C for 30 s did not completely eliminate *E. coli*, *S. typhimurium* and *L. monocytogenes*. Results suggested that a temperature of washing material was more effective in reducing the numbers of pathogens than a kind of washing material. Although spray washing for 30 s with hot temperature water and lactic acid completely eliminated microbial on the surface of carcasses,



pork loin showed undesirable color and water-holding capacity at 24 hrs postmortem (Table 2). The lightness values of pork loin treated hot water and lactic acid were significantly higher than those of cold treatments. Also drip loss % was significantly increased in loins from carcasses that spray washed with water and 2% lactic acid at 80°C for 30 s. After spray washing with hot water for 30 s, pork loins showed pale color, soft texture and exudative surface of meat. The PSE condition of pork loin was probably due to denaturation of proteins by hot temperature spray washing. However, pork loin treated with hot water for 20 s had a normal color and WHC. These results suggested that spray washing with 2% lactic acid at 80°C for 20 s would be the most effective for reducing bacterial numbers on the surface of pork carcass without deterioration of ultimate pork quality.

Conclusions

Spray washing of pork carcass with 2% lactic acid at 80°C for 20 s prior to cooling is the most effective way to reduce microbial including pathogens without any deterioration of pork quality in Korea.

References

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Table 1. Effects of spray washing with hot water and 2% lactic acid on reducing of microbial numbers

Treatments	Spray washing times (seconds)		
	10	20	30
Total plate count (log CFU/cm ²)			
Water 15°C	-	-	3.49
80°C	2.57	1.97	0.70
Lactic acid 15°C	2.97	2.32	1.92
80°C	2.08	0.90	0
<i>E. coli</i> (log CFU/cm ²)			
Water 15°C	-	-	2.32
80°C	1.99	0.43	0
Lactic acid 15°C	2.04	1.81	1.23
80°C	0.99	0	0
<i>S. typhimurium</i> (log CFU/cm ²)			
Water 15°C	-	-	2.69
80°C	2.04	1.40	0
Lactic acid 15°C	2.26	1.90	0.60
80°C	1.04	0	0
<i>L. monocytogenes</i> (log CFU/cm ²)			
Water 15°C	-	-	2.36
80°C	1.92	0.23	0
Lactic acid 15°C	2.08	0.99	0.78
80°C	0.97	0	0



Table 2. Effects of spray washing with hot water and 2% lactic acid on color and water-holding capacity of pork loin

Measurements	Treatments	Spray washing times (seconds)		
		10	20	30
Color (CIE L*)	Water 15°C	-	-	45.41 ^B
	80°C	46.45 ^c	50.97 ^{bA}	54.85 ^{aA}
	Lactic acid 15°C	43.39	44.38 ^B	44.42 ^B
	80°C	45.61 ^b	48.18 ^{bA}	57.92 ^{aA}
Water-holding capacity (% Drip loss)	Water 15°C	-	-	2.34 ^B
	80°C	2.82 ^b	4.92 ^{aA}	4.94 ^{aA}
	Lactic acid 15°C	2.81	2.79 ^B	2.85 ^B
	80°C	2.87 ^b	4.98 ^{aA}	5.28 ^{aA}

^{A,B} Means with different superscript in the same column are significantly different (P<0.05)

^{a,b} Means with different superscript in the same row are significantly different (P<0.05)