Epidemiological investigations into the sources of Salmonella contamination of pork

M. Swanenburg¹, B.R. Berends², H.A.P. Urlings¹,², J.M.A. Snijders², F. van Knapen²

¹: Department of Infectious Diseases and Food Chain Quality, Institute of Animal Science and Health, P.O. Box 65, 8200 AB Lelystad, The Netherlands. Phone: +31 320 238176, Fax: +31 320 238961.
E-mail: M.Swanenburg@id.wag-ur.nl ²: Department of the Science of Food of Animal Origin, Faculty of Veterinary Medicine, Utrecht University, The Netherlands.

Summary: This study was conducted to elucidate which phases of the pork production chain contribute to the Salmonella contamination on pork after slaughter. Results showed that the slaughterline was the most important source of Salmonella contamination of carcasses. The farm was the most important source of contamination of livers, tongues, rectal samples and mesenterial lymphnodes, for pigs originating from sero-positive herds. The lairage was the most important contamination source for pigs originating from sero-negative herds, for all samples, except carcasses. It is recommended to avoid each direct or indirect contact between different herds along the whole pork production chain, especially between Salmonella-infected and Salmonella-free herds.

Key words: slaughter, pork production chain, lairage, genotype

Introduction: The results of earlier experiments showed that separate slaughter of infected and non-infected herds can be useful to decrease the prevalence of Salmonella-contaminated pork (Swanenburg, 2000). However, in these experiments, pigs from sero-negative herds, slaughtered at the beginning of the day, were not all free of Salmonella after slaughter. This implies that other phases of the pork production chain, such as transport and lairage, can also play a role in the contamination of the end products with Salmonella. In order to take preventive measures in the right phases, and to estimate the effect of such measures on the overall Salmonella contamination of pork after slaughter, it is necessary to know which of the contamination routes have a high impact on the Salmonella contamination of pork after slaughter.

To our knowledge, only a few studies (Williams and Newell, 1968, Berends, 1998) were carried out with the aim to appraise the contribution of different sources to the Salmonella contamination of pork. Though extensive literature research made it possible to obtain an impression (Berends, 1998), the quantitative contribution of the farm, transport, lairage and slaughterline on the Salmonella contamination of
pork after slaughter is actually not known. This study was conducted to elucidate which phases of the pork production chain contribute to the Salmonella contamination on pork after slaughter.

**Materials and methods:** In two slaughterhouses, samples were collected of randomly selected slaughter pigs, of pigs from selected Salmonella-infected (sero-positive) and Salmonella-free (sero-negative) herds and the slaughterhouse environment (Swanenburg, 2000). Samples were collected at the farm (pen samples), from pigs during slaughter (carcass swab, liver swab, tongue swab, rectal contents, mesenterial lymphnode and tonsil), from the slaughterhouse environment and from trucks and lairages. The Salmonella strains, isolated in these experiments, were genotyped with a standardized ERIC PCR (Swanenburg, 2000).

The pork production chain from farm to slaughter, was divided into four phases, as possible sources of contamination: farm, transport, lairage and slaughterline. The most likely source of contamination of a sample was determined by comparing the genotype of the Salmonella isolate in this sample, with the genotypes of the Salmonella isolates in related samples, and in samples, taken from possible sources for the contamination of the pig sample. The relative contribution of the four sources to the Salmonella contamination of pork after slaughter was calculated separately for pigs of sero-positive herds (≥ 10% sero-positive pigs in herd at slaughter) and for pigs of sero-negative herds (≤ 10% sero-positive pigs in herd at slaughter (Swanenburg, 2000)). A more detailed description of the methods is given by Swanenburg et al. (2001).

**Results:** For pigs originating from sero-positive herds, the farm was the most important contamination source for livers, tongues, rectal samples and mesenterial lymphnodes, whereas the lairage contributed to approximately 35% of the contamination of the tonsils. For pigs originating from sero-negative herds, the lairage was the most important contamination source, and contributed to about 75% of the Salmonella contamination of pork for all samples, except carcasses. The slaughterline was the most important contamination source for carcasses of pigs from both sero-negative and sero-positive herds. This was mostly due to the carcass splitter in slaughterhouse 2, that was shown to be consistently contaminated with S. infantis (Swanenburg, 2000).

**Discussion:** The described methods did not result in the exact percentages of the relative contributions of the four sources to the Salmonella contamination of pork, but resulted in a rough estimation. The contribution of lairage, transport and slaughterline was underestimated, and the contribution of the farm was overestimated, because all contaminations with the Salmonella strain that was present on the farm, were attributed to the farm. However, the transmission of this
Salmonella strain to the pig could also have happened during transport, in the lairage, or during slaughter.
The contribution of transport to the Salmonella contamination of pork seemed to be small. As was explained, only contaminations with Salmonella types, different from the farm type, could be attributed to transport. Therefore it can be concluded that only a very limited number of “new” Salmonella types were introduced during transport. Although some trucks in the experiments were contaminated with Salmonella already before transport, infections from pig to pig seemed to be more important than infections from truck to pig. The contribution of the lairage to the Salmonella contamination of pork was rather high. This can be explained by the fact that Salmonella was present in the lairage already before pigs were delivered, which was also earlier described by Swanenburg (2000), and by the crowding of pigs from many different herds.
It can be concluded that measures to avoid contamination of pigs with Salmonella should be implemented in all phases of the pork production chain. The most important measure is to avoid each direct or indirect contact between different herds, along the whole pork production chain, especially between Salmonella-free and Salmonella-infected herds, so that no cross contamination between herds can happen.

References