**Table of Contents for Supplemental Materials**

[**Table S1.** Initial (not final) search in CABI Abstracts for a systematic review of pathogen reduction treatments against *Salmonella* on pork carcasses (additional terms highlighted in green) 2](#_Toc444551393)

[**Table S2.** Search conducted in SCI-EXPANDED and CPCI-S on 25 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* (Timespan=1900-2015, searched on Web of Science) 5](#_Toc444551394)

[**Table S3.** Search strategy in Ovid MEDLINE® In-Process & other non-Indexed citations and Ovid MEDLINE® (1946 to Present) on Ovid conducted on 25 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* 7](#_Toc444551395)

[**Table S4.** Search run in Science.gov (http://www.science.gov/scigov/) on 30 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* 10](#_Toc444551396)

[**Table S5.** Search strategy used for the International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork (1996–2012) (http://lib.dr.iastate.edu/safepork/) on 31 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* 11](#_Toc444551397)

[**Table S6.** Study-level information form used in the data extraction phase of a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* 12](#_Toc444551398)

[**Table S7.** Intervention-Outcome information form used in the data extraction phase of a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* 17](#_Toc444551399)

[**Table S8.** Risk-of-Bias tool used in a systematic review of *Salmonella* reduction treatments on pig carcasses (modified from The Cochrane Collaboration’s Risk-of-Bias Tool (Higgins *et al.*, 2011)) 22](#_Toc444551400)

[**Table S9.** List of documents excluded at Level 2 (full-text assessment) with reasons for exclusions in a systematic review of *Salmonella* reduction treatments on pig carcasses 26](#_Toc444551401)

[**Protocol S1.** Protocol for the assessment of the magnitude of change in the prevalence of *Salmonella* and quantity of *Salmonella* after administration of pathogen reduction treatments on pork carcasses 40](#_Toc444551402)

[*Objectives and PICO(S) review question* 40](#_Toc444551403)

[*Eligibility criteria (PRISMA item 6)* 40](#_Toc444551404)

[*Information sources (PRISMA item 7)* 41](#_Toc444551405)

[*Search strategy (PRISMA item 8)* 42](#_Toc444551406)

[*Study selection (PRISMA item 9)* 44](#_Toc444551407)

[*Data collection process (PRISMA item 10)* 45](#_Toc444551408)

[*Data items (PRISMA item 11)* 45](#_Toc444551409)

[*Assessment of risk of bias in included studies (PRISMA item 12)* 45](#_Toc444551410)

[*Summary measures (PRISMA item 13)* 45](#_Toc444551411)

[*Synthesis of results (PRISMA item 14)* 45](#_Toc444551412)

[*Risk of bias across studies (PRISMA item 15)* 46](#_Toc444551413)

[*Additional analyses (PRISMA item 16)* 46](#_Toc444551414)

[*Protocol Table P 1. Proposed Study level data extraction form for relevant papers* 48](#_Toc444551415)

[*Protocol Table P 2. Proposed intervention and outcome level form for relevant studies* 52](#_Toc444551416)

[**References** 57](#_Toc444551417)

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# **Table S1.** Initial (not final) search in CABI Abstracts for a systematic review of pathogen reduction treatments against *Salmonella* on pork carcasses (additional terms highlighted in green)[[1]](#footnote-1)

|  |  |  |
| --- | --- | --- |
| Search  no. | No.  hits | Search string |
| #1 | 25,552 | TS=((pork or swine or pig or pigs or hog or hogs or boar or boars or sow or sows) near/7 (carcass\* OR slaughter\* or abattoir\* or bellies))  Index=CAB Abstracts Timespan=All years |
| #2 | 7614 | TS=(pathogen near/4 reduc\*) OR TS=prt  Index=CAB Abstracts Timespan=All years |
| #3 | 57,209 | TS=(wash or washes or washing or washed or rinse or rinses or rinsing or rinsed)  Index CAB Abstracts Timespan=All years |
| #4 | 192,274 | TS=(spray or sprays or spraying or sprayed)  Index=CAB Abstracts Timespan=All years |
| #5 | 157 | TS=(Organic NEAR/5 (decontaminat\* or saniti\* ))  Index=CAB Abstracts Timespan=All years |
| #6 | 46,191 | TS=(PEROXYACETIC OR LACTIC)  Index=CAB Abstracts Timespan=All years |
| #7 | 57,823 | TS=(ACETIC OR hypobromous or citric or "mineral acid$" or peracetic) |
| #8 | 6609 | TS=((HYDROCHLORIC OR NITRIC OR PHOSPHORIC OR ACID) NEAR/5 (spray\* or decontaminat\* or saniti\* or wash\*))  Index=CAB Abstracts Timespan=All years |
| #9 | 134 | TS=NONACID  Index=CAB Abstracts Timespan=All years |
| #10 | 50,030 | TS=((hot or cold or electrolyzed or electrolysed or warm) NEAR/3 water ) OR TS=(“heat treatment”)  Index=CAB Abstracts Timespan=All years |
| #11 | 70,878 | ts="water treatment$"  Index=CAB Abstracts Timespan=All years |
| #12 | 24,497 | TS=steam  Index=CAB Abstracts Timespan=All years |
| #13 | 70 | TS="AQUEOUS OZONE"  Index=CAB Abstracts Timespan=All years |
| #14 | 2975 | TS=("POTASSIUM HYDROXIDE" OR "POTASSIUM SORBATE")  Index=CAB Abstracts Timespan=All years |
| #15 | 10,343 | ts=("sodium hypochlorite" OR NaClO or "sodium acetate" or "sodium citrate" or "sodium chlorite" or "sodium lactate")  Index=CAB Abstracts Timespan=All years |
| #16 | 232,715 | ts=(TSP or phosphate$ or antibacterial$ or disinfect\*)  Index=CAB Abstracts Timespan=All years |
| #17 | 139,833 | TS=(CHLORINE OR ALCIDE OR ULTRAVIOLET OR UV OR IRRADIAT\* OR "DRY HEAT" OR ULTRASOUND)  Index=CAB Abstracts Timespan=All years |
| #18 | 264,693 | TS=(contaminat\* or decontaminat\* ) OR TS=(“food sanitation”)  Index=CAB Abstracts Timespan=All years |
| #19 | 34,856 | TS=(Chilling or "freezing air" or "high air velocity" or blasting)  Index=CAB Abstracts Timespan=All years |
| #20 | 1,050,577 | #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 |
| #21 | 3476 | #20 AND #1 [[2]](#footnote-2) |
| #22 | 473 | TI=((DECONTAMINAT\* OR CONTAMINAT\*) AND CARCASS\*)[[3]](#footnote-3) |
| #23 | 3842 | #22 OR #21[[4]](#footnote-4) |

# **Table S2.** Search conducted in SCI-EXPANDED and CPCI-S on 25 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella* (Timespan=1900-2015, searched on Web of Science)

|  |  |  |
| --- | --- | --- |
| Search no. | No. hits | Search string |
| # 1 | [9258](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=1&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=((pork or swine or pig or pigs or hog or hogs or boar or boars or sow or sows) near/7 (carcass\* OR slaughter\* or abattoir\* or bellies))  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 2 | [5338](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=2&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(pathogen near/4 reduc\*) OR TS=prt  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 3 | [79,602](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=3&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(wash or washes or washing or washed or rinse or rinses or rinsing or rinsed)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 4 | [100,629](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=4&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(spray or sprays or spraying or sprayed)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 5 | [230](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=5&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(Organic NEAR/5 (decontaminat\* or saniti\* ))  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 6 | [64,083](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=6&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(PEROXYACETIC OR LACTIC)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 7 | [96,531](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=7&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=(ACETIC OR hypobromous or citric or "mineral acid$")  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 8 | [5351](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=8&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=((HYDROCHLORIC OR NITRIC OR PHOSPHORIC OR ACID) NEAR/5 (spray\* or decontaminat\* or saniti\* or wash\*))  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 9 | [461](http://apps.webofknowledge.com/summary.do?product=WOS&doc=1&qid=9&SID=S1rkcfMI4VHlGMrbs9J&search_mode=AdvancedSearch&update_back2search_link_param=yes) | TS=NONACID  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 10 | 37,518 | TS=((hot or cold or electrolyzed or electrolysed or warm) NEAR/3 water )  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 11 | 34,935 | ts="water treatment$"  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 12 | 61,104 | TS=steam  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 13 | 237 | TS="AQUEOUS OZONE"  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 14 | 5538 | TS=("POTASSIUM HYDROXIDE" OR "POTASSIUM SORBATE")  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 15 | 16,014 | ts=("sodium hypochlorite" OR NaClO or "sodium acetate" or "sodium citrate" or "sodium chlorite" or "sodium lactate")  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 16 | 320,726 | ts=(TSP or phosphate$)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 17 | 1,004,162 | TS=(CHLORINE OR ALCIDE OR ULTRAVIOLET OR UV OR IRRADIAT\* OR "DRY HEAT" OR ULTRASOUND)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 18 | 26,255 | TS=((Prevent\* or reduc\*) near/4 contaminat\*) or TS=decontaminat\*  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 19 | 78,332 | TS=(Chilling or "freezing air" or "high air velocity" or blasting)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 20 | 1,849,801 | #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 21 | 780 | #20 AND #1  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 22 | 359 | TI=((DECONTAMINAT\* OR CONTAMINAT\*) AND CARCASS\*)  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |
| # 23 | 1099 | #22 OR #21  Indexes=SCI-EXPANDED, CPCI-S Timespan=1900–2015 |

