

Title: Interventions for *Salmonella* contamination in raw poultry products during processing: Protocol for a scoping review and evidence map

Registration:

The protocol will be made available at Systematic Reviews for Animals and Food (SYREAF) (<http://www.syreaf.org>).

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Author contributions:

Annette M. O'Connor conceived the idea, developed the protocol, and is the guarantor of the review.

Sarah Totton helped draft and revise the protocol and provided critique and refinement of the protocol.

Amendments:

None to report.

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Conduct and reporting guidelines:

We used PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) (Shamseer et al., 2015) and PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) (Tricco et al., 2018) when drafting this protocol.

37 1. Introduction

38

39 1.1. Rationale

40 *Salmonella enterica* is responsible for the highest burden of foodborne disease globally
41 (Kirk et al., 2015). In the United States, nearly one quarter (23.2%) of all foodborne *Salmonella*
42 infections are attributable to eating poultry products (chicken or turkey) (Interagency Food
43 Safety Analytics Collaboration, 2021). Further, recent outbreaks of *Salmonella* in Not Ready to
44 Eat (NRTE) poultry products have prompted increased interest in mitigation strategies for
45 *Salmonella* in raw poultry (Ford et al., 2023). Adequate prevention of infection involves all
46 components of the farm-to-fork continuum, including processing (WHO, 2018).

47 Information is needed on which types of processing interventions for reducing
48 *Salmonella* contamination of raw poultry products have been studied, how often these have been
49 tested, and gaps in the research literature on this topic. Scoping reviews are an evidence
50 synthesis tool that can provide this information (Munn et al., 2018).

51 A recent (1 August 2024) search of PubMed revealed a systematic review of ultrasound
52 processing interventions on poultry meat (Al-Hilphy et al., 2020) and a 2012 systematic review
53 of chilling interventions for broiler chickens (Bucher et al., 2012). More recently, Leone and
54 others (2024) conducted a systematic review of chilling and post-chilling interventions against
55 *Salmonella* in poultry during processing. We were unable to find a recent systematic or scoping
56 review of processing interventions for *Salmonella* in raw poultry products apart from post-
57 chilling and chilling interventions.

58

59 1.2. Objectives

60 Our objective is to conduct a scoping review of mitigation strategies to reduce or
61 eliminate *Salmonella* contamination during processing of raw poultry products.

62

63 2. Methods

64

65 2.1. Eligibility criteria

66 We used the PCC framework (population, concept, context) (Tricco et al., 2018) for
67 defining our eligibility criteria.

68 Eligible population: Raw poultry products (chicken or turkey) intended for human
69 consumption are eligible.

70 Eligible concept: Eligible interventions are those that are applied during processing from
71 slaughter, scalding/defeathering, rehang, evisceration, carcass washing, pre-chill, chill, post-chill,
72 cutting into parts and comminution (mincing) that are intended to reduce *Salmonella* log CFU
73 concentration. Eligible interventions should likely be relatively rapid (take < 30 minutes). Only
74 those interventions that are permitted by the USDA's Food Safety and Inspection Service are
75 eligible. Ultraviolet, irradiation, and high-pressure processing pasteurization are eligible. Cloacal
76 wash interventions are not eligible. Interventions applied during and after packaging are also not
77 eligible.

78 Eligible context/settings: Eligible settings include commercial poultry processing plants,
79 pilot plants, and laboratory/experimental settings that mimic a commercial processing plant. Any
80 studies conducted outside of these facilities (e.g., outside the processing plant after the product is
81 comminuted, packaged and shipped) will not be eligible.

82 Eligible study designs: Comparative challenge studies, randomized controlled trials as
83 well as comparative natural contamination studies will be eligible (historical control OK). Only
84 primary research will be eligible. Reviews, guideline documents and simulation models will not
85 be eligible.

86 Eligible study characteristics: Studies conducted in any country (provided they meet the
87 standards of commercial processing) and in any year are eligible. As we do not have a budget for
88 translation, only studies for which the full text is available in English will be eligible. Studies
89 published in journals and conference proceedings (provided they have > 1000 words) will all be
90 eligible.

