Salmonella-prevalences in Danish organic, free-range, conventional and breeding herds

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Abstract

The results from the Danish serological Salmonella surveillance on meat juice from slaughter pigs in the herd types: conventional herds, organic herds, free-range herds and breeder herds were compared. Seropositive samples were found in all herd types. The relative risk for a sample to be seropositive in free-range herds was 1.7 compared to conventional herds (p=0.0001) when confounder control for herd size was applied. An apparent increased risk in organic herds and reduced risk in breeder herds were not statistically significant. The analysis of results from organic herds was based on relatively few samples. Due to the expected increase in number of alternative production systems and difficulties in application of the full panel of recommendations for reduction of the Salmonella infection in these herds, future studies should focus on identification of specific Salmonella risk factors within alternative production systems and develop new tools based on this knowledge.

Introduction

More than 15000 herds with a deliverance of more than 100 pigs per year are monitored monthly in the Danish Salmonella surveillance system by analysis of meat-juice samples from slaughter pigs for antibodies against Salmonella using the Danish Salmonella-Mix-Elisa (3). The cut-off value for seropositivity is salmonella values > 30 (= OD percents > 40). Around 800,000 samples are analysed per year. The herds are every month assigned to one of three Salmonella-levels based on the seroprevalence from the preceding three months and the herd size (Level 1 (acceptable infection level, no intervention), Level 2 (increased infection level, mandatory herd intervention) and Level 3 (highest infection level, mandatory herd intervention and special hygienic precautions at slaughter).

The Danish Central Herd Register (CHR) is based on yearly collection of herd informations from the farmer via a written questionnaire. One of the registered characteristics is the herd type. Each herd have a unique herd number enabling us to link the herd characteristics to the Danish Zoonosis Register (ZOOR) in which all data from the surveillance of herds delivering >100 pigs for slaughter per year are collected (2).

In Denmark the number of herds producing pigs under some kind of non-conventional concept like organic farming or free-range production are expected to increase over the next years due primarily to the consumers concern for animal welfare. The obvious difficulties in applying the recommended cleaning and disinfection procedures for reduction of Salmonella contamination on outdoor areas (pastures) and use of permanent straw-bedded areas might pose a risk for increased Salmonella infection levels in the non-conventionally produced slaughter pigs. On the contrary, the access to green pastures and the frequent use of crude feed in some of the alternative production systems combined with a reduced stocking rate might contribute to a reduction in the Salmonella infection level. The aim of this study was to analyse the influence of herd type on the Salmonella infection level, measured by meat juice serology in slaughter pigs.

Materials and Methods

From the CHR-register the herd type for each herd number was obtained. The most common herd types are: conventional production, organic production, free-range production and breeding herd. Free-range herds are herds having free-range pigs. In general only the sows are free-range, but in few herds, weaners and finishers are free-range as well. Breeding herds are breeding or multiplying (gilt producing) herds.

The organic herds and free-range herds are generally considerably smaller than conventional productions, whereas the breeding herds generally are somewhat larger.

From ZOOR a data set was created including the serological results from meat juice samples from the Salmonella survey of slaughter pigs in the period 1st of January 1997 to mid-October 1998 where the study was performed (a total of 1,329,622 test results). The percent of Level 2 and Level 3 herds for each herd type in October 1998 was registered, and the distribution of seroprevalences for the preceding 3 months period (1st of July-30th of September 1998) was found for each herd type. The data from approximately this period were the basis for the assignment of Salmonella levels in October 1998. A total of 15,941 herds had a Salmonella level in October 1998. Of these herds 14,075 were sampled in the period from 1st of July to 30th of
September 1998, the remaining herds had their Salmonella level transferred from earlier months.

For the statistical analysis of the influence of herd type on seropositivity of a meat juice sample a logistic regression analysis on single sample level was run on the entire data set. In the analysis a correction for overdispersion was used (Williams correction) and further the herd size (log (delivery in the preceding 3 months)) was added as an explanatory variable.

**Results**

Herds registered as conventional farms and organic farms had an overall seroprevalence of 3.0 %, free-range herds had a seroprevalence of 4.4% and breeding/multiplying herds had a seroprevalence of 2.6%.