# **Table S3.** Search strategy in Ovid MEDLINE® In-Process & other non-Indexed citations and Ovid MEDLINE® (1946 to Present) on Ovid conducted on 25 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella*

|  |  |  |
| --- | --- | --- |
| Search  no. | No.  hits | Search string |
| #1 | 179,296 | exp Swine/ |
| #2 | 4465 | Abattoirs/ |
| #3 | 59,989 | Meat-Packing Industry/ or Food Contamination/ or Food-Processing Industry/ or Meat/ or Meat Products/ |
| #4 | 8060 | 1 and (2 or 3) |
| #5 | 4254 | ((pork or swine or pig or pigs or hog or hogs or boar or boars or sow or sows) adj7 (carcass\* or slaughter\* or abattoir\* or bellies)).ti,ab,kf. |
| #6 | 10,631 | or/4–5 |
| #7 | 2163 | ((pathogen adj4 reduc\*) or prt).ti,ab,kf. |
| #8 | 65,754 | (wash or washes or washing or washed or rinse or rinses or rinsing or rinsed).ti,ab,kf. |
| #9 | 9755 | Disinfectants/ |
| #10 | 25,086 | (spray or sprays or spraying or sprayed).ti,ab,kf. |
| #11 | 45 | (Organic adj5 (decontaminat\* or saniti\*)).ti,ab,kf. |
| #12 | 3523 | Decontamination/ |
| #13 | 33,240 | (PEROXYACETIC or LACTIC).ti,ab,kf. |
| #14 | 8964 | exp acetic acid/ or peracetic acid/ |
| #15 | 32,199 | lactic acid/ or sodium lactate/ |
| #16 | 42,343 | (ACETIC or hypobromous or citric or "mineral acid$").ti,ab,kf. |
| #17 | 9656 | exp bromates/ or exp hydrobromic acid/ |
| #18 | 7862 | exp Citric Acid/ |
| #19 | 100,388 | hydrochloric acid/ or nitric acid/ or exp phosphorus acids/ |
| #20 | 2128 | ((HYDROCHLORIC or NITRIC or PHOSPHORIC or ACID) adj5 (spray\* or decontaminat\* or saniti\* or wash\*)).ti,ab,kf. |
| #21 | 278 | nonacid.ti,ab,kf. |
| #22 | 9550 | ((hot or cold or electrolyzed or electrolysed or warm) adj3 water).ti,ab,kf. |
| #23 | 10208 | disinfection/ |
| #24 | 5765 | "water treatment$".ti,ab,kf. |
| #25 | 5427 | steam.ti,ab,kf. |
| #26 | 1737 | steam/ |
| #27 | 53 | "aqueous ozone".ti,ab,kf. |
| #28 | 1730 | ("POTASSIUM HYDROXIDE" or "POTASSIUM SORBATE").ti,ab,kf. |
| #29 | 9964 | ("sodium hypochlorite" or NaClO or "sodium acetate" or "sodium citrate" or "sodium chlorite" or "sodium lactate").ti,ab,kf. |
| #30 | 3520 | Sodium Hypochlorite/ |
| #31 | 492 | Sodium Acetate/ |
| #32 | 212,849 | (TSP or phosphate$).ti,ab,kf. |
| #33 | 85,548 | exp Phosphates/ |
| #34 | 473,536 | (CHLORINE or ALCIDE or ULTRAVIOLET or UV or IRRADIAT\* or "DRY HEAT" or ULTRASOUND).ti,ab,kf. |
| #35 | 9187 | Chlorine/ |
| #36 | 64,614 | Ultraviolet Rays/ |
| #37 | 1604 | Food Irradiation/ |
| #38 | 13,907 | (((Prevent\* or reduc\*) adj4 contaminat\*) or decontaminat\*).ti,ab,kf. |
| #39 | 3279 | (Chilling or "freezing air" or "high air velocity" or blasting).ti,ab,kf. |
| #40 | 20,190 | Freezing/ |
| #41 | 60,900 | exp Cold Temperature/ |
| #42 | 1,059,030 | or/7–41 |
| #43 | 1265 | 6 and 42 |
| #44 | 197 | ((DECONTAMINAT\* or CONTAMINAT\*) and CARCASS\*).ti. |
| #45 | 1440 | 43 or 44 |

# **Table S4.** Search run in Science.gov (http://www.science.gov/scigov/) on 30 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella*

|  |  |
| --- | --- |
| Sources searched within Science.gov | Search strategy |
| Science.gov websites | Searched all fields:  (pork or swine or pig or pigs or hog or hogs or boar or boars or sow or sows)  AND  (wash or washing or washed or washes or rinse or rinsing or rinses or rinsed or spray or sprays or spraying or sprayed or acid or acids or decontamination or decontaminated or decontaminate or contaminants or contamination or contaminated or sanitised or sanitized or nonacid or water or steam or ozone or potassium or sodium or phosphate or chlorine or alcide or ultraviolet or irradiation or irradiated or heat or ultrasound or chilling or freezing or blasting)  AND  (carcass or carcasses or abattoir or abattoirs or slaughter or slaughterhouse or slaughterhouses) |
| AGRICOLA |
| Center for Food Safety and Applied Nutrition |
| Technology Transfer Automated Retrieval System |
| USDA Food and Nutrition Center |
| Applied Science and Technologies databases |
| Biology and nature databases |
| General science databases |

# **Table S5.** Search strategy used for the International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork (1996–2012) (http://lib.dr.iastate.edu/safepork/) on 31 January 2015 for a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella*

|  |  |
| --- | --- |
| No. hits | Search string |
| 651 | Using the ‘All fields’ option and no date limits:  wash\* OR rinse\* OR rinsing OR spray\* OR acid OR acids Or decontaminat\* OR contamina\* OR saniti\* OR nonacid OR water OR steam OR ozone OR potassium OR sodium OR phosphate OR chlorine OR alcide OR ultraviolet OR irradiat\* OR radiation OR heat OR ultrasound OR chilling OR freezing OR blasting    AND    carcass\* OR abattoir\* OR slaughter\* OR pork |

# **Table S6.** Study-level information form used in the data extraction phase of a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella*

|  |  |  |
| --- | --- | --- |
| Study-Level Information Form | | |
| Question | Style | Response |
| Q1. In what year(s) was the data collected? | Radio | Specify year or Not Reported.  Do not use publication date to answer this question. |
| Q2. In what country was the study carried out? | Checkbox | (Select all that apply)  List of countries with option for the reviewer to add to the list as needed.  Not Reported |
| Q3. In what setting was the study conducted? | Radio | Commercial Abattoir  University/Research Slaughter Plant  Laboratory  Small Holder Slaughter (Exclude)  Not Reported |
| Q4. If the study was conducted in a commercial abattoir, was the slaughter capacity reported? | Radio (only visible if Q3 = commercial) | Yes: Enter number  No |
| Q5. If the slaughter capacity was reported, what were the units? | Text (only visible if Q3 = commercial) | Specify the units |
| Q6. If the study was conducted in a commercial abattoir, what was the total number of slaughter plants? | Radio (only visible if Q3 = commercial | Specify number or Not Reported |
| Q7. What was the experimental unit in this study (i.e., the unit to which the intervention was assigned)? | Checkbox | Select all that apply  Carcass  Pork belly  Skin  (Option for reviewer to add items to this list as needed) |
| Q8. What was the weight of the experimental units in this study? | Radio | Specify weight in kg  Not Reported |
| Q9. What was the descriptor the weight of the experimental units? | Radio | Mean  Median  Range  Not Reported  Not Applicable |
| Q10. What was the dispersion of the experimental unit weight? | Radio | Specify a number or Not Reported |
| Q11. What was the dispersion descriptor for the experimental unit’s weight? | Radio | SD  SEM  Not Reported  Not Applicable |
| Q12. Did the investigators artificially contaminate the experimental units? | Radio | Yes  No  Can’t Tell |
| Q13. What was the concentration of *Salmonella* applied to the experimental unit? | Radio (only visible if Q12 = yes) | Specify number  Not Reported |
| Q14. What were the units of the concentration of *Salmonella* applied to each experimental unit? | Radio (only visible if Q12 = yes) | Specify units  Not Reported |
| Q15. What was the contact time (i.e., the number of seconds that the *Salmonella* was kept on the experimental unit)? | Radio (only visible if Q12 = yes) | Specify time (in seconds)  Not Reported |
| Q16. What serotype of *Salmonella* was inoculated onto the experimental unit? | Radio (only visible if Q12 = yes) | Specify serotype(s)  Not Reported |
| Q17. What was the method used to inoculate the experimental unit? | Radio (only visible if Q12 = yes) | Sprayed  Injected  Brushed on  (Option for reviewer to add different methods as necessary)  Not Reported |
| Q18. At what locations on the carcass/what parts of the experimental unit was *Salmonella* inoculated? | Checkbox (only visible if Q12 = yes) | Check all that apply  Jowls  Pork Belly  (Option for reviewer to add new locations as necessary)  Not Reported |
| Q19. How many times was *Salmonella* applied to the experimental unit? | Radio (only visible if Q12 = yes) | Specify number of times  Not Reported |
| Q20. What was the time interval between inoculation and application of the intervention? | Radio (only visible if Q12 = yes) | Specify time interval (seconds)  Not Reported  Not Applicable (this is the control group, i.e., it didn’t receive an intervention) |
| Q21. Which diagnostic method(s) were used to determine the prevalence or level of the bacteria? | Checkbox | Select all that apply:  Bacterial culture  PCR  ELISA  Other (specify)  Not Reported |
| Q22. If bacterial culture was used, what was the pre-enrichment media? | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported  Not Applicable (pre-enrichment not done) |
| Q23. If bacterial culture was used, what was the pre-enrichment incubation time? | Radio (only visible if Q21 = Bacterial culture) | Specify time (h)  Not Reported  Not Applicable (pre-enrichment not done) |
| Q24. If bacterial culture was used, what was the pre-enrichment incubation temperature? | Radio (only visible if Q21 = Bacterial culture)) | Specify temperature (oC)  Not Reported  Not Applicable (pre-enrichment not done) |
| Q25. If bacterial culture was used, specify the enrichment media. | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported  Not Applicable (enrichment not done) |
| Q26. If bacterial culture was used, specify the enrichment incubation time. | Radio (only visible if Q21 = Bacterial culture) | Specify (h)  Not Reported  Not Applicable (enrichment not done) |
| Q27. If bacterial culture was used, specify the enrichment incubation temperature. | Radio (only visible if Q21 = Bacterial culture) | Specify temperature (oC)  Not Reported  Not Applicable (enrichment not done) |
| Q28. If bacterial culture was used, specify the culture media. | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported |
| Q29. If bacterial culture was used, specify the culture incubation time. | Radio (only visible if Q21 = Bacterial culture) | Specify (h)  Not Reported |
| Q30. If bacterial culture was used, specify the culture incubation temperature. | Radio (only visible if Q21 = Bacterial culture) | Specify (oC)  Not Reported |
| Q31. If bacterial culture was used, was a confirmation method also used? | Radio (only visible if Q21 = Bacterial culture) | Yes (specify method)  No  Confirmation done, but method not reported |
| Q32. If bacterial culture was used and concentration of bacteria was determined, what was the enumeration method used? | Radio (only visible if Q21 = Bacterial culture) | Specify method  Not Reported  Not Applicable (enumeration of bacteria not done) |
| Q33. If PCR was used to detect the bacteria, please give details of the methods (i.e., PCR type, conditions, primer name, target sequence) (copy-paste from text) | Text (only visible if Q21 = PCR) | Give details or Not Reported |
| Q34. If ELISA was used to detect the bacteria, please give details of the methods used. (copy-paste from text) | Text (only visible if Q21 = ELISA) | Give details or Not Reported |
| Q35. Are there any additional comments? | Text | Please add any additional information about the study not captured by the previous questions that you think is relevant to this review. |
| Q36. Specify the ARM. | Radio | Option for reviewer to name the arm (e.g., Ref ID# 40004 Pilot Slaughter Plant) |

