Persistent environmental strains of *Salmonella* Infantis at two Danish slaughterhouses, two case-stories.

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**Introduction**

In this paper we present two cases of persistent environmental strains of *Salmonella* Infantis at two slaughterhouses in Denmark. The continuous presence of *S.* Infantis was revealed by samples taken in accordance with the Danish Salmonella Surveillance and Control programme.

Some of the elements of the Danish Salmonella Surveillance and Control Programme are surveillance of slaughterpig herds, of pigs slaughtered under increased hygiene precautions and surveillance of the Salmonella prevalence in fresh pork.

Pigs from herds assigned to Level 3 are slaughtered under special hygiene precautions. This includes monitoring of the slaughter hygiene by swab samples taken from the carcasses randomly. The swab samples are examined for the presence of Salmonella bacteria. If the proportion of positive samples is too high, the group of carcasses represented by the samples will be heat treated. *Salmonella* Typhimurium is by far the most dominating serotype in the swab samples, and in 1997 it was found in 66 pctl. of the positive swab samples, while *S.* Infantis was found only in 2 pctl. of the positive samples.

At the slaughterhouses in Denmark a total of 2200 samples of pork and offal are analysed every month for the presence of Salmonella bacteria. The number of samples of pork is about 1200 - 1400 every month. Also in pork *S.* Typhimurium is by far the most dominating serotype, and in 1997 it was found in 68 pctl. of the positive samples of pork, while *S.* Infantis was only found in 8 pctl. of the positive samples.

At the beginning of 1998 the slaughterhouse noticed an increasing number of positive swab samples when slaughtering pigs from Level 3. In order to slaughter pigs from Level 3 herds in accordance with their degree of infection and the following risk of contamination of the slaughter line it was decided to examine caecal samples from all Level 3 herds delivering pigs to the slaughterhouse. The results of serotyping of isolates from the caecal samples showed, that the pigs were infected with *S.* Typhimurium while the swab samples were positive for *S.* Infantis. Bearing in mind the differences of prevalence of *S.* Typhimurium compared to *S.* Infantis, the conclusion was, that there was a source of *S.* Infantis contamination at the slaughterhouse.

As the next step swab samples were taken from carcasses along the slaughterline. These samples showed, that the source of contamination must be found in this area. Then samples were taken from all parts of slaughter equipment, that came into contact with the carcasses. Samples were taken both before and after cleaning. Even though all but one of these samples were negative, the slaughter line was subjected to an intensive cleaning and disinfection.

Samples taken a few days later from the splitting saw were positive for Salmonella. Exhaustion and filter in the splitting saw were cleaned. Extra samples from filter and exhaustion were positive for Salmonella. The result of the serotyping was not yet available, but still the interim conclusion was, that the splitting saw was the cause of contamination, and the filter and exhaustion channel were cleaned.

Further sampling from the splitting saw showed, that *S.* Infantis was dripping from the filter. The filter was cleaned and desinfected every day. Samples were taken before cleaning, and these samples showed, that the filter was *S.* Infantis negative in the morning but *S.* Infantis positive after slaughter. It was presumed, that *S.* Infantis had colonized the exhaustion channel far above the filter. A video recording of the channel had revealed, that there was dust or dirt far up in the channel.

From the beginning of February and until May *S.* Infantis was isolated in varying numbers from every batch of swab
samples taken during slaughter of pigs from Level 3 herds. Practically all carcasses from Level 3 herds were referred to heat treatment during this period.

During May and June there was extensive cleaning and sampling of the splitting saw, the filter and the exhaust. In June a new exhaust was installed over the splitting saw. S. Infantis could still be found now and then in the swab samples. Finally in the beginning of the autumn the entire exhaust channel from the splitting saw out to the open was taken apart and cleaned thoroughly. After this procedure S. Infantis was only isolated from one batch of carcasses during the rest of 1998.

To find and eliminate this persistent strain of S. Infantis at the slaughterline took about 6 months and required at least 2400 caecal samples, 1000 samples after cleaning and 550 other kinds of samples.

**Slaughterhouse B**

During the late spring and summer of 1998 this slaughterhouse had an increasing number of positive samples of fresh pork. The results of the serotyping showed that S. Infantis was found in most of the samples. As S. Typhimurium is by far the most prevalent serotype in pork, the frequent findings of S. Infantis indicated that a contamination at the slaughterhouse could be the cause.

Sampling at the slaughterline showed, that the carcasses were contaminated already when leaving the polishing machine. Then sampling was concentrated on the polishing machine. The machine was thoroughly cleaned and disinfected and more samples were taken. Some of these samples were Salmonella positive and it was decided to disassemble the machine and clean it. Samples were taken afterwards, all Salmonella negative. A few days later samples were again taken at the polishing machine, 4 out of 17 samples were Salmonella positive. Still, after cleaning and disinfection of the machinery, the prevalence of Salmonella positive samples had decreased.

In the beginning of 1999 S. Infantis could occasionally be isolated from the polishing machine. The sampling was then extended to the lairage, to the runway, the water in the scalding tank and the dehairer. No S. Infantis was isolated from the lairage, the runway or the scalding water.

Samples from the dehairer and from carcasses sampled at the gambrelling table showed a high prevalence of Salmonella. The laboratory analysing the samples uses a kit to place the Salmonella isolates in different serogroups where S. Typhimurium belongs to serogroup B, and S. Infantis belongs to serogroup C. The kit is SPECTATE® from Rhône diagnostics. Isolates from the dehairer and from the carcasses did all belong to serogroup C, indicating that they could be S. Infantis. Because of these findings the dehairer was disassembled, cleaned and disinfected. Afterwards samples were taken from the water passing through the dehairer. Salmonella was not isolated from these samples. S. Infantis has been isolated from samples taken later on, but then less frequently.

Despite the intensive cleaning and disinfection analysis of samples of water collected from the various machinery showed that S. Infantis still occurred. To eliminate any Salmonella contamination from the dehairer the effect of the singeing oven has been increased.

Sampling is still being done at the slaughterhouse to determine if the persistent strain of S. Infantis has been eliminated. An other explanation could be that a herd with an unidentified problem with S. Infantis is causing a repeatedly contamination of the slaughter line. The intensive cleaning and disinfection of the dehairer and the polishing machine has been effectfull. Since the beginning of March no samples of fresh pork has been found positive for S. Infantis.

To solve the problem at this slaughterhouse a new technique has been introduced. Instead of swab sampling water from the machinery is collected in buckets or other containers and Salmonella analysis are then performed on samples from this water. The technique seems to be better to reveal contamination of the machinery with Salmonella. Until the water sampling technique was introduced the course had been prolonged because there were several periods of days up to two weeks where the swab samples were negative.

So far there has been analysed more than 5000 samples to locate the source of contamination.

**Discussion and Conclusion**

The aim of the Danish Salmonella Surveillance and Control System is to reduce the level of Salmonella in slaughterpig herds and in pork. The two case stories described above show, that the surveillance system will also reveal if a slaughterhouse has problems with a persistent environmental strain of Salmonella.

In the two cases we have been lucky that the persistent strains were both S. Infantis, which is not the dominating serotype in Danish pigs or in pork. This made it more obvious that persistent strains somewhere in the environment was the cause of the increased number of positive samples. If we should experience a persistent strain of S. Typhimurium, we must rely on the phagetyping. Since August 1 1998 all isolates of S. Typhimurium from samples of pork are phagetyped.

We conclude, that to identify a problem with a persistent strain of Salmonella at a slaughterline is relatively easy. To locate and to eliminate it is laborious and troublesome.