Figure 1 shows the percent of Level 2 and Level 3 herds for each herd type. In organic herds 2 out of 24 herds were in Level 2 in October 1998. No organic herds were in Level 3. The percent of free-range Level 2 and Level 3 herds seemed to be somewhat higher than in conventional herds. The percent of Level 3 breeder herds was marked below the percent in conventional herds, whereas the percent of Level 2 breeder herds was similar to that of conventional herds.

Figure 2 shows the distribution of herd seroprevalences for each herd type in the period July-September 1998. Apparently the proportion of herds with at least one seropositive sample were at the same level in the four herd types (12-15%). Only 21 organic herds were sampled in this period, in four herds seropositive samples were found. The seroprevalence generally seemed somewhat higher in free-range herds and a little lower in breeder herds than in conventional productions.

Table 1 shows the OR for seropositivity in organic herds, free-range herds and breeding herds compared to conventional herds. The risk for a meat juice sample from a free-range herd to be seropositive was significantly increased (factor 1.7) compared to conventional herds. The apparent higher risk in organic herds and lower risk in breeder herds compared to conventional herds were not significant when controlling for herd-size.

The effect of herd size was also investigated. A significant effect of herd size was demonstrated (table 1). OR for a doubling the herd size was 1.06 (p=0.0001).

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**Figure 1.** Percent herds in Salmonella Level 2 and Level 3 for each herd type (October 1998). Total number of herds and number of herds in Level 2/Level 3 are shown below the columns.

<table>
<thead>
<tr>
<th>Total No.</th>
<th>15350 Conv.</th>
<th>24 Organic</th>
<th>241 Free-range</th>
<th>297 Breeders</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2/L3:</td>
<td>426 / 201</td>
<td>2 / 0</td>
<td>9 / 5</td>
<td>9 / 1</td>
</tr>
</tbody>
</table>

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Figure 2. The distribution of herd Salmonella seroprevalence for each herd type in the period 1st of July 1998 to 30th of September 1998. The percentage of herds with no seropositive meat juice samples are shown below the columns.

Table 1: The number of samples and the relative risk and significances for a meat juice sample to be seropositive in Salmonella mix-ELISA in different herd types compared to the risk in conventional herds. Further the relative risk from doubling in herds size is shown.

<table>
<thead>
<tr>
<th>Herd type</th>
<th>Salmonella survey results from the period January 1997 -&gt; October 1998</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. meat juice samples</td>
<td>Odds ratio</td>
</tr>
<tr>
<td>Conventional production</td>
<td>1.291,830</td>
<td>1</td>
</tr>
<tr>
<td>Organic herds</td>
<td>822</td>
<td>1.7</td>
</tr>
<tr>
<td>Free range herds</td>
<td>10,587</td>
<td>1.7</td>
</tr>
<tr>
<td>Breeding/multiplying herds</td>
<td>26,383</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Doubling herd size: Odds Ratio = 1.06 (p=0.0001)

Discussion

The data quality of the herd data from the CHR-register depends on the accuracy of the farmer to fill in the questionnaire. Misclassifications of herd types might therefore occur. This is not critical as long as the misclassifications do not depend on the salmonella infection levels. But it might lead to reduced power of the study. The herd type of the two organic herds in Level 2 was confirmed by contact to the farmers.

Previous studies has shown a significant, yet not very big herd-size-effect (1). This effect was also seen in the present study (table 1), and the herd size was therefore included in the epidemiological analysis as confounder-control.

The CHR-register do not hold informations on which age groups of pigs in free-range herds that are outdoor. In the majority of Danish free-range herds only the sows are free-range. Only in few herds, weaners and finishers are free-range as well. Conclusions on the effect of free-range finishers can thus not be obtained from this study.

Only few test results are available from the few organic herds. The power of the study on the effect of organic farming is therefore limited.

The study shows, that Salmonella infections can be found
in organic herds and free-range herds as well as in conventional productions. It stresses the importance of studying the risk factors within the alternative production systems in order to be able to compensate for the limited use of hygienic measures to reduce the contamination in the pigs environment.

Earlier published studies on the dependency of herd type on Salmonella infection levels are sparse.

References