# **Table S7.** Intervention-Outcome information form used in the data extraction phase of a systematic review of pathogen reduction treatments of pork carcasses against *Salmonella*

|  |  |  |
| --- | --- | --- |
| Intervention/Outcome Form | | |
| Question | Style | Response |
| Q1. Description of ARM / Methods as described by authors (copy/paste from text) | Radio | Describe the intervention used and outcome(s) measured  (Option for reviewer to add new ARM descriptions as needed.) |
| Q2. Which treatment (intervention) was applied to the experimental unit? (check all that apply for this particular ARM) | Checkbox | List of interventions with option for the reviewer to add more as necessary  No treatment (control group) |
| Q3. Is there any additional descriptive information about this intervention (not captured by the other questions on this form) that you would like to add? | Text |  |
| Q4. What was the pH of the intervention as it was applied to the experimental units? | Radio | Specify pH  Not Reported/Not Discernible  Not Applicable (if it’s a no-intervention control group) |
| Q5. What was the concentration of the intervention? | Radio | Specify concentration (number only)  Not Reported/Not Discernible  Not Applicable (e.g., if it’s a no-intervention control group or if it’s pure water) |
| Q6. What were the units of the intervention concentration? | Radio | Specify units (e.g., %)  Not Reported  Not Applicable |
| Q7. What was the temperature of the intervention? | Radio | Specify temperature (number only)  Not Reported  Not Applicable |
| Q8. What were the units of the temperature of the intervention? | Radio | Specify units (oC, oF)  Not Reported  Not Applicable |
| Q9. How was the intervention applied? | Radio | Spray  Rinse  Immersion  Other (Specify)  Not Reported/Not Discernible  Not Applicable |
| Q10. At what pressure was the intervention applied? | Radio | Specify pressure (number only)  Not Reported/Not Discernible  Not Applicable |
| Q11. What units were used to describe the pressure the intervention was applied at? | Radio | Specify units  Not Reported  Not Applicable |
| Q12. At what point(s) in the processing chain was the intervention applied? Regardless of how the investigators described the data, report the data collection as occurring after the processing point. For example, if the original author described the sample as being collected pre-kill, refer to such a sample as a bleed sample, meaning the post-bleeding but pre-killing sample point. | Checkbox | Final wash,  Immediately after chill,  18–48 h after chilling  Stun  Bleed  Kill  Scald  Dehair  Singe  Polish  Bung removal  Evisceration  Split  Stamp  Not Reported  Not Applicable (no-treatment control group)  Other (specify) |
| Q13. What was the total duration that the intervention was applied? | Radio | Specify the total duration (s)  Not Reported  Not Applicable |
| Q14. What was the number of times that the intervention was applied? | Radio | Specify number of times  Not Reported  Not Applicable |
| Q15. If the intervention was applied more than once, what was the time interval between the applications? | Radio | Specify time (s)  Not Reported/Not Discernible  Not Applicable |
| Q16. In which type of sample was the outcome measured? | Radio | Carcass Rinse  Carcass Swab  Excised Skin Sample  Not Reported  (Option for reviewer to add to this list as needed) |
| Q17. Which bacteria were measured as the outcome? | Radio | *Salmonella* (specify serotype, strain, etc., if reported) |
| Q18. N (number of samples analyzed for prevalence) for this ARM | Radio | Report number analysed  Not Reported  Not Applicable (prevalence not estimated) |
| Q19. R (if prevalence data are described) (Note that we are only interested in results less than or equal to 24h after application of the intervention.) | Radio | Report number of positive samples  Not Reported  Not Applicable (prevalence not estimated) |
| Q20. N (number of samples analyzed for concentration estimate) | Radio | Report number analyzed  Not Reported  Not Applicable (concentration not estimated) |
| Q21. What was the concentration of the bacteria after the intervention? (Note that we are only interested in results less than or equal to 24h after application of the intervention.) | Radio | Specify concentration (no units)  Not Reported  Not Applicable |
| Q22. What are the units of the reported concentration? | Radio | Specify units  Not Reported  Not Applicable |
| Q23. What is the precision of the concentration estimate? | Radio | Specify number only  Not Reported  Not Applicable (concentration not estimated) |
| Q24. What was the descriptor of the precision of the concentration estimate? | Radio | SD  SEM  95% Confidence Interval  Not Reported  Not Applicable  Other (specify) |
| Q25. Did the investigators report an effect estimate? | Radio | Yes  No |
| Q26. What was the comparison or control group? | Radio | Describe control group  Not Applicable (This was the control group or the authors did not report an effect size or a p-value) |
| Q27. What was the Effect Estimate? | Checkbox (only visible if reviewer answered Yes to Q25) | Odds Ratio (specify)  Risk Ratio (specify)  Mean Difference (specify)  Not Reported  (Option for reviewer to add another selection to the list) |
| Q28. What was the dispersion of the effect estimate? | Checkbox (only visible if the reviewer answered Yes to Q25) | SD (specify)  SEM (specify)  95% Confidence Interval (specify)  Not Reported  (Option for reviewer to add another selection to the list) |
| Q29. What was the P-value for the comparison? | Radio | Specify  Not Reported  Not Applicable (no statistical tests performed or this was a control group) |
| Q30. Were the outcome assessors blinded to the intervention groups? | Radio | Yes  No  Not Reported |
| Q31. Additional Comments | Text | Please add any additional information about the intervention that you feel is relevant that wasn't captured by the other questions in this form. |

# **Table S8.** Risk-of-Bias tool used in a systematic review of *Salmonella* reduction treatments on pig carcasses (modified from The Cochrane Collaboration’s Risk-of-Bias Tool (Higgins *et al.*, 2011))

|  |  |  |
| --- | --- | --- |
| Question | Style | Response |
| Selection Bias | | |
| Q1. Was allocation to treatment group randomized? | Radio | Yes (method of randomization reported)  Reported random, but method of randomization not disclosed  No (method of allocation reported, but was not random)  Method of allocation not reported |
| Q2. What was the risk of bias due to allocation method? (If the authors did not describe the method used to randomize allocation, choose "Unclear". If the authors described the method used to achieve randomization, choose "Low", if the authors did not randomize allocation, choose, "High".) | Radio | Low  High  Unclear |
| Q3. What was the rationale for risk of bias due to allocation method | Text |  |
| Performance Bias | | |
| Q4. Were measures to blind owners/personnel described? | Radio | Yes  No |
| Q5. What was the risk of bias due to knowledge of the allocated interventions by owners/handlers/personnel during the study? Answer "High" if the method of sampling was swabbing but the method used to swab was not described or was obviously subject to individual variation. Answer "Low" if the method of sampling was tissue excision, carcass rinse or an objective method of swabbing (e.g., FSIS method). | Radio | Low  High  Unclear |
| Q6. What was the rationale for risk of bias due to blinding of owners/personnel (e.g., personnel collecting the swab samples could tell what treatment the experimental unit received and might therefore have swabbed more or less vigorously based on whether they expected to find *Salmonella*) | Text |  |
| Detection Bias | | |
| Q7. Do they describe measures to blind outcome assessors? | Radio | Yes  No |
| Q8. What was the risk of bias due to knowledge of the allocated interventions by outcome assessors? | Radio | Low  High  Unclear |
| Q9. What was the rationale for risk of bias due to blinding of outcome assessors? | Text |  |
| Attrition Bias | | |
| Q10. Were there incomplete outcome data in the study? (If this was not reported, choose "unable to assess") | Radio | No loss to follow-up  Loss to follow-up present but explained  Loss to follow-up present but not explained  Unable to assess (numbers not reported comprehensively) |
| Q11. What was the risk of bias due to amount, nature, or handling of incomplete outcome data? (If the authors performed a sensitivity analysis to see how the missing or lost data would have affected the effect measure, then select "Low". If data/animals are missing and the authors do nothing to address this, the risk of bias is High). | Radio | Low  High  Unclear |
| Q12. What is the rationale for risk of bias due to incomplete outcome data? | Text |  |
| Reporting Bias | | |
| Q13. Was there selective reporting of outcomes? | Radio | Yes  No  Unable to discern |
| Q14. What was the risk of bias due to selective outcome reporting? (Might the funding source for the study affect the authors' motivation to report all results?) Answer "High" if it looks the authors were "data-mining" in order to find any kind of significant difference between intervention and control groups or if the authors reported results in something other than the standard "prevalence" or "concentration" of *Salmonella*. | Radio | Low  High  Unclear |
| Q15. What was the rationale for risk of bias due to selective reporting of outcomes? | Text |  |
| Other Bias | | |
| Q16. Other potential sources of bias identified: Did the analyses fail to take into account pseudo replication? We acknowledge that this bias in truth affects precision, rather than a systematic direction bias. | Text |  |
| Q17. Are there concerns about multiplicity? (e.g., If the authors did an ANOVA then did an F-test and it’s significant and then the authors look at all the comparisons within the ANOVA and did a Bonferroni correction within the test, but not correct for multiple comparisons across the study (just within the ANOVA), there are still multiplicity problems if you do, say, 20 ANOVAs, there's still a problem with multiplicity. | Radio | Yes  No  Unclear |
| Q18. What was the risk of bias due to other potential sources of bias not identified in the preceding questions? | Radio | Low  High  Unclear |
| Q19. What was the rationale for risk of bias due to other sources of bias? | Text |  |
| Q20. Additional Comments (any additional information you feel is relevant to the assessment of risk of bias that was not captured by the previous questions) | Text |  |
| Q21. Give a description of the ARM. | Radio | Describe the ARM (e.g., Ref ID, setting, etc.). Option for reviewer to add new ARM |

