Research Article

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Biosecurity measures in European slaughterhouses to prevent the contamination of pig carcasses with Salmonella

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Introduction

Salmonella and hepatitis E virus (HEV) are zoonotic pathogens that commonly cause subclinical infections in pigs. At the same time, it must be kept in mind that *Salmonella* often causes gastrointestinal infections in humans through the consumption of contaminated food. HEV infection can be fatal to humans and it is an emerging zoonotic pathogen in Europe in recent years, with pork being considered to be the main source. Slaughterhouse workers may be at higher risk of contracting both pathogens because they are more likely to come into contact with pigs and carcasses.

The BIOPIGEE (Biosecurity practices for pig farming across Europe) project collected relevant evidence on the extent of biosecurity measures that could affect carcass contamination / cross-contamination with *Salmonella* / HEV in a slaughterhouse. The aim was to identify the best biosecurity methods that would reduce the transmission of the aforementioned pathogens to

humans. The research developed a questionnaire to gather information on biosecurity practices applied to control *Salmonella* and HEV contamination / cross-contamination in different European slaughterhouses.

Materials and methods

A preliminary literature review was conducted based on the following keywords: Slaughter, Biosecurity, Abattoir, Pigs, Salmonella, and HEV. From which, 67 potentially useful sources of information were identified. Based on the information gathered, a questionnaire was prepared and an online survey was conducted. QuestionPro software (QuestionPro. Inc., USA) was used for the online survey. The target group of the survey was slaughterhouse employees who are directly responsible for implementing biosecurity measures. The survey was translated and transmitted in English, Italian, German, Czech and Estonian.

The questionnaire covered the following areas: General (number of questions = 3), transport (1), lairage (4), scalding (2), singing (1), evisceration (4), carcase splitting (2), decontamination (1) and cooling (2). Most questions were closed (multiple choice) with the option to add comments.

Results and discussion

A total of 32/48 participants responded to the questionnaire in full-length, from the following countries: Austria (n = 3), the Czech Republic (10), Estonia (2), Germany (6), Italy (5), the United Kingdom (4) and the Netherlands (2). The respondents were divided according to the animals to be slaughtered as follows: multi-species (in addition to pigs: cattle, sheep, goats, horses, etc.) (n = 14), fattening and other pigs (e.g. sows, boars) (7) or fattening pigs only (11). The results of the partially answered questionnaires were not taken into account.

The weekly capacity of the slaughterhouses in the study ranged from 20 to 37,000 pigs (median 4,000). Based on this, they were classified as either small (<4,000 pigs / week) or large (> 4,000 pigs / week) for data analysis.

Approximately half (54%) of the slaughterhouses reported that, on average, pigs had to stay in the lairage for less than two hours before slaughter and 81% of the pigs were prevented from coming into contact with pigs originating from other farms at the lairage. In most slaughterhouses, singing lasted less than 15 seconds (n = 26; 81%), while in six it lasted more than 15 seconds.

A two-knife system in which the knives were sterilized with 82° C water was used in 28 (87%) slaughterhouses, where the knife was kept in hot water for an average of 2.7 minutes. Most institutions checked the temperature stability of the water used for sterilization on a daily basis (n = 25), with two slaughterhouses doing so weekly and one respondent once a month.

During evisceration, most slaughterhouses took additional measures to prevent lung ruptures (e.g. pleural adhesion) (81%), to handle tonsils and mandibular lymph nodes with extreme caution (65%) and to avoid touching the tongue (68%). In a few slaughterhouses, slowing down the evisceration stage with a branched slaughter line (15%) and round-tipped knives (25%) was used to avoid puncturing intestines.

The majority of respondents (81%) collected additional bacteriological samples on the slaughter line, more than required by legislation. For example, additional samples were collected from the carcasses before chilling in 16 (61%) slaughterhouses and not in eight (31%) while in two facilities it was not applicable, whereas three (11%) slaughterhouses collected samples from scalding water and 21 (81%) did not.

At present, there is no publicly available checklist for European slaughterhouses for self-assessment of biosecurity measures aimed at reducing *Salmonella* and HEV contamination, based on up-to-date scientific information. The literature review, together with the results of the survey, will help to develop an effective tool for self-assessing biosecurity measures in slaughterhouses, providing new ideas and showing how often they are currently being implemented. It should be noted that participation in the survey was voluntary and respondents were anonymised, so it is difficult to assess how representative the sample was. In addition, there may be significant differences between countries and regions, for example, carcass cooling is often not used in Italy. However, the results have shown the usefulness of the

questionnaire and helped benchmark use of effective controls, and future work comparing between countries and size will be completed.

Summary and conclusion

The current study asked personnel responsible for biosecurity in slaughterhouses in different European countries to find out how widely best practices are being applied to prevent (cross-) contamination of pig carcases with *Salmonella* / HEV. The results indicated usefulness of the questionnaire and helped benchmark use of effective controls, and future work comparing between countries and size will be completed. Most of the participating slaughterhouses had some room for improvement in specific sections of the slaughter line, which would help to prevent contamination of carcasses.

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Biosecurity measures in European slaughterhouses to prevent the contamination of pig carcasses with Salmonella

The main aim of the study was to define the best biosecurity practices that would reduce contamination of pigs' carcasses with Salmonella and Hepatitis E Virus. An online survey was designed and distributed to multiple European slaughterhouses in order to map which biosecurity measures are implemented. Obtained results indicate that there most of the responded slaughterhouses implement good level of biosecurity, however there were several scientifically proven techniques which were used infrequently.

Keywords: *pig, slaughterhouse, biosecurity, salmonella*

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