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The use of risk assessment to support control of Salmonella in pork

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Introduction

Despite the effectivity of control measures in the past decade, domestic pork was estimated to be the most important food source for salmonellosis in Denmark in 2014 (Anonymous 2015). Therefore, there is a continued focus on the identification of effective intervention measures in the pig and pork production chain. In this paper, an overview will be given of the results of some research projects that have been performed at the National Food Institute to study the potentials of interventions. In these projects, the specific objective was to estimate the effectivity in terms of reduction of the risk of salmonellosis for the Danish population. The results of these projects illustrate how quantitative microbiological risk assessments (QMRAs) can be applied to support the control of *Salmonella* in pork.

DECONT

A Danish project (DECONT) aimed to study carcass contamination and the potential effectivity of decontamination of pig carcasses during slaughter. In this project, a large number of quantitative samples was taken for indicator bacteria and *Salmonella*. First, the hypothesis was tested that *Salmonella* contamination of carcasses could be predicted from the fecal carriage of *Salmonella* and the fecal contamination of carcasses, as predicted from *E. coli* data in animal feces and hygiene performance of the slaughterhouse. This hypothesis could not be confirmed (Nauta et al. 2013).

Farm to Fork QMRA

Next, a QMRA model was constructed to assess the effect of decontamination of carcasses on human health risk. Until now, several authors have published QMRAs related to Salmonella in pigs and pork, one of these being the recently published “farm to fork” risk assessment performed for EFSA (Snary et al., 2016). Such risk assessments are very useful to evaluate and compare proposed specific interventions in the pork production chain, but may have the disadvantage that they are difficult to use outside the specific scope for which they are developed. A special challenge is these “farm to fork” models is the consumer phase, where the consumers transport, store and prepare their pork products. The transfer, growth and survival of Salmonella during this phase is difficult to predict due to a large variation between consumers and a scarcity of data. Yet, it is of crucial importance for the assessment of the risk. Models targeted at specific products and specific populations have been developed (e.g. Møller et al. 2015, Swart et al. 2016), but may not be generally applicable. Therefore, an alternative generic approach was developed that strongly simplifies the consumer phase and is based on an epidemiological estimate of incidence of salmonellosis in Denmark.

Application of the QMRA model

Using this model, Duarte et al. (2016) were able to estimate the effect of different (hypothetical) decontamination scenarios. An interesting finding was that it is important to not only estimate the mean

effect of decontamination in terms of log reduction obtained, but that an estimate in the variation of that effect is at least as important. In general, a larger variation in the effect will lead to a reduced efficiency of carcass decontamination. Hence, the most effective decontamination strategy is not only effective in terms of mean log reduction, it also shows little variation in its effect.

The same model was applied by Bollerslev et al. (2016a and 2016b), who studied the feasibility of using either enterococci or *E.coli* as an indicator for the presence of higher concentrations of *Salmonella* on pig meat. More specifically the objective of these studies was to develop an approach which could make it possible to define microbiological limits for a bacterial indicator that is associated with an increased risk of salmonellosis, due to bacterial growth or improper hygiene at the slaughterhouse. It was estimated that the majority of salmonellosis cases, caused by the consumption of pork in Denmark, is caused by the small fraction of pork products that has enterococci concentrations above 5 log CFU/g. The results obtained can be used to evaluate the potential effect of different microbiological limits on the risk of salmonellosis and consequently they may be used for the definition of a risk-based microbiological limit for enterococci and development of a process hygiene criterion in cutting plants and retail butcher shops. For the hygiene indicator *E.coli,* the results showed that there was a positive correlation between *E.coli* concentration and prevalence and concentration of *Salmonella,* which suggests a correlation between hygiene performance and the risk of salmonellosis.

Discussion

These results show that quantitative microbiological risk assessment allows an evaluation of the effect of control measures to reduce *Salmonella* in pork in terms of reduced risk of salmonellosis. Hence, it can practically support decision making. Some challenges in the QMRA remain, for example on the effect of the simplifying assumptions about the effects of consumer food handling and preparation.

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