91

92 *2.2. Information sources*

93 The search will initially be conducted in PubMed and CABI (in the Michigan State
94 University Web of Science interface). Validation of the search will be performed by checking the
95 reference list of the recent systematic review on chilling and post-chilling interventions by Leone
96 and others (2024) to ensure that the references cited by that review were captured by our search.
97 We will then use Citation Chaser (<https://estech.shinyapps.io/citationchaser/>) (Haddaway et al.,
98 2022) to identify other relevant studies, including any potentially relevant gray literature . The
99 rationale for this approach is based on our experience with other reviews, which had incredibly
100 diverse sources of articles. This approach provides the most comprehensive review of the
101 literature.

102 Also, we will hand-search the reference lists of all records passing full-text screening for
103 any additional relevant references.

104 We will not be contacting study authors for additional references. We will not be
105 searching conference abstracts as the abstracts from the two that were considered most relevant
106 to our topic (Poultry Science Association Annual Meetings, International Association of Food
107 Protection Annual Meetings) are < 1000 words.

108

109 *2.3. Search strategy*

110 Table 1 illustrates the search strategy for PubMed, which incorporates the PCC
111 framework: 1) the study population (raw poultry products), 2) the context (*Salmonella* mitigation
112 strategies), and 3) the setting/context (applied during processing). There will be no restrictions
113 on date of publication or type of publication.

114

115 **Table 1.** Proposed search strategy in PubMed for a scoping review of interventions for
116 *Salmonella* contamination in raw poultry products during processing (conducted on 23
117 December 2024).

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119

Search	Search string	Number of hits
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1 (population)	chicken* OR poultry OR broiler* OR gallus* OR turkey*	202,355
2 (concept)	<i>Salmonella</i> [Title/Abstract] OR <i>Salmonella</i> [MeSH]	103,200
3 (concept)	rins* OR disinfect* OR spray* OR wash* OR dip OR decontaminat* OR sanitize* OR inactivat* OR control* OR limit* OR intervention* OR reduc* OR antimicrobial OR inhibit* OR prevent* OR treatment*	16,082,269
4 (context)	process* OR product* OR slaughter* OR chill* OR “post-chill” OR “postchill” OR eviscerat* OR defeather* OR scald* OR receiving OR prechill OR “pre-chill”	5,416,131
5	#1 AND #2 AND #3 AND #4	3,016

120
121 Polyglot (<https://sr-accelerator.com/#/polyglot>) was used to translate the search string into CABI
122 (Web of Science).
123

124 2.4. Study records

125 2.4.1. Data management

126 Results of each search (PubMed and CABI) will be downloaded as RIS files, which will
127 then be imported into online systematic review software (DistillerSR®, Ottawa, ON, Canada)
128 and de-duplicated.
129

130 2.4.2. Selection process

131 Screening of the search results will occur in two phases. In the first phase (Level 1
132 screening), each record will be screened based on the title and/or abstract, using a form created in
133 DistillerSR®. Two reviewers (AMOC and SCT), working independently, will pretest the form
134 on the first 100 records from the PubMed search before official screening begins. Subsequently,
135 AMOC and SCT will independently screen the records found in the PubMed and CABI searches.
136 Conflicts will be resolved via discussion. For the Citation Chaser search results, AOC and SCT
137 will independently screen each of the first 500 records with any disagreements resolved by
138 discussion. We will subsequently use AI as a second reviewer to complete the Level 1
139 screening. For the title/abstract screening, the following question will be used:
140

141 **Q1.** Does the title and/or abstract describe primary research on one or more interventions
142 to reduce *Salmonella* concentration on raw poultry products that are not comminuted, applied
143 during relevant processing system?

- 144 • Yes (include for full-text evaluation)
- 145 • Unclear (include for full-text evaluation)
- 146 • No (exclude with no further review)

147 Records for which the reviewers answered “Yes” or “Unclear” will move to the second
148 phase of screening (Level 2 screening), during which the full text will be assessed for eligibility.