# **Table S9.** List of documents excluded at Level 2 (full-text assessment) with reasons for exclusions in a systematic review of *Salmonella* reduction treatments on pig carcasses

|  |  |
| --- | --- |
| Reference information | Reason for exclusion |
| Delchev H and Savov D (1967). Investigations into the source of bacterial contamination of pork. I. In skinning. *Veterinarnomeditsinski Nauki* **4**: 19–25. | Non-English language (Bulgarian) |
| Gerats GE, Snijders JMA and van Logtestijn JG (1981). Slaughter methods and contamination of pig carcasses Slachttechniek en contaminatie van varkenskarkassen. *Vleesdistributie en Vleestechnologie* **16**: 31–33. | Non-English language (Dutch) |
| de Kruijf JM(1979). Bacteriological quality of pig liver Bacteriologische kwaliteit van varkenslever. PhD Thesis, University of Utrecht, The Netherlands. | Non-English language (Dutch) |
| Snijders JMA (1976). Pig slaughtering hygiene Hygiene bij het slachten van varkens PhD Thesis, University of Utrecht, The Netherlands. | Non-English language (Dutch) |
| le Roux A, Minvielle B and Gault E (2007). Control of carcase contamination levels at line end: utility of lactic acid Maitrise du niveau de contamination des carcasses en fin de chaine: interet de l'acide lactique. *Techni-Porc* **30**:29–33, 2. | Non-English language (French) |
| Boudry C, Korsak N, Jacob B, Etienne G, Thewis A and Daube G (2002). Ecology of *Salmonella* in slaughter pigs digestive tract and study of the contamination of carcasses Ecologie de *Salmonella* dans le tube digestif du porc a l'abattage et etude de la contamination des carcasses. *Annales De Médecine Vétérinaire* **146**:353–360. | Non-English language (French) |
| Rheault N and Quessy S (1999). Comparison of hot water wash and trimming of pork carcasses for reducing the level of bacterial contamination Comparaison de l'effet du parage et du lavage a l'eau chaude des carcasses de porcs afin de reduire le niveau de la contamination microbienne. *Canadian Veterinary Journal* **40**: 792–795. | Non-English language (French) |
| Schertenleib TI, Stephan R, Scheeder M and Zweifel C (2011). Visual and microbiological process analysis of pig slaughtering in a small-scale abattoir Visuelle und mikrobiologische Prozessanalyse der Schweineschlachtung in einem Kleinbetrieb. *Archiv für Lebensmittelhygiene* **62**:52–57. | Non-English language (German) |
| Zweifel C, Spescha C and Stephan R (2007). Process stages in pig slaughter: influence on the microbiological contamination of carcasses in two abattoirs Prozessstufen in der Schweineschlachtung: Einfluss auf den Oberflachenkeimgehalt von Schlachttierkorpern am Beispiel zweier Betriebe. *Archiv für*  *Lebensmittelhygiene* **58**:7–12. | Non-English language (German) |
| Troeger K (1993). Influence of scalding and dehairing technique on the bacterial contamination of pig carcasses Bruh- und Enthaarungstechnik. Einfluss auf den Keimgehalt von Schweineschlachtkorperchen. *Fleischwirtschaft* **73**: 128–133, 171. | Non-English language (German) |
| Troeger K (1993). Changes in the microbial count of scalding water during a pig slaughter session, and its effect on surface contamination of the carcass Keimzahlentwicklung im Bruhwasser im Schlachtverlauf. Auswirkung auf die Oberflachenkeimgehalte der Schweineschlachttierkorper. *Fleischwirtschaft* **73**: 816–819. | Non-English language (German) |
| Jones B, Nilsson T and Sorqvist S (1984). Contamination of pig carcasses with scalding water. Continued studies with radiolabelled solutes and particles. *Fleischwirtschaft* **64**:1226–1228, 1243–1246. | Non-English language (German) |
| Jones B, Nilsson T, Ekman L and Ostlund K (1979). Contamination of pig carcasses with scalding water studied with a radiolabelled colloid Nachweis von Bruhwasser in Schlachtschweinen mit einem radioaktiven Kolloid. *Fleischwirtschaft* **59**:1524–1526. | Non-English language (German) |
| Snijders JMA, Gerats GE and Corstiaensen GP (1977). Hygiene in pig slaughtering. V. Chlorinated water to clean carcasses Hygiene bei der Schlachtung von Schweinen. V. Verwendung chlorierten Wassers bei der Reinigung der Tierkorper-Oberflachen. *Fleischwirtschaft* **57**:2212–2215. | Non-English language (German) |
| Snijders JMA (1975). Hygiene in the slaughter of pigs. I. Scalding Hygiene bei der Schlachtung von Schweinen. I. Das Bruhen der Schlachtschweine. *Fleischwirtschaft* **55**:836–840. | Non-English language (German) |
| Troeger K (1992). Extent of an internal contamination of carcasses of slaughter pigs by microorganisms in the scalding water. *Archiv für*  *Lebensmittelhygiene* **43**:11–13. | Non-English language (German) |
| Woltersdorf W and Mintzlaff HJ (1995). Pig scalding using a condensation method – is it a practicable one I Scalding effect and surface bacterial content. *Fleischwirtschaft* **75**:1077–1081. | Non-English (German) |
| Takacs I (1985). Hygiene in swine slaughter technology. I. Hygiene of scalding and singeing A sertesvagas technologiai higieniaja. I. *Magyar Allatorvosok Lapja* **40**:407–412. | Non-English language (Hungarian) |
| Bersani C and Fava M (2004). Enforcement of the decision 2001/471/CE in a pig slaughterhouse Applicazione della Decisione 2001/471/CE in un macello suino. *Industrie Alimentari* **43**:376–381. | Non-English language (Italian) |
| Hara K, Watanabe M, Yosizaki S, Endou T and Yokota T (1998). Contamination of hog carcasses skinned by standing-type skin stripper. *Journal of the Japan Veterinary Medical Association* **51**: 687–691. | Non-English language (Japanese) |
| Takeshige K, Iida T, Takagi H, Kurihara S, Ogawa J, Tensho T and Maruyama T (1995). Epidemiological studies of *Listeria monocytogenes* from dressed carcasses at a slaughter house. *Nippon Juishikai Zasshi* **48**: 131–135. | Non-English language (Japanese) |
| Akashi K, Kuroki H and Ebara S (1972). Studies on microorganisms contaminating carcasses. IV. Microbial contamination of porcine carcasses in the scalding tank and subsequent processes and the protease activity of the bacteria isolated. *Nippon Juishikai Zasshi* **25**:70–76. | Non-English language (Japanese) |
| Yang HS, Jeong JY, Moon SH, Park GB and Joo ST (2007). Establishment of an optimal washing condition of a high temperature steaming system for the production of high quality pork. *Journal of Animal Science and Technology* **49**:121–128. | Non-English language (Korean) |
| Kim IS, Kim DH, Hwang SK, Shin DK and Lee M (1999). Assessment of microbial contamination of pork carcasses during the slaughtering process. *Korean Journal of Animal Science* **41**:199–206. | Non-English language (Korean) |
| Colla FL, Mion L, Parizotto L, dos Santos LA, Pilotto F, Rodrigues LB, do Nascimento VP and dos Santos LR (2014). Antimicrobial sensitivity and efficacy of sanitizers against the *Salmonella* spp. isolated from swine slaughterhouse in southern Brazil Perfil de sensibilidade aos antimicrobianos e eficacia de sanitizantes frente aos isolados de *Salmonella* spp. oriundos de carcacas suinas no Rio Grande do Sul. *Pesquisa Veterinária Brasileira* **34**:320–324. | Non-English language (Portuguese) |
| de Carli EM, Terra NN, Fries LLM, de Menezes CR and Palezi SC (2013). Decontamination pig carcasses of organic acids with commercial and saline acidified ultraviolet light Descontaminacao de cortes suinos com acidos organicos comerciais, solucao salina acidificada e luz ultravioleta. *Semina: Ciências Agrárias (Londrina)* **34**:1195–1204. | Non-English language (Portuguese) |
| Abreu Dias M (1997). Carcass decontamination in abattoirs Descontaminacao de carcacas nos matadouros. *Veterinária Técnica* **7**:24–25. | Non-English language (Portuguese) |
| Panetta JC, Augusto A, Riccetti RV, Miguel O and Calil RM (1977). Disinfectant effect of chloramine-T in the scalding water for slaughtered swine Comportamento do paratolueno-cloro-sulfamida-sodico na descontaminacao da agua de escaldamento de suinos abatidos. *Revista da Faculdade de Medicina Veterinária, Universidade de São Paulo* **14**:293–300. | Non-English language (Portugese) |
| Vlad-Sabie A, Carp-Carare M, Bradatan G and Cretu C (2007). Research regarding the presence of the *E. coli* and *Salmonella* spp. of the bovine and swine carcasses Cercetari privind prezenta speciilor *E. coli* si *Salmonella* spp. de pe carcasele de bovine si suine. *Lucrǎri Ştiinţifice - Medicinǎ Veterinarǎ, Universitatea de Ştiinţe Agricole şi Medicinǎ Veterinarǎ "Ion Ionescu de la Brad" Iasi* **51**:1012–1015. | Non-English language (Romanian) |
| Chaichana S, Tuitemwong P, Tuitemwong K and Bangtrakulnonth A (2007). Reduction of *Salmonella* spp. contamination on pork carcasses with saturated ozone water. *Proceedings of the 45th Kasetsart University Annual Conference*, Kasetsart University, Kasetsart, Thailand. pp. 173–180. | Non-English language (Thai) |
| Kunev Zh, Ionova I, Milev M, Dokov Ts and Pavlov A (1981). Microbiological study in pork production. *Veterinarno-meditsinski nauki* **18**:81–86. | Non-English language (language unknown) |
| Dan SD (2007). Residual antimicrobian effect of lactic and acetic acids on the microbial load and configuration of pork carcasses during chill storage. *Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Animal Science and Biotechnologies* **64:** 590. | Full-text not available. Article consists only of an abstract and bibliography. |
| Kich J, Pissetti C, Cardoso M, Coldebella A, Nogueira M and Ferraz FM (2011). Effect of different treatments on swine carcasses surface contamination with *Salmonella* Typhimurium. *Ninth International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork,* Maastricht, The Netherlands. p. 278. | Conference abstract (no extractable data) |
| Christiansen P, Sørensen AMH, Krag R, Larsen BS and Aabo S (2009). Evaluation of pathogen reduction obtained by decontamination of pig carcasses by Steam-Ultrasound (Sonosteam®). *Seventh Symposium on Food Microbiology: Abstracts*, LMC, Copenhagen, Denmark. | Conference abstract (unable to procure) |
| Wheatley P, Giotis ES and McKevitt AI (2014). Effects of slaughtering operations on carcass contamination in an Irish pork production plant. *Irish Veterinary Journal* **67**:1. | *Salmonella* not found in any samples or not tested for. |
| Smulders FJM, Wellm G, Hiesberger J, Bauer A and Paulsen P (2012). The potential of the combined application of hot water sprays and steam condensation at subatmospheric pressure for decontaminating inoculated pig skin and muscle surfaces. *Food Control* **24**: 154–159. | *Salmonella* not found in any samples or not tested for. |
| Trivedi S, Reynolds AE and Chen J (2008). Effectiveness of commercial household steam cleaning systems in reducing the populations of *Listeria monocytogenes* and spoilage bacteria on inoculated pork skin surfaces. *LWT - Food Science and Technology* **41**:295–302. | *Salmonella* not found in any samples or not tested for. |
| Dan SD, Mihaiu M, Rotaru O and Dalea I (2007). Microbial changes on the surface of pork carcasses due lactic and acetic acids decontamination. *Bulletin of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Animal Science and Biotechnologies* **64**:403–408. | *Salmonella* not found in any samples or not tested for. |
| Dan SD, Rotaru O and Dalea I (2006). The effects of lactic and acetic acid treatment on the psychrotrophic bacterial growth on the surface of beef and pork. *Bulletin UASVM Agriculture* **63**: 245–250. | *Salmonella* not found in any samples or not tested for. |
| Conter M, Zanardi E, Ghidini S, Guidi E and Campanini G (2006). Microbiological condition of carcasses and equipment in a pig slaughterhouse and evaluation of a steam decontamination system. *Italian Journal of Food Science* **18**: 387–396. | *Salmonella* not tested for in steam part of the study. |
| Pipek P, Houska M, Hoke K, Jelenikova J, Kyhos K and Sikulova M (2006). Decontamination of pork carcasses by steam and lactic acid. *Journal of Food Engineering* **74**: 224–231. | *Salmonella* not found in any samples or not tested for. |
| Spescha C, Stephan R and Zweifel C (2006). Microbiological contamination of pig carcasses at different stages of slaughter in two European Union-approved abattoirs. *Journal of Food Protection* **69**: 2568–2575. | *Salmonella* not found in any samples or not tested for. |
| Ockerman HW, Sethakul J, Pilasombut K and Khopaiboon P (2002). Reduction of bacterial contamination on the surface of pork carcasses by the use of lactic acid and chlorine solutions. *Special Circular - Ohio Agricultural Research and Development Center* **2002**:77–80. | *Salmonella* not found in any samples or not tested for. |
| Rivas T, Vizcaino JA and Herrera FJ(2000). Microbial contamination of carcasses and equipment from an Iberian pig slaughterhouse. *Journal of Food Protection* **63:** 1670–1675. | *Salmonella* not found in any samples or not tested for. |
| ShewLing Yu and Palumbo SA (2000). Enumeration of *Aeromonas* for verification of the hygienic adequacy of swine carcass dressing processes. *Journal of Food Safety* **20**: 43–52. | *Salmonella* not found in any samples or not tested for. |
| ShewLing Yu, Bolton D, Laubach C, Kline P, Oser A and Palumbo SA (1999). Effect of dehairing operations on microbiological quality of swine carcasses. *Journal of Food Protection* **62**:1478–1481. | *Salmonella* not found in any samples or not tested for. |
| van Netten P, Mossel DAA and Huis In 'T Veld JHJ(1997). Microbial changes on freshly slaughtered pork carcasses due to "hot" lactic acid decontamination. *Journal of Food Safety* **17**:89–111. | *Salmonella* not found in any samples or not tested for. |
| Gill CO, McGinnis DS, Bryant J and Chabot B (1995). Decontamination of commercial, polished pig carcasses with hot water. *Food Microbiology* **12**:143–149. | *Salmonella* not found in any samples or not tested for. |
| Fu AH, Sebranek JG and Murano EA (1994). Microbial and quality characteristics of pork cuts from carcasses treated with sanitizing sprays. *Journal of Food Science* **59**:306–309. | *Salmonella* not found in any samples or not tested for. |
| Prasai RK, Acuff GR, Lucia LM, Morgan JB, May SG and Savell JW (1992). Microbiological effects of acid decontamination of pork carcasses at various locations in processing. *Meat Science* **32**:413–423. | *Salmonella* not found in any samples or not tested for. |
| Gobat PF and Jemmi T (1990). Epidemiological studies on *Listeria* spp. in slaughterhouses. *Fleischwirtschaft* **70**: 1448–1450. | *Salmonella* not found in any samples or not tested for. |
| Skelley GC, Fandino GE, Haigler JH and Sherard RC (1985). Bacteriology and weight loss of pork carcasses treated with a sodium hypochlorite solution. *Journal of Food Protection* **48**:578–581. | *Salmonella* not found in any samples or not tested for. |
