Salmonella in pigs – here today, gone tomorrow?

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Salmonella is an important cause of foodborne illness in humans. Farm animals and foods of animal origin form an important source of human salmonella infections.

To address this fact the EU Commission issued two major regulations: the Dir. 2003/99/EC demanding a regular and EU-standardised monitoring and reporting, and the Reg. (EC) 2061/2003 demanding the systematic reduction of the occurrence of zoonotic pathogens in food animals and, thus, in the food chain.

In this article the current knowledge on salmonella in pig production and the possibilities of an efficient reduction of salmonella in the pre-harvest phase is explained.

Here today?

Yes, there is no doubt that salmonella in pigs is here today. A Working Group of EFSA has agreed some years ago on the following assumptions (EFSA 2006):

- Up to 80% of the salmonella contamination of food results from salmonella positive food animals (either they are the direct source or at least the reservoir).
- On average, out of the human salmonellosis cases due to food of animal origin, about 60% are due to poultry products, 30% are due to pork and 10% are due to bovine products.

These percentage estimates are representing the European average. However, there are significant differences in the national prevalence of salmonella infections in food animals.

Whereas Sweden, Finland and Norway can be proud of a very low salmonella prevalence in all food animal species (ie also in pigs), the prevalence of salmonella infections in the national food animal populations of the other EU member states is significantly higher.

For the EU baseline survey in slaughter pigs, the sampling of slaughter pigs took place between October 2006 and September 2007. All participating EU member states and Norway sampled ileocaecal lymph nodes from the selected slaughtered pigs. In total 18,751 slaughter pigs were sampled and 18,663 valid lymph node samples were collected.

Some 24 of the 25 participating Member States isolated Salmonella spp., which resulted in an EU prevalence of salmonella-positive slaughter pigs of 10.3%. This means that in the European Union at the point of slaughter around one in 10 slaughter pigs were estimated to be infected with salmonella in the lymph nodes. The national salmonella prevalence figures, however, varied widely amongst the nember states: from 0.0% to 29.6% (see Fig. 1).

It is noteworthy that although there was a large variation in the national slaughter pig salmonella prevalence, the serovar distribution was not remarkably varied between the EU member states, because two specific salmonella serovars, S. typhimurium and S. derby, which are two very common serovars found in salmonella infection cases in humans, accounted for a major part of the positive findings at the EU level and for most salmonella positive EU member states.

Risk factors

Risk factors for salmonella infection in pigs are related to:

- The introduction of salmonella into the herd.
- The spread of salmonellae within the herd.
- The capability of pigs to withstand infection and to minimise the multiplication and shedding of the pathogen.

Risk factors for the introduction of salmonella into the herd:

- Bringing infected pigs into the herd is probably the most important source of introduction of salmonella.
- Feed, or specific feed components if feed components are bought separately, can be a source of salmonella.
- All visitors to a herd can bring salmonella with them.

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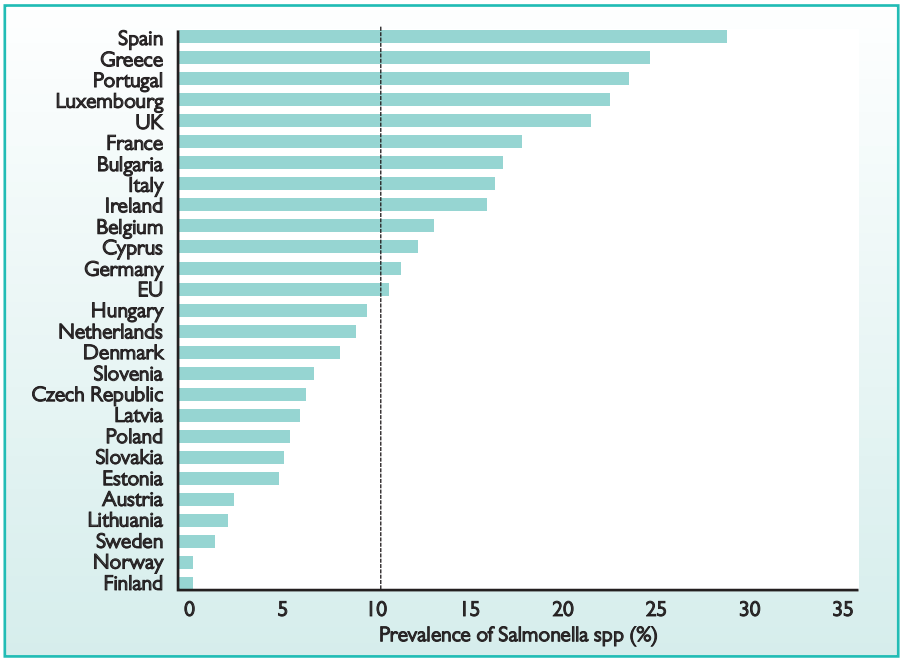
Fig. 1. Observed prevalence of slaughter pigs infected with Salmonella spp. in lymph nodes, with 95% confidence intervals, in the EU and Norway, 2006-2007.



