CA18105

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Risk-based meat inspection and integrated meat safety assurance

Chemical interventions – To chlorine or not to chlorine?

Case 5 | 22-June-2022 | Leader: Avelino Alvarez Ordonez |
Participants: Marta Kis, Alex Royden, Eduarda Gomes Neves, Ines Mira

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WG3 Overview of Chemical Interventions

- Application of a substance at a given step during the slaughter and/or cutting process in order to reduce the microbial contamination level of carcasses or meat cuts

- Processing aids: "intentionally used in the processing of raw materials, foods or their ingredients, to fulfil a certain technological purpose during treatment or processing"

- In the EU (Regulation 853/2004): the use of any substance other than potable water to remove/reduce surface contamination from products of animal origin is not authorized, unless the use of the substance has been approved following an assessment of its safety and efficacy by the risk assessment authority.

- **Three main aspects are considered: i) the safety of the intended substance itself (toxicological assessment); ii) its effect as to the development of antimicrobial resistance; and iii) the efficacy i.e. does the use of the substance in practice decrease the level of contamination of pathogenic microorganisms**

- Guidance document on the submission of data for the evaluation of the safety and efficacy of substances for the removal of microbial surface contamination of foods of animal origin intended for human consumption

WG3 EFSA Requirements

European Food Safety Authority

- The toxicological safety of the substance (**ToR1**)
- The risk related to the release of the processing plant effluents, following the use of the substance, into the environment (**ToR4**)

- The potential emergence of reduced susceptibility to biocides and/or resistance to therapeutic antimicrobials linked to the use of the substance (**ToR3**)

- **The efficacy, i.e. does the use of this substance significantly reduce the level of contamination of pathogens on carcasses from wild game and small stock aforementioned (ToR2)**

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WG3 When is something 'efficacious'?

- **The use of chemical solutions as decontaminating agents will be regarded efficacious when a reduction of the prevalence and/or numbers of pathogenic target microorganisms set according to determined criteria, is statistically significant when compared to a control group.**

- The achieved reduction should be expected to provide benefits to public health but the satisfactory level of this benefit is a risk management decision.

- Efficacy depends on a range of factors: concentration of the decontaminating agent, pathogen, contact time, temperature, mode of application (i.e. spraying or dipping), etc

- Only studies conducted under conditions directly related to the intended conditions of use should be considered for the efficacy assessment. Studies must include a comparison of the prevalence and/or numbers of the target pathogenic microorganisms

WG3 Our Challenge…

Concen-tration	Temperature	Product to be treated	Method	Duration
800-1,200 ppm	15-30ºC	Poultry carcasses at the end of the slaughter line after final inspection. Poultry meat before at the end of the processing line	Spray or dipping	10-30 s

- The approval is sought for treatments using acidified sodium chlorite solutions with concentrations from **800 to 1,200 ppm**.
- The acidified sodium chlorite solutions are to be applied at temperatures ranging from **15 to 30ºC** on poultry carcasses or poultry meat cuts by **spraying or dipping**.
- The treatment duration ranges from **10 to 30 seconds**.
- The target pathogens identified by the applicant are: ***Salmonella* spp. and *Campylobacter* spp.**

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WG3 Literature to review…

Concen-tration	Temperature	Product to be treated	Method	Duration
800-1,200 ppm	15-30ºC	Poultry carcasses at the end of the slaughter line after final inspection. Poultry meat before at the end of the processing line	Spray or dipping	10-30 s