| Snijders JMA, van Logtestijn JG, Gerats GE and Corstiaensen GP (1977). The effect of chlorine and infra-red on the carcass surface flora in the pig slaughterline. *Seventh Internationales Symposium, World Association of Veterinary Food Hygienists*, Garmisch-Partenkirchen, Bundesrepublik Deutschland. p. 247–254. | *Salmonella* not found in any samples or not tested for. |
| Reynolds AE and Carpenter JA (1974). Bactericidal properties of acetic and propionic acids on pork carcasses. *Journal of Animal Science* **38**:515–519. | *Salmonella* not found in any samples or not tested for. |
| Dockerty TR, Ockerman HW, Cahill VR, Kunkle LE and Weiser HH (1970). Microbial level of pork skin as affected by the dressing process. *Journal of Animal Science* **30**:884–890. | *Salmonella* not found in any samples or not tested for. |
| Baltzer J and Wilson DC (1965). The occurrence of clostridia on bacon slaughter lines. *Journal of Applied Bacteriology* **28**:119–124. | *Salmonella* not found in any samples or not tested for. |
| Gill CO, Bedard D and Jones T (1997). The decontaminating performance of a commercial apparatus for pasteurizing polished pig carcasses. *Food Microbiology* **14**:71–79. | *Salmonella* not found in any samples or not tested for. |
| Gill CO, Jones T and Badoni M (1998). The effects of hot water pasteurizing treatments on the microbiological conditions and appearances of pig and sheep carcasses. *Food Research International* **31**:273–278. | *Salmonella* not found in any samples or not tested for. |
| Jayawardana BC, Shimada K, Liyanage R, Fukushima M and Sekikawa M (2009). Removing of central nervous tissues from dressed carcasses: Washing with a low concentration of lactic acid in spraying cabinet. *Food Control* **20**:386–390. | *Salmonella* not found in any samples or not tested for. |
| Smulders FJM, Wellm G, Hiesberger J, Rohrbacher I, Bauer A and Paulsen P (2011). Microbiological and sensory effects of the combined application of hot-cold organic acid sprays and steam condensation at subatmospheric pressure for decontamination of inoculated pig tissue surfaces. *Journal of Food Protection* **74**:1338–1344. | *Salmonella* not found in any samples or not tested for. |
| van Netten P, Valentijn A, Mossel DAA and HuisintVeld JHJ (1997). Fate of low temperature and acid-adapted *Yersinia enterocolitica* and *Listeria monocytogenes* that contaminate lactic acid decontaminated meat during chill storage. *Journal of Applied Microbiology* **82**:769–779. | *Salmonella* not found in any samples or not tested for. |
| Vannetten P, Jhhi Veld and Mossel DAA (1994). The effect of lactic acid decontamination on the microflora on meat. *Journal of Food Safety* **14**:243–257. | *Salmonella* not found in any samples or not tested for. |
| Snijders JM, van Logtestijn JG, Mossel DA and Smulders FJ (1985). Lactic acid as a decontaminant in slaughter and processing procedures. *Veterinary Quarterly* **7**:277–282. | *Salmonella* not found in any samples or not tested for. |
| Jensen T and Christensen H (2001). Decontamination of pig carcasses with hot water. *Proceedings of the 4th International Symposium on the Epidemiology and Control* Salmonella *and Other Food-Borne Pathogens in Pork* Iowa State University, Ames, IA, USA. p 127–129. | *Salmonella* not found in any samples or not tested for. |
| Dickson JS (1998). Hot water rinses as a bacteriological intervention strategy on swine carcasses. Swine Research Report, 1997. Paper 32. Iowa State University, Ames, IA. | *Salmonella* not found in any samples or not tested for. |
| Latha C, Sherikar AT, Waskar VS, Dubal ZB and Ahmed SN (2009). Sanitizing effect of salts on experimentally inoculated organisms on pork carcasses. *Meat Science* **83**: 796–799. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Nesbakken T and Borch E (1995). Prophylactic measures in order to reduce contamination of pig carcasses with *Yersinia enterocolitica* during slaughter. *Contributions to Microbiolboy and Immunology* **13**: 62–66. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Miller AJ, Schultz FJ, Oser A, Hallman JL and Palumbo SA (1994). Bacteriological safety of swine carcasses treated with reconditioned water. *Journal of Food Science* **59**:739–741, 746. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Troeger K (1993). Scalding and dehairing technology. Influence on the bacterial count of pig carcasses. *Fleischwirtschaft* **73**: 1157–1160. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Troeger K and Woltersdorf W (1988). Microbial contamination by scalding water of pig carcases via the vascular system. *Fleischwirtschaft* **68**: 1550–1552. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Gerats GE, Snijders JMA and van Logtestijn JG (1981). Slaughter techniques and bacterial contamination of pig carcasses. *Proceedings of the 27th European Meeting of Meat Research Workers,* The Meeting Rotterdam, The Netherlands. p 198–200. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Scholefield J, Menon TG and Lam CW (1981). Psychrotroph contamination of pig carcasses. *Proceedings of the 27th European Congress of Meat Research Workers*, The Meeting Rotterdam, The Netherlands. p 621–624. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Thornton H (1974). So-called scalding-water lungs in slaughtered pigs. *Veterinary Record* **94**:72–73. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Dempster JF (1971). An evaluation of the efficiency of cleaning methods in a bacon factory. *The Journal of Hygiene (London)* **69**: 133–140. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Kampelmacher EH, Guinee PAM and Van Noorle Jansen LM (1965). Studies on the use of surface decontamination of *Salmonella*-contaminated mesenteric lymph nodes by boiling water. *Zentralblatt*  *für Bakteriologie Parasitenkunde Infektionskrankheiten und Hygiene* **196**:34–52. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Downing HE, McMahan JR and Baker C (1956). Antibiotic preservation of meats. IV. Intraperitoneal injection of oxytetracydine in hogs. *Antibiotics Annual* **1955/1956**:737–738. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Jepsen A (1947). Bacteriology of pork, microbial contamination acquired in the meatworks. *Kongelige Veterinaer- og Landbohoiskoles Årsskrift.* **85**:40–85. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Larivière-Gauthier G, Letellier A, Quessy S, Fournaise S and Fravalo P (2013). Assessment of the efficiency of ozonated water as bacterial contamination reduction tool in a pork cutting plant. *Tenth International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork*, Iowa State University, Ames, IA, USA. pp. 143–146. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Wilkin C-A, Purnell G, James SJ, Howell M and James C (2007). Changes in carcass microbial distribution and water conditions during the scalding and dehairing of pig carcasses. *Seventh International Symposium on the Epidemiology and Control of Foodborne Pathogens in Pork*, Iowa State University, Ames, IA, USA. pp. 257–260. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Davies RH, McLaren IM and Bedford S (1999). Distribution of *Salmonella* contamination in two pig abattoirs. *Third International Symposium on the Epidemiology and Control of* Salmonella *in Pork*, Iowa State University, Ames, IA, USA. pp. 267–272. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Quessy S, Larivière-Gauthier G, Fravalo P, Fournaise S and Letellier A (2011). Evaluation of ozonated water as a microbiological risk mitigation option in pork production. *Ninth International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork*, Iowa State University, Ames, IA, USA. pp. 298–300. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Frederick TL, Miller MF, Thompson LD and Ramsey CB (1994). Microbiological properties of pork cheek meat as affected by acetic acid and temperature. *Journal of Food Science* **59**:300–302. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Hamby PL, Savell JW, Acuff GR, Vanderzant C and Cross HR (1987). Spray-chilling and carcass decontamination systems using lactic and acetic-acid. *Meat Sci*ence **21**: 1–14. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Troeger K (1994). Development of bacterial count in scalding water during slaughter – effect on surface bacterial counts on pig carcasses. *Fleischwirtschaft* **74**:518–520. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Van Netten P, Valentijn A, Mossel DAA and Huis in’t Velt JHJ (1998). The survival and growth of acid-adapted mesophilic pathogens that contaminate meat after lactic acid decontamination. *Journal of Applied Microbiology* **84**: 559–567. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Castelo MM, Kang DH, Siragusa GR, Koohmaraie M and Berry ED (2001). Evaluation of combination treatment processes for the microbial decontamination of pork trim. *Journal of Food Protection* **64**:335–342. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Castelo MM, Koohmaraie M and Berry ED (2001). Microbial and quality attributes of ground pork prepared from commercial pork trim treated with combination intervention processes. *Journal of Food Protection* **64**:1981–1987. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Choi YM, Kim OY, Kim KH, Kim BC and Rhee MS (2009). Combined effect of organic acids and supercritical carbon dioxide treatments against nonpathogenic *Escherichia coli*, *Listeria monocytogenes*, *Salmonella* Typhimurium and *E. coli O157:H7* in fresh pork. *Letters in Applied Microbiology* **49**:510–515. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Dempster JF **(**1977). Cold water, ultra-high pressure cleaning of abattoirs. *The Journal of Hygiene (London)* **78**:11–16. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Greer G and Dilts BD (1995). Lactic acid inhibition of the growth of spoilage bacteria and cold tolerant pathogens on pork. *International Journal of Food Microbiology* **25**:141–151. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| King AM, Miller RK, Castillo A, Griffin DB and Hardin MD (2012). Effects of lactic acid and commercial chilling processes on survival of *Salmonella*, *Yersinia enterocolitica*, and *Campylobacter coli* in pork variety meats. *Journal of Food Protection* **75**:1589–1594. | Not primary research on pathogen reduction wash/rinse/spray on pork carcasses or pork carcass parts. |
| Sanguankiat A (2013). Molecular epidemiology and serodiversity of *Salmonella enterica* in a pork chain "From Farm to Fork" in Northern Thailand. Thesis, Freie Universität Berlin, Berlin, Germany. | No parallel comparison group |
| Cocora AM, Dobai G, Lazarescu C and Tibru I (2013). The impact of the slaughtering technological's flow stages on the *Salmonella* spp. prevalence. *Lucrǎri Ştiinţifice - Universitatea de Stiinte Agricole a Banatului Timişoara, Medicinǎ Veterinarǎ* **46**:37–42. | No parallel comparison group |
| Mannion C, Fanning J, McLernon J, Lendrum L, Gutierrez M, Duggan S and Egan J **(**2012). The role of transport, lairage and slaughter processes in the dissemination of *Salmonella* spp. in pigs in Ireland. *Food Research International* **45**:871–879. | No parallel comparison group |
| Alban L and Sørensen LL (2010). Hot-water decontamination is an effective way of reducing risk of *Salmonella* in pork Dekontamination mit heissem Wasser: Effektive Reduktion des Salmonellenrisikos in Schweinefleisch. *Fleischwirtschaft* **90**:109–113. | No parallel comparison group |
| Tibru I, Cerna D and Barna A (2009). Hog carcass decontamination with lactic acid. *Lucrǎri Ştiinţifice - Medicinǎ Veterinarǎ, Universitatea de Ştiinţe Agricole şi Medicinǎ Veterinarǎ "Ion Ionescu de la Brad" Iasi* **52**:1196–1199. | No parallel comparison group |
| Delhalle L, de Sadeleer L, Bollaerts K, Farnir F, Saegerman C, Korsak N, Dewulf J, de Zutter L and Daube G (2008). Risk factors for *Salmonella* and hygiene indicators in the 10 largest Belgian pig slaughterhouses. *Journal of Food Protection* **71**:1320–1329. | No parallel comparison group |
| Hald T, Wingstrand A, Swanenburg M, von Altrock A and Thorberg BM (2003). The occurrence and epidemiology of *Salmonella* in European pig slaughterhouses. *Epidemiology and Infection* **131**:1187–1203. | No parallel comparison group |
| Larsen ST, McKean JD, Hurd HS, Rostagno MH, Griffith RW and Wesley IV (2003). Impact of commercial preharvest transportation and holding on the prevalence of *Salmonella enterica* in cull sows. *Journal of Food Protection* **66**:1134–1138. | No parallel comparison group |
| Bolton DJ, Pearce RA, Sheridan JJ, Blair IS, McDowell DA and Harrington D (2002). Washing and chilling as critical control points in pork slaughter hazard analysis and critical control point (HACCP) systems. *Journal of Applied Microbiology* **92**: 893–902. | No parallel comparison group |
| Davies RH, McLaren IM and Bedford S (1999). Observations on the distribution of *Salmonella* in a pig abattoir. *Veterinary Record* **145**: 655–661. | No parallel comparison group |
| Chau PY, Shortridge KF and Huang CT (1977). *Salmonella* in pig carcasses for human consumption in Hong Kong: a study on the mode of contamination. *The Journal of Hygiene (London)* **78**: 253–260. | No parallel comparison group |
| Alban L and Sørensen LL (2009). Prevalence of *Salmonella* spp. after hot-water decontamination of finishers slaughtered in a Danish abattoir during 2004–2008. *International Conference on the Epidemiology and Control of Biological, Chemical and Physical Hazards in Pigs and Pork*, Iowa State University, Ames, IA, USA. pp. 405–408. | No parallel comparison group |
| Brustolin JC, Pisol AD, Steffens J, Toniazo G, Valduga E, Di Luccio M and Cansian RL (2014). Decontamination of pig carcasses using water pressure and lactic acid. *Brazilian Archives of Biology and Technology* **57**:954–961. | No parallel comparison group |
| Saidealbornoz JJ, Knipe CL, Murano EA and Beran GW (1995). Contamination of pork carcasses during slaughter, fabrication, and chilled storage. *Journal of Food Protection* **58**:993–997. | No parallel comparison group |
| Tadee P, Boonkhot P and Patchanee P (2014). Quantification of contamination levels and particular risk of *Salmonella* spp. in pigs in slaughterhouses in Chiang Mai and Lamphun provinces, Thailand. *Japanese Journal of Veterinary Research* **62**:171–179. | No parallel comparison group |
| Shotts EB jr, Martin WT and Galton MM (1962). Further studies on *Salmonella* in human and animal foods and in the environment of processing plants. *Proceedings of the 65th Annual Meeting of the U.S. Livestock Sanitary Association,* Minneapolis, MN, USA. pp. 309–318. | No parallel comparison group |
| Carpenter CE, Smith JV and Broadbent JR (2011). Efficacy of washing meat surfaces with 2% levulinic, acetic, or lactic acid for pathogen decontamination and residual growth inhibition. *Meat Science* **88**:256–260. | Outcome measured only greater than 24 h after the intervention was applied |