149 Each record will be assessed by two reviewers (AMOC and SCT) working independently on a
150 form which will be created in DistillerSR and pretested on five records. Conflicts will be
151 resolved via discussion. The Level 2 form will be created in DistillerSR and will consist of the
152 following questions:

153

154 **Q1.** Is the full text available and longer than 1000 words?

- 155 • Yes (proceed to Q2)
- 156 • No (exclude)

157 **Q2.** Is the full text in English?

- 158 • Yes (proceed to Q3)
- 159 • No (exclude with no further review) (specify language) _____

160 **Q3.** Is this primary research?

- 161 • Yes (proceed to Q4)
- 162 • No (exclude with no further review)

163 **Q4.** Is this research on raw poultry products (chicken or turkey) that are not comminuted
164 and/or packaged?

- 165 • Yes (proceed to Q5)
- 166 • No (exclude with no further review)

167 **Q5.** Is the outcome concentration of *Salmonella*?

- 168 • Yes (proceed to Q6)
- 169 • No (exclude with no further review)

170 **Q6.** Is this a study of a relevant intervention (not cloacal wash, not chill, not post-chill)
171 permitted by the USDA’s Food Safety and Inspection Service for use against *Salmonella* applied
172 during processing (i.e., not on the farm, during or after packaging, during shipping, at retail or
173 during kitchen preparation)?

- 174 • Yes (proceed to data charting)
- 175 • No (exclude with no further review)

176

177 Citation Chaser will be applied to all of the records passing Level 2 screening. Citation Chaser
178 will also be applied to the set of studies identified by Citation Chaser that are found to be
179 relevant. For the last set of citation chaser papers, we will use AI to screen out irrelevant studies
180 and retain the “possible relevant papers” for review by AMOC and SCT. After completing this
181 entire process, we will then use AI error detection to determine if citations that should have been
182 considered have been inadvertently missed. This work will be conducted in DistillerSR. As no
183 standards are available for using artificial intelligence in scoping reviews, we will use current
184 best practices (O’Connor et al., 2018; O’Connor et al., 2019; O’Connor et al., 2020).

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186 2.4.3. Data charting process

187 The data charting form will be created in DistillerSR® and will undergo pretesting on
188 three relevant references by both reviewers (AMOC and SCT). Subsequently, both reviewers
189 will chart data from each relevant study, working independently and resolving any conflicts via
190 discussion. Authors of the studies will not be contacted to confirm data or to provide additional
191 information. Missing data will be scored as “Not reported.”

192

193 *2.5. Data items*

194 We will extract the following variables from each relevant study (headings indicate
195 where they will appear on the Evidence Gap Map):

196 Columns

- 197 • Country in which the study was conducted
- 198 • Setting of study (commercial plant, pilot plant, laboratory, etc.)
- 199 • Study design

200 Bubbles

- 201 • Type of poultry examined (chicken, turkey)
- 202 • Whether the intervention was applied to the whole bird or to parts of the bird (breasts,
203 thighs, etc.)

204 Rows

- 205 • Stage of processing during which the intervention was applied (e.g., scalding,
206 defeathering, etc.)
- 207 • Category of intervention(s) examined: physical, chemical, biological (e.g.,
208 bacteriophages)

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211 *2.6. Critical appraisal of individual sources of evidence*

212 This will not be done, as this is a scoping review.

213

214 *2.7. Synthesis of results*

215 Descriptive statistics and tables will be used to summarize the data. In addition, charted
216 data will be coded using EPPI-Reviewer version 4 (Thomas et al., 2023), then exported to EPPI-
217 Mapper (Digital Solution Foundry and EPPI Centre, 2023) to create an Evidence Gap Map that
218 cross-tabulates the data available on the topic and gives easy access to the information. Cross-
219 tabulation categories will be determined after a closer literature evaluation and consultation with
220 the U.S. Poultry & Egg Association stakeholders.

221

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