❖Bashor, M.P., Curtis, P.A., Keener, K.M., Sheldon, B.W., Kathariou, S., Osborne, J.A., 2004. Effects of carcass washers on Campylobacter contamination in large broiler processing plants. Poultry Science 83, 1232-1239.
❖Chantarapanont, W., Berrang, M.E., Frank, J.F., 2004. Direct microscopic observation of viability of Campylobacter jejuni on chicken skin treated with selected chemical sanitizing agents. Journal of Food Protection 67, 1146-1152.
❖Chousalkar, K., Sims, S., McWhorter, A., Khan, S., Sexton, M., 2019. The effect of sanitizers on microbial levels of chicken meat collected from commercial processing plants. International Journal of Environmental Research and Public Health 16.
❖Del Río, E., Muriente, R., Prieto, M., Alonso-Calleja, C., Capita, R., 2007. Effectiveness of trisodium phosphate, acidified sodium chlorite, citric acid, and peroxyacids against pathogenic bacteria on poultry during refrigerated storage. Journal of Food Protection 70, 2063-2071.
❖Kere Kemp, G., Aldrich, M.L., Guerra, M.L., Schneider, K.R., 2001. Continuous online processing of fecal- and ingesta contaminated poultry carcasses using an acidified sodium chlorite antimicrobial intervention. Journal of Food Protection 64, 807-812.
❖Özdemir, H., Gücükoğlu, A., Koluman, A., 2006. Acidified sodium chlorite, trisodium phosphate and populations of Campylobacter jejuni on chicken breast skin. Journal of Food Processing and Preservation 30, 608-615.
❖Özdemir, H., Pamuk, Ş., 2006. Acidified sodium chlorite, trisodium phosphate and populations of Salmonella typhimurium and Staphylococcus aureus on chicken-breast skin. Journal of Food Processing and Preservation 30, 110-117.
❖Purnell, G., James, C., James, S.J., Howell, M., Corry, J.E.L., 2014. Comparison of Acidified Sodium Chlorite, Chlorine Dioxide, Peroxyacetic Acid and Tri-Sodium Phosphate Spray Washes for Decontamination of Chicken Carcasses. Food and Bioprocess Technology 7, 2093-2101.

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WG3 Inclusion Criteria

- Does acidified sodium chlorite significantly reduce the level of contamination of *Campylobacter* spp. or *Salmonella* spp. on carcasses or cuts from poultry?

Population	Poultry carcasses before chilling and post-chilling cuts
Intervention	Acidified sodium chlorite at a concentration from 800 to 1,200 ppm applied at temperatures ranging from 15 to 30ºC for 10 to 30 seconds. Concentration, temperatures and duration of treatment must be reported to confirm this
Comparator	Water (or other solution) treated or untreated carcasses or cuts
Outcome of interest	The change in numbers (log reduction) and/or in presence of *Campylobacter* spp. or *Salmonella* spp. on the treated carcass/cut at any time point after the treatment (immediately after treatment, during storage or at the endo of shelf life
Study design and setting	Experimental controlled studies at the laboratory, pilot plant or industrial (commercial) setting

WG3 Strength of Evidence

Study type	Natural contamination	Inoculated studies[a]
Industrial	High	Not applicable
Pilot-scale[b]	High[c]/medium	Medium[d]
Laboratory	Medium[d]	Low[e]

(a): Includes studies where the meat surface was inoculated with pathogens in pure culture prior to the decontamination treatment.
(b): Experiments using industrial equipment in non-industrial settings.
(c): If the pilot process is representative of the industrial process; otherwise, evidence makes a 'medium' contribution to the body of evidence.
(d): Data demonstrate a disinfectant effect, reproducible in practice, but would not be sufficient to derive a quantitative microbial risk assessment or to allow conclusions on risk reduction.
(e): Data are indicative of a disinfectant effect that may be reproducible in practice, but are inconclusive on risk reduction.

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RELIABILITY OF THE EXPERIMENTS

- Comparability of the control and treatment groups
- Inoculation procedure of the target organism and coverage of the meat surface with the substance
- Detection and enumeration method of the target organism
- Statistical analysis and reproducibility

Rating	Risk of bias	Precision
4	Definitively low risk of bias	Definitively appropriate
3	Probably low risk of bias	Probably appropriate
2	Probably high risk of bias	Probably not appropriate
1	Definitively high risk of bias	Definitively not appropriate

RELIABILITY OF THE EXPERIMENTS

No	Question	Rating	Explanation for expert judgement
1	**Comparability of control and treated groups**	4	There is **direct** evidence that the only difference between the treated and control group is the presence or absence of the decontaminating substance and not the method of application or other factors (e.g. inoculated with the target organism using the same procedure, stored at the same temperature and under the same storage conditions, same detection and/or enumeration method used). The control treatment is identical to the treated sample, except for the substance
		3	There is **direct** evidence of the above (scored 4), except that the control group is left untreated (e.g. no water used) OR There is **indirect** evidence of the above (scored 4)
		2	There is **indirect** evidence that the treated and control group differ in other aspects than being untreated
		1	There is **direct** evidence of the above (scored 2)