# **Protocol S1.** Protocol for the assessment of the magnitude of change in the prevalence of *Salmonella* and quantity of *Salmonella* after administration of pathogen reduction treatments on pork carcasses

*Summary*

To be completed

*Rationale*

To be completed

## *Objectives and PICO(S) review question*

The purpose of this project is to describe changes in *Salmonella* prevalence or quantity (most probably number of colony forming units) in pork carcasses after receiving pathogen reduction treatments during processing. The question is a PICO question: What is the change in *Salmonella* prevalence or quantity (O=Outcome) associated with the use of pathogen reduction treatments applied as washes, rinses or sprays (I=interventions) to pork carcasses (P=population)?

*Protocol registration*

The protocol is not registered.

## *Eligibility criteria (PRISMA item 6)*

*Relevant participants*

Pork carcasses produced from commercial swine in commercial abattoirs. Smallholder slaughter approaches are not applicable

*Intervention and comparators*

Pathogen reduction treatments that are applied as a wash/rise/spray to pork carcasses; this includes organic acids such as peroxyacetic acid, lactic acid, non-acid chemical treatments, acetic acid, lactic acid, hypobromous acid, peroxyacetic acid, citric acid, mineral acids, hydrochloric acid, nitric acid, phosphoric acid, and/or hot water and water treatments such as hot or cold water, steam vacuuming and steam pasteurization, and other compounds such as aqueous ozone, electrolyzed water, potassium hydroxide, potassium sorbate, sodium hypochlorite (NaClO), trisodium phosphate (TSP), cholorine and Alcide® . Combinations of these components are also of interest.

*Outcomes*

The outcome of interest are the following measures of *Salmonella* on the carcass: *Salmonella* prevalence measured by culture (using any culture measure including prescreening with ELISA methods or the presence of *Salmonella* antigen measured by PCR or other antigen detection methods), and *Salmonella* quantity measures (either *Salmonella* colony-forming units and most probable number or “quantifiable PCR” if such an approach exists).

