

EU-wide baseline survey on the prevalence of *Salmonella* in holdings with breeding pigs, 2008 - prevalence and factors associated with *Salmonella* positivity

*Amore, G.**

Boelaert, F., Riolo, F., Mäkelä, P.

Zoonoses Data Collection Unit, European Food Safety Authority