RELIABILITY OF THE EXPERIMENTS

2	**Inoculation procedure of the target organism and coverage of the meat surface with the substance**	**4**	(for artificial contamination) There is **direct** evidence that the inoculum was evenly distributed over the meat surface and that the time between inoculation of the target organism and treatment with the substance was sufficient to allow attachment of the bacteria (e.g. at least 15 min) and the substance was evenly distributed over the meat surface (for natural contamination) There is **direct** evidence the substance was evenly distributed over the meat surface
		3	There is **indirect** evidence of the above (scored 4)
		2	There is **indirect** evidence that the above (scored 4) does not apply
		1	There is **direct** evidence that the above (scored 4) does not apply

RELIABILITY OF THE EXPERIMENTS

3	**Detection and enumeration method of the target organism**	4	There is **direct** evidence that a validated reference method or parts thereof, that maximises the recovery of the bacteria, has been used for the detection and enumeration of the target organism (e.g. FDA method, ISO method)
		3	There is **direct** evidence that an acceptable method other than a validated reference method (e.g. Petri film), that maximises the recovery of the bacteria, has been used for the detection and enumeration of the target organism
		2	There is **indirect** evidence of the above (scored 3 or 4)
		1	There is **direct** or **indirect** evidence that the detection and enumeration method contains errors (to be spelled out when scoring)

RELIABILITY OF THE EXPERIMENTS

4	**Statistical analysis and reproducibility**	**4**	Definitively appropriate: There is **direct** evidence of statistical analysis (e.g. ANOVA, t-test, post-hoc test) and independent experimental trials using representative samples (replicates) have been used
		3	Probably appropriate: There is **direct** evidence of statistical analysis but the method and/or the number of independent trials and representative samples (replicates) are not specified
		2	Probably not appropriate: Independent trials (replicates) were used but there is **direct** evidence that a statistical analysis was not used
		1	Definitively not appropriate: A single trial is used (no replicates) and no or insufficient statistical analysis has been performed

WG3 Scoring

Reference	Bacterial group	Concentration	Temperature	Duration	Timing of sampling	Strength of evidence	Control group	Appraisal score	Mean log reduction
Bashor	Campylobacter	1,200ppm Spraying	-	15 s	Post-eviscera-tion prior to 1st carcass washer, after the final carcass washer, post antimicrobial spray if present (plant C-TSP and plant D-ASC), and post chill tank.	High	No??	-/3/2/4	1.26
Chantarapanont	Campylobacter	40-100ppm		2-15 min					
Chousalkar	Campylobacter; Salmonella	900 ppm; Immersion/dipping	5, 15, 22ºC	20 s		Medium (NB - natural contamination/laboratory experiment)	Water wash control group	4/4/4/4	2 log for Campy at 15ºC. 0.1 log for Salmonella at 15ºC. No reduction on Salmonella prev.
Del Río	Salmonella	1,200 ppm		15 min					
Kere Kemp	Campylobacter; Salmonella	1,100 ppm	14-18ºC	15 s		High	?? No	-/4/4/4	E. coli and Campylobacter titers post-COP were 0.59 and 1.14 log10 CFU/ml, respectively, compared to 2.37 and 2.89 log10 CFU/ml after of reprocessing. The incidence of Salmonella and Campylobacter were also sig. lower following COP (10.0 and 49.1%, respectively) than following reprocessing (31.6 and 73.2%).

WG3 Discussion & Conclusions

- Very difficult to compare studies!
- Reliability and comparability of experiments:
  - Comparability of control and treated groups
  - Detection and enumeration method of target organism
  - Statistical analysis and reproducibility
  - Natural contamination v. artificial inoculation of carcasses with target organism
  - Application method of chemical intervention
- Standardisation of methods, control groups needed!!!
- Recommendations for publications – better peer review process?!
- If applicable to industry, study design must be reproducible

Thank you for the attention.

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