We will also identify studies that have *E coli*, coliforms, Enterobacteriae, and Total Plate Counts (TPC) and may include these in a second review.

*Relevant study designs*

Data may come from comparative experiments. The experiments may use either deliberate contamination or naturally occurring levels of *Salmonella* on the carcasses.

## *Information sources (PRISMA item 7)*

The electronic indexes searched will be science citation index, Medline search and CABI. We will also hand search the reference lists of relevant reviews identified during the search and the conference proceedings of Safe Pork.

## *Search strategy (PRISMA item 8)*

Initially, two search strategies were run in CABI (Web of ScienceTM, Thomson ReutersTM), one containing additional indexing terms to maximize the number of hits; the second search (below) did not contain any of those additional terms. The first search resulted in 1899 hits more than the second search. Those additional records were sorted by relevance and the first 300 of those 1899 were screened for relevance using the Level 1 screening question. None of those 300 records were found to be relevant. Therefore, the final search was run using the search without the additional indexing terms. This search was conducted in in CABI on January 21st, 2015. No restrictions were made with respect to language or document type. Timespan=all years.

De-duplication was performed in EndNote and 5 records were removed, resulting in 1938 records being uploaded to Distiller for screening.

|  |  |  |  |
| --- | --- | --- | --- |
| Search No | No  Hits | Search Terms Used | Comments |
| # 23 | 1943 | #22 OR #21 | Both options ORed |
| # 22 | 473 | TI=((DECONTAMINAT\* OR CONTAMINAT\*) AND CARCASS\*) | Title words only decontamination of carcasses |
| # 21 | 1,516 | #20 AND #1 | Pork carcasses etc AND decontamination techniques (title or abstract) |
| # 20 | 756,777 | #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 |  |
| # 19 | 34,856 | TS=(Chilling or "freezing air" or "high air velocity" or blasting) |  |
| # 18 | 15,540 | TS=((Prevent\* or reduc\*) near/4 contaminat\*) or TS=decontaminat\* |  |
| # 17 | 139,833 | TS=(CHLORINE OR ALCIDE OR ULTRAVIOLET OR UV OR IRRADIAT\* OR "DRY HEAT" OR ULTRASOUND) |  |
| # 16 | 144,840 | ts=(TSP or phosphate$) |  |
| # 15 | 10,343 | ts=("sodium hypochlorite" OR NaClO or "sodium acetate" or "sodium citrate" or "sodium chlorite" or "sodium lactate") |  |
| # 14 | 2,975 | TS=("POTASSIUM HYDROXIDE" OR "POTASSIUM SORBATE") |  |
| # 13 | 70 | TS="AQUEOUS OZONE" |  |
| # 12 | 24,497 | TS=steam |  |
| # 11 | 70,878 | ts="water treatment$" |  |
| # 10 | 26,217 | TS=((hot or cold or electrolyzed or electrolysed or warm) NEAR/3 water ) |  |
| # 9 | 134 | TS=NONACID |  |
| # 8 | 6,609 | TS=((HYDROCHLORIC OR NITRIC OR PHOSPHORIC OR ACID) NEAR/5 (spray\* or decontaminat\* or saniti\* or wash\*)) |  |
| # 7 | 56,989 | TS=(ACETIC OR hypobromous or citric or "mineral acid$") |  |
| # 6 | 46,191 | TS=(PEROXYACETIC OR LACTIC) |  |
| # 5 | 157 | TS=(Organic NEAR/5 (decontaminat\* or saniti\* )) |  |
| # 4 | 192,274 | TS=(spray or sprays or spraying or sprayed) |  |
| # 3 | 57,209 | TS=(wash or washes or washing or washed or rinse or rinses or rinsing or rinsed) |  |
| # 2 | 7,614 | TS=(pathogen near/4 reduc\*) OR TS=prt |  |
| # 1 | 25,552 | TS=((pork or swine or pig or pigs or hog or hogs or boar or boars or sow or sows) near/7 (carcass\* OR slaughter\* or abattoir\* or bellies)) |  |

## *Study selection (PRISMA item 9)*

Two reviewers will screen the abstracts. For Level 1 we will include studies for which any reviewer says yes. Exclusion will require both reviewers to say no. For Level 2, if both reviewers agree that at the form level it should be excluded, that study will be excluded. The questions will be sequential so that the reason for exclusion will be the 1st question in the sequence that has a response of no by both reviewers.

*Screening for eligibility for the review*

The 1st level of screening will be based on the title, abstract, year and language. The Level 1 form will have one question:

“Does the study appear to be primary research on pathogen reduction washes/ rinses/ sprays for pork carcasses or parts of a pork carcass?”

Yes—likely (Include)

No (Exclude)

No details—can’t tell (Include)

No, but is a relevant review (Exclude)

The second level of screening based on the full text is provided below.

## *Data collection process (PRISMA item 10)*

For the data collection process two reviewers will extract data independently from all relevant studies into DistillerSR® (Ottawa, ON, Canada).

## *Data items (PRISMA item 11)*

The data extraction forms for the study level information and the outcome level information are included in the Protocol Table P1 and Protocol Table P2.

## *Assessment of risk of bias in included studies (PRISMA item 12)*

As most of the studies are likely to be experimental we will use the Cochrane Risk of Bias Tool modified to include information about the challenge for experimental studies that use deliberate contamination of the carcass.

## *Summary measures (PRISMA item 13)*

The summary measures will be mean differences for continuous outcomes, and summary risk ratio or summary odds ratio for categorical outcomes.

## *Synthesis of results (PRISMA item 14)*

*Dealing with missing data*

We will not contact authors to obtain missing data.

*Assessment of heterogeneity*

We propose, if the sample size is sufficient, to conduct a meta-regression to determine what factors are associated with the magnitude of the effect size based on the demographic factors collected (see Protocol Table P 1 and Protocol Table P 2).

*Data synthesis*

We will attempt to conduct a mixed treatment comparison meta-analysis and ranking the interventions. The potential to do this will depend upon the how comprehensively the results of the studies are reported.

## *Risk of bias across studies (PRISMA item 15)*

We will assess studies to have a high risk of bias if they have at least one high risk of bias domain. If possible we will also conduct an analysis for small-study effects. However it is unclear if this will be useful as most of the studies will be small and it might not be possible to detect small-study effects. The sample size for small is based on the number of experimental units not the number of pseudo-replicates.

## *Additional analyses (PRISMA item 16)*

At this point we do not propose to do any additional analyses however if we do they will be reported here as they are not proposed *a priori*.

*Proposed level 2 full text screening form*

Q1. Is the full text available in English?

Yes (Include)

No (Exclude)

Q2. Based on the full text, is the study about primary research on pathogen reduction washes/ rinses/ sprays for pork carcasses or parts of a pork carcass?

Yes (Include)

No (Exclude)

Q3. Did the investigators look at *Salmonella*?

Yes (Include)

No, but they did look at *E. coli*, Enterobacteriaciae, coliforms and/or Total Plate Count (TPC) (Exclude)

No, the authors did not look at any of the above (Exclude)

Q4. Based on the full text does the study have a parallel comparative group?

Yes (Include)

No (Exclude)

Q5. Did the investigators measure the outcome \*only\* greater than 24h after application of the intervention?

Yes (Exclude)

No (Include)

Q6. What type of study is this?

Challenge (artificial contamination)

Control (natural contamination)

## *Protocol Table P 1. Proposed Study level data extraction form for relevant papers*

|  |  |  |
| --- | --- | --- |
|  | | |
| Question | Style | Response |
| Q1. In what year(s) was the data collected? | Radio | Specify year or Not Reported.  Do not use publication date to answer this question. |
| Q2. In what country was the study carried out? | Checkbox | (Select all that apply)  List of countries with option for the reviewer to add to the list as needed.  Not Reported |
| Q3. In what setting was the study carried out? | Radio | Commercial Abattoir  University/Research Slaughter Plant  Laboratory  Small Holder Slaughter (Exclude)  Not Reported |
| Q4. If the study was conducted in a commercial abattoir, was the slaughter capacity reported? | Radio (only visible is Q3 = commercial) | Yes: Enter number  No |
| Q5. If the slaughter capacity was reported, what were the units? | Text (only visible is Q3 = commercial) | Specify the units |
| Q6. If the study was conducted in a commercial abattoir, what was the total number of Slaughter Plants? | Radio (only visible is Q3 = commercial | Specify number or Not Reported |
| Q7. What was the experimental unit in this study (i.e., the unit the intervention was assigned to)? | Checkbox | Select all that apply  Carcass  Pork belly  Skin  (Option for reviewer to add items to this list as needed) |
| Q8. What was the weight of the experimental units in this study? | Radio | Specify weight in kg  Not Reported |
| Q9. What was the descriptor the weight of the experimental units? | Radio | Mean  Median  Range  Not Reported  Not Applicable |
| Q10. What was the dispersion of the experimental unit weight? | Radio | Specify a number or Not Reported |
| Q11. What was the dispersion descriptor for the experimental unit weight? | Radio | SD  SEM  Not Reported  Not Applicable |
| Q12. Did the investigators artificially contaminate the experimental units? | Radio | Yes  No  Can’t Tell |
| Q13. What was the concentration of *Salmonella* applied to the experimental unit? | Radio (only visible if Q12 = yes) | Specify number  Not Reported |
| Q14. What were the units of the concentration of *Salmonella* applied to each experimental unit? | Radio (only visible if Q12 = yes) | Specify units  Not Reported |
| Q15. What was the contact time (i.e., the number of seconds that the *Salmonella* was kept on the experimental unit)? | Radio (only visible if Q12 = yes) | Number or Not Reported |
| Q16. What serotype of *Salmonella* was inoculated onto the experimental unit? | Radio (only visible if Q12 = yes) | Specify serotypes or Not Reported |
| Q17. What was the method used to inoculate the experimental unit? | Radio (only visible if Q12 = yes) | Sprayed  Injected  Brushed On  Not Reported |
| Q18. At what locations on the carcass/what parts of the experimental unit was *Salmonella* inoculated? | Checkbox (only visible if Q12 = yes) | Check all that apply  Jowls  Pork Belly  Not Reported  Option for Reviewer to add to this list if needed. |
| Q19. How many times was *Salmonella* applied to the experimental unit? | Radio (only visible if Q12 = yes) | Specify number of times  Not Reported |
| Q20. What was the time interval between inoculation and application of the intervention? | Radio (only visible if Q12 = yes) | Specify time interval (s)  Not Reported  Not Applicable (if this is the control group, i.e., it didn’t receive an intervention) |
| Q21. Which diagnostic method(s) were used to determine the prevalence or level of the bacteria? | Checkbox | Bacterial culture  PCR  ELISA  Other (specify)  Not Reported |
| Q22. If bacterial culture was used, what was the pre-enrichment media? | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported  Not Applicable (pre-enrichment not done) |
| Q23. If bacterial culture was used, what was the pre-enrichment incubation time? | Radio (only visible if Q21 = Bacterial culture) | Specify time (h)  Not Reported  Not Applicable (pre-enrichment not done) |
| Q24. If bacterial culture was used, what was the pre-enrichment incubation temperature? | Radio (only visible if Q21 = Bacterial culture)) | Specify temperature (in oC)  Not Reported  Not Applicable (pre-enrichment not done) |
| Q25. If bacterial culture was used, specify the enrichment media. | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported  Not Applicable (enrichment not done) |
| Q26. If bacterial culture was used, specify the enrichment incubation time. | Radio (only visible if Q21 = Bacterial culture) | Specify (h)  Not Reported  Not Applicable (enrichment not done) |
| Q27. If bacterial culture was used, specify the enrichment incubation temperature. | Radio (only visible if Q21 = Bacterial culture) | Specify temperature (oC)  Not Reported  Not Applicable (enrichment not done) |
| Q28. If bacterial culture was used, specify the culture media | Radio (only visible if Q21 = Bacterial culture) | Specify  Not Reported |
| Q29. If bacterial culture was used, specify the culture incubation time | Radio (only visible if Q21 = Bacterial culture) | Specify (h)  Not Reported |
| Q30. If bacterial culture was used, specify the culture incubation temperature | Radio (only visible if Q21 = Bacterial culture) | Specify (oC)  Not Reported |
| Q31. If bacterial culture was used, was a confirmation method also used? | Radio (only visible if Q21 = Bacterial culture) | Yes (specify method)  No  Confirmation done, but method not reported |
| Q32. If bacterial culture was used and concentration of bacteria was determined, what was the enumeration method used? | Radio (only visible if Q21 = Bacterial culture) | Specify method  Not Reported  Not Applicable (enumeration of bacteria not done) |
| Q33. If PCR was used to detect the bacteria, please give details of the methods (i.e., PCR type, conditions, primer name, target sequence) (copy-paste from text) | Text (only visible if Q21 = PCR) | Give details or Not Reported. |
| Q34. If ELISA was used to detect the bacteria, please give details of the methods used. (copy-paste from text) | Text (only visible if Q21 = ELISA) | Give details or Not Reported |
| Additional Comments | Text | Please add any additional information about the study not captured by the previous questions that you think is relevant to this review. |