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- Rats, mice, flies, birds, cats and dogs, but also other farm animals can get contaminated and infected with salmonella and spread this salmonella to other animals, for example pigs.
- Sharing farm equipment can introduce salmonella into the herd.
- Water, other than from the municipal supply (for example wells on the farm), can introduce salmonella.

Risk factors for the spread of salmonella within the herd:

- Improper cleaning and disinfection procedures promote the spread of salmonella.
- Continuous flow or deficiencies in the all-in/all-out management increase the spread of salmonella.
- Lack of age group separation supports the transmission of salmonella from older to younger pigs and vice versa.
- Lack of solid pen separation walls also supports the transmission of salmonella from one pen to another.
- Pest animals can spread salmonella within the herd.

Risk factors that increase the susceptibility of pigs for salmonella infection:

- Infection with Ascaris suum.
- Infection with other enteric pathogens for example Brachyspira hyodysenteriae and Lawsonia intracellularis.
- Using antibiotics and antimicrobial growth promoters that are disturbing the microbial balance in the gut.

Intervention methods for preventing and minimising the introduction and spread of salmonella within the herd:

- Bringing non-infected pigs into the herd is probably the most important precondition to be able to run a salmonella minimised pig production. It is important to know that it is possible to rear growers and finishers free from salmonella that come from sow herds that are infected with salmonella using all-in/all-out and thorough cleaning and disinfection, and increasing the maternal antibody concentration in suckling piglets.
- Decontaminating potentially contaminated feed or high risk feed components, for example with formic acid or by heating, will reduce contamination considerably.
- All visitors to a herd can bring salmonella with them. For this reason visitors should have to change their footwear and wear coveralls and wash their hands before entering a herd. It is important that the caretaker of the pigs complies with these rules as well as he/she is the most frequent 'visitor' to the herd.
- Biosecurity of buildings should include measures which prevent rats, mice, birds, cats and dogs from entering the herd.
- An effective way to prevent the spread of salmonella is using all-in/all-out with thorough cleaning and disinfection between batches. This is demonstrated by the difference in prevalence between sows, which are kept in a sort of continuous system and finishers which are kept under all-in/all-out conditions. Closed pen separation can additionally prevent transmission of faecal material from one pen to another.
- Proper pest control strategies will result in a lower transmission rate by pest animals.
- Tools such as shovels and brooms should, like boots, preferably be allocated to a particular barn or age group of pigs.
- Passages from one age group to another or from one barn to another should preferably be equipped with hygiene facilities.
- Antimicrobial treatments or antimicrobial growth promoters can disrupt the gut flora and increase the susceptibility of pigs to salmonella infection. Unnecessary or prolonged antimicrobial treatment should be prevented.

Feed is not only a potential source of salmonella contamination but also a way by which salmonella intervention can be reached.

There are several possibilities:

- As shown by Edel et al. (1970) pelleting is a possibility to strongly reduce salmonella contamination of complete feeds (prevent recontamination after pelleting).
- The fact that feeding pigs with fermented liquid feed containing by-products from the human food industry strongly protects against salmonella in pigs is as well known as the fact that meal feeding is linked to a lower salmonella infection status than feeding pelleted feed. This is not only due to a high risk of the recontamination of pellets, but also due to a different (salmonella reducing) fermentation pattern in the gut in case of fermented liquid and meal feeding.
- Adding 'salmonella-reducing' feed additives such as organic acids (for example propionic acid) or potassium diformate or 'Bio-Mos' to the feed of pigs. Increasing the percentage of raw fibre and barley in roughly ground compound feed increases the enzymatic digestion in the large bowel, which reduces the multiplication in the distal parts of the gut.
- An oral attenuated live vaccine based on Salmonella typhimurium is available in Germany. It has been proven that it increases the maternal antibodies in piglets, which then have a higher chance to get weaned salmonella-free from salmonella positive sows.

Gone tomorrow?

No, there is no doubt, salmonella in pigs will not be gone tomorrow, but it can be reduced towards zero, by keeping it out of the food production chain at each level: feed, animals, transport, slaughter, processing and retail.

The only way to do this is to implement quality management systems along the food chain, with known and feasible intervention measures capable of minimising the introduction and multiplication of salmonella in the food chain. ■

References are available from the author on request