Changes in *Salmonella* prevalence in pork cuttings in supermarkets and butchers’ shops in Denmark from 2002 to 2006

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Abstract

The prevalence of *Salmonella* in fresh pork cuttings and the distribution of suppliers of these products to retailers in Denmark were investigated in 2002 and again in 2006. Samples were taken at retail level and the supplying slaughterhouses and cutting plants were identified. In 2002, a total of 1,025 and 3,473 samples were taken from butcher’s shops and supermarkets, respectively. The corresponding numbers in 2006 were 259 from butchers’ shops and 628 from supermarkets. All samples were tested qualitatively for *Salmonella*. For the positive samples the concentration was determined using a semi-quantitative method. In 2002, 1.2% samples were *Salmonella* positive. Samples taken from butcher’s shops accounted for 35% of the positive samples corresponding to a prevalence of 1.8% of *Salmonella* in fresh pork cuttings from this type of retailer. The corresponding prevalence for samples taken from supermarkets was 1.0%. In 2006, the prevalence in pork cuttings had increased to 4.2% and for meat bought in butchers’ shops and supermarkets the prevalence was 8.1% and 2.6%, respectively. Hence, increases around 3- to 5-fold were found. In the same time period there have been no comparable increases in the *Salmonella* prevalence in the Danish slaughterhouses. Possible explanations for this will be discussed.

Introduction

Pork meat is a substantial source of human *Salmonella* infections in Denmark accounting for 10-20% of all *Salmonella* cases. In Denmark close to 25 millions slaughter pigs are produced annually. Only a minor part is distributed to the domestic market. Around 10 large export-authorized slaughterhouses under the Danish Meat Association (DMA) account for more than 95% of the production, while the remaining 5% is produced under a smaller slaughter association called Danske Slaightermestres Landsforening (DSL) housing the small- and medium-sized slaughterhouses. Small- and medium-sized slaughterhouses is expected to provide up to 40-50% of the fresh pork at retail but no solid data on the distribution of pork meat to retail is available.

The Danish *Salmonella* control programme aims at reduction of the consumer risk from Danish fresh pork. The programme includes serological classification of slaughter pig herds into three *Salmonella* infection levels, sanitary slaughter of pigs from herds belonging to the highest infection level, and *Salmonella* surveillance of fresh meat at the slaughterhouse. Fresh meat surveillance data from 2001/2002 showed an overall *Salmonella* prevalence of 1.7% (Anon. 2002a) with 1.8% positive carcasses from the large export-authorized slaughterhouses, 1.1% from medium-sized export-authorized slaughterhouses and 0.6% from the small slaughterhouses. The latter are only approved for the domestic market. In 2006, the overall *Salmonella* prevalence had decreased to 0.9% (Anon. 2006), DMA members having 1.0% positive carcasses and the remaining slaughterhouses having 0.9%. Thus, the Danish surveillance data, particular from 2002, suggested that meat from the small slaughterhouses might be safer for the consumer compared to meat from the larger slaughterhouses.

It is uncertain how the *Salmonella* carcass contamination defined by swabbing at the slaughterhouses transforms into *Salmonella* levels in meat cuts at retail. Therefore, a retail survey on the distribution of fresh pork cuttings and the prevalence of *Salmonella* in retail butchers’ shops and supermarkets was performed. The objectives of the study were:
• To map the distribution of retail suppliers of fresh pork cuttings
• To establish the prevalence of Salmonella in pork cuttings from Danish retailers
• To compare the Salmonella prevalence at retail level to the prevalence at slaughterhouse level
• To investigate whether the unequal distribution of Salmonella observed between the different groups of slaughterhouses in Denmark is reflected at retail.

Materials and Methods

In 2002 and again in 2006, samples of at least 200 g fresh pork meat were taken from butchers’ shops and supermarkets throughout Denmark. In each shop, three cuttings each originating from the shoulder, middle and leg part, respectively, were collected. All samples were transported to the local Food Administration Centre, where Salmonella was detected in 25-g-samples using a standard enrichment procedure (Anon. 2002b). A fraction of the isolates were selected for conformation by serotyping according to the Kauffmann and White scheme (Popoff and Minor 1997). For each sample additional information of the authorization number of the supplier was registered. From the authorization number the specific supplier was identified and its approval for export or domestic market as well as its organizational affiliation was established.

Results

Salmonella prevalence. In 2002, a total of 1,025 and 3,473 samples were taken from butchers’ shops and supermarkets, respectively. The corresponding numbers in 2006 were 259 from butchers’ shops and 628 from supermarkets (Table 1). In 2002, Salmonella was detected in 1.2 % of the samples. Samples taken from butchers’ shops accounted for 35 % of the positive samples corresponding to a prevalence of 1.8 % of Salmonella in fresh pork cuttings from this type of retailer. The corresponding prevalence for samples taken from supermarkets was 0.98 %. In 2006, the average prevalence in pork cuttings had increased to 4.2 %. The largest change was observed for meat bought in butchers’ shops, where a 4.6-fold increase to 8.1 % was observed. For supermarkets the prevalence had increased to 2.6 %, which was 2.6-fold higher than in 2002 (Table 1).

Table 1. Detection of Salmonella spp. in fresh pork cuttings collected in butchers’ shops and supermarkets in Denmark in 2002 and 2006.

<table>
<thead>
<tr>
<th>Type of retailer</th>
<th>2002</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of samples</td>
<td>No. of positives</td>
</tr>
<tr>
<td>Butchers’ shops</td>
<td>1,025</td>
<td>18</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>3,473</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td>4,498</td>
<td>52</td>
</tr>
</tbody>
</table>

* Numbers in parentheses are 95% confidence intervals

As shown in Table 2, there was a significantly ($\chi^2$-test $P \leq 0.038$) lower prevalence of Salmonella in the cuttings originating from the hind part of the carcass in 2002, as compared to the middle and shoulder parts. Independent on type of retailer and year of investigation, the Salmonella prevalence was always highest in cuttings originating from the shoulder part (Table 2).

In 2002, 12 isolates of Salmonella, coming from 11 different stores, were serotyped and seven Typhimurium, three Ohio, one Infantis and one Orion were found. In 2006, nine Typhimurium and eight Idikan were found in samples coming from 7 different stores.

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Table 2. Detection of *Salmonella* spp. in cuttings originating from shoulder, middle and hind parts collected at retail in Denmark in 2002 and 2006.

<table>
<thead>
<tr>
<th>Type of retailer</th>
<th>Cutting from</th>
<th>2002</th>
<th></th>
<th>2006</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Butchers' shops</td>
<td>Shoulder</td>
<td>324</td>
<td>9</td>
<td>2.8 (1.3-5.2)</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>410</td>
<td>7</td>
<td>1.7 (0.7-3.5)</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Hind</td>
<td>291</td>
<td>2</td>
<td>0.7 (0.1-2.5)</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>Shoulder</td>
<td>1,206</td>
<td>18</td>
<td>1.5 (0.9-2.4)</td>
<td>160</td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>1,237</td>
<td>12</td>
<td>1.0 (0.5-1.7)</td>
<td>226</td>
</tr>
<tr>
<td></td>
<td>Hind</td>
<td>1,030</td>
<td>4</td>
<td>0.4 (0.1-1.0)</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>17</td>
</tr>
</tbody>
</table>

* Numbers in parentheses are 95% confidence intervals

Retail supply routes. The distribution of fresh pork cuttings, from slaughter to retail, was established for the samples. Four retail supply routes were identified. In 2002, 10 % percent of the pork cuttings were supplied directly from slaughterhouses, which were authorized only for slaughter, 57 % from cutting plants associated with the slaughterhouse and 32 % were distributed from specialized cutting plants to the retailers. The last 2 % was distributed to retail through wholesalers (Figure 1). In 2006, this pattern had changed significantly (CHI²-test; P < 0.001). The most pronounced changes were a 2.5-fold decrease in samples traced back to slaughterhouses and a 2.5-fold increase in samples traced back to wholesalers.

As seen in Table 3, the supply routes could be divided further into three different categories, dependent on authorization for export or domestic markets and organizational association. In 2002 as well as 2006, butcher's shops traded more frequently with small suppliers approved for the domestic market (14-15 %) compared to supermarkets (1-3 %). For supermarkets, the majority (>75 %) of the samples originated from the large DMA members, whereas the main suppliers for butcher's shops were the medium-sized export approved companies from DSL represented by ca. 60 % of samples both in 2002 as well as in 2006 (Table 3). The most conspicuous change from 2002 to 2006 was observed for butchers' shops. In 2002, a significantly (CHI²-test, P < 0.001) larger proportion of the samples originated directly from DSL, export authorized slaughterhouses, whereas in 2006 a significantly (CHI²-test, P < 0.001) larger proportion came through DSL, export authorized cutting plants.

Figure 1. Retail supply routes of fresh pork cuttings in Denmark in 2002 and 2006.
Table 3. Distribution of the retail suppliers of fresh pork cuttings collected in butchers’ shops and supermarkets in Denmark in 2002 and in 2006.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughterhouse without cutting plant:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA(^a)</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>DSL(^b), export</td>
<td>16%</td>
<td>2%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>DSL, domestic</td>
<td>10%</td>
<td>2%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Cutting plant associated with the slaughterhouse:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA</td>
<td>15%</td>
<td>50%</td>
<td>14%</td>
<td>47%</td>
</tr>
<tr>
<td>DSL, export</td>
<td>39%</td>
<td>5%</td>
<td>56%</td>
<td>9%</td>
</tr>
<tr>
<td>DSL, domestic</td>
<td>2%</td>
<td>&lt;1%</td>
<td>4%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Specialized cutting plant:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMA</td>
<td>4%</td>
<td>34%</td>
<td>3%</td>
<td>30%</td>
</tr>
<tr>
<td>DSL, export</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>DSL, domestic</td>
<td>3%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Other(^c)</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Unknown</td>
<td>4%</td>
<td>2%</td>
<td>6%</td>
<td>9%</td>
</tr>
</tbody>
</table>

\(^a\) DMA: Danish Meat Association (large enterprises)  
\(^b\) DSL: Danske Slagtermesters Landsforening (small- and medium-sized enterprises)  
\(^c\) This category covers samples that were delivered from other types of suppliers e.g. wholesalers

Discussion

The present survey indicated that the prevalence of *Salmonella* positive carcasses at the slaughterhouse did not transform into a uniform retail prevalence. The supermarkets, having the lowest *Salmonella* prevalence (Table 1), were mainly supplied by the DMA members (Table 3) having the highest prevalence of *Salmonella* positive carcasses among the Danish slaughterhouses, whereas the butchers’ shops, showing the highest *Salmonella* prevalence (Table 1), were mainly supplied by the small- and medium-sized slaughterhouses (Table 3), which had the lowest proportion of *Salmonella* positive carcasses. This makes it difficult to draw a direct link between slaughterhouse data and the degree of *Salmonella* contamination at retail. In order to improve risk assessment of *Salmonella* in fresh pork meat, this survey underlines the need for thorough data from retail.

Several factors may have contributed to the increased *Salmonella* contamination of pork cuts at retail observed from 2002 to 2006. There was no indication of increase in prevalence of *Salmonella* positive carcasses from 2002 to 2006 or of a change in supply routes towards slaughterhouses with higher prevalence (Table 3). Thus, the hygiene levels through the preceding whole meat processing chain, and the ability to avoid cross-contamination and to prevent growth of the organism, could be responsible factors. Looking into the diversity of serotypes and the concentration in the samples could illuminate this.

References

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