## *Protocol Table P 2. Proposed intervention and outcome level form for relevant studies*

|  |  |  |
| --- | --- | --- |
|  | | |
| Question | Style | Response |
| Q1. Description of ARM / Methods (as described by authors - copy - paste from text) | Radio | Describe the intervention used.  (Option for reviewer to add new ARM descriptions as needed.) |
| Q2. Were the interventions assigned randomly? | Radio | Yes (method of randomization was reported)  Reported random but method of randomization not disclosed  Not Reported |
| Q3. Which treatment (intervention) was applied to the experimental unit? | Checkbox | Check all that apply:  Acetic Acid  Chlorine  Citric Acid  Electrolyzed Oxidizing  Water  Hot Water  Hydrochloric Acid  Hypobromous Acid  Lactic Acid  Ozone (aqueous)  Peroxyacetic Acid  Potassium Hydroxide  Steam  Not Reported  (Option for reviewer to add new items to the list as needed) |
| Q4. Is there any additional descriptive information about this intervention (not captured by the other questions on this form) that you would like to add? | Text |  |
| Q5. What was the pH of the intervention as it was applied to the experimental units? | Radio | Specify pH  Not Reported/Not Discernible  Not Applicable (control group) |
| Q6. What was the concentration of the intervention? | Radio | Specify concentration (number only)  Not Reported/Not Discernible  Not Applicable (e.g., if it’s a no-intervention control group or if it’s pure water) |
| Q7. What were the units of the intervention concentration? | Radio | Specify units (e.g., %)  Not Reported  Not Applicable |
| Q8. What was the temperature of the intervention? | Radio | Specify temperature (number only)  Not Reported  Not Applicable |
| Q9. What were the units of the temperature of the intervention? | Radio | Specify units (degrees C, degrees F)  Not Reported  Not Applicable |
| Q10. How was the intervention applied? | Radio | Spray  Rinse  Not Reported/Not Discernible  Not Applicable  Other (Specify) |
| Q11. At what pressure was the intervention applied? | Radio | Specify pressure (number only)  Not Reported/Not Discernible  Not Applicable |
| Q12. What units were used to describe the pressure the intervention was applied at? | Radio | Specify units  Not Reported  Not Applicable |
| Q13. At what point(s) in the processing chain was the intervention applied? Regardless of how the authors described the data, we always reported data as occurring after the processing point. For example, if the original author described the sample as being collected pre-kill, we referred to such a sample as a bleed sample, meaning the post-bleeding but pre-killing sample point. | Radio | final wash,  immediately after chill,  18–48 h after chilling  Not Reported  Not Applicable (control group)  stun,  bleed,  kill,  scald,  dehair,  singe,  polish,  bung removal,  evisceration,  split,  stamp,  Other (specify) |
| Q14. What was the total duration that the intervention was applied? | Radio | Specify the total duration (s)  Not Reported  Not Applicable |
| Q15. What was the number of times that the intervention was applied? | Radio | Specify number of times  Not Reported  Not Applicable |
| Q16. If the intervention was applied more than once, what was the time interval between the applications? | Radio | Specify time (s)  Not Reported/Not Discernible  Not Applicable |
| Q17. In which type of sample was the outcome measured? | Radio | Carcass Rinse  Carcass Swab  Excised Skin Sample  Not Reported  (Option for reviewer to add to this list as needed) |
| Q18. Which bacteria were measured as the outcome? | Radio | *Salmonella*  (Option for reviewer to add to this list as needed.) |
| Q19. N (number of samples analyzed for prevalence) for this arm | Radio | Report number analysed  Not Reported  Not Applicable (prevalence not estimated) |
| Q20. R (if prevalence data are described) (Note that we are only interested in results less than 24h after application of the intervention.) | Radio | Report number positive samples  Not Reported  Not Applicable (prevalence not estimated) |
| Q21. N (number of samples analyzed for concentration estimate) | Radio | Report number analyzed  Not Reported  Not Applicable (concentration not estimated) |
| Q22. What was the concentration of the bacteria after the intervention? (Note that we are only interested in results less than 24h after application of the intervention.) | Radio | Specify concentration (no units)  Not Reported  Not Applicable |
| Q23. What are the units of the concentration? | Radio | Specify units  Not Reported  Not Applicable |
| Q24. What is the precision of the concentration estimate? | Radio | Specify number only  Not Reported  Not Applicable (concentration not estimated) |
| Q25. What was the descriptor of the precision of the concentration estimate? | Radio | SD  SEM  95% Confidence Interval  Not Reported  Not Applicable  Other (specify) |
| Q26. Did the investigators report an effect estimate? | Radio | Yes  No |
| Q27. What was the comparison or control group? | Radio | Describe control group  Not Applicable (control group) |
| Q28. What was the Effect Estimate? | Checkbox (only visible if reviewer answered Yes to Q26) | Odds Ratio (specify)  Risk Ratio (specify)  Mean Difference (specify)  Not Reported  (Option for reviewer to add another selection to the list) |
| Q29. What was the dispersion of the effect estimate? | Checkbox (only visible if the reviewer answered Yes to Q26) | SD (specify)  SEM (specify)  95% Confidence Interval (specify)  Not Reported  (Option for reviewer to add another selection to the list) |
| Q30. What was the P-value for the comparison ? | Radio | Specify  Not Reported  Not Applicable (no statistical tests performed) |
| Q31. Were the outcome assessors blinded to the intervention groups? | Radio | Yes  No  Not Reported |
| Additional Comments | Text |  |

# **References**

Higgins JPT, Altman DG and Sterne JAC (2011). *Chapter 8: Assessing risk of bias in*

*included studies.* In: Higgins JPT and Green S (eds) *Cochrane handbook for systematic*

*reviews of interventions*, Version 5.1.0 (updated March 2011). The Cochrane

Collaboration, 2011. Available from www.cochrane-handbook.org.

**Table S10.** List of potentially relevant studies to be evaluated in a future update of a systematic review of *Salmonella* reduction treatments on pig carcasses

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| --- |
| Clayton NC (2002). The efficacy of various *Salmonella* intervention methods applied to pork carcasses during slaughter. MS Thesis, University of Kentucky, Lexington, KY, USA. |
| Le Roux A, Minvielle B and Gault E (2008). Validation of steam-vacuum process as corrective measure for visible faecal contamination on carcasses: preliminary results. *Proceedings of the Fifty-Fourth International Congress of Meat Science and Technology*, Cape Town, South Africa. pp. 2A–12. |
| Reynolds AE (2005). Utilisation of spray wash with organic acids (peroxyacetic acid and lactic acid) and chlorinated wash in combination, utilizing direct application methods, for pathogen reduction on pork and beef carcasses in small and very small meat processing plants. Research Note: FSIS New Food Safety Technologies Applicable for Small and Very Small Plants. [Available online at www.fsis.usda.gov/PDF/New\_Technology\_C29\_Summary\_FY2003.pdf] Last accessed September 25, 2015. |

1. Initially, a more detailed search strategy was used to search CABI Abstracts, which included the additional search terms: Topic field tag (TS) = contaminat\*, decontaminat\*, “food sanitation”, antibacterial$ or disinfect\*, “heat treatment” and peracetic. This search produced 3842 records. An abbreviated search that did not use those terms returned 1943 records. The additional records found using the full search but not by the abbreviated search were sorted by relevance and the first 300 of these were screened. None of these records was found to be relevant, so it was decided to use the abbreviated search in CAB Abstracts as the final search strategy. [↑](#footnote-ref-1)
2. Pork carcasses, etc. AND decontamination techniques (title or abstract). [↑](#footnote-ref-2)
3. Title words only decontamination of carcasses. [↑](#footnote-ref-3)
4. Both options OR’d. [↑](#footnote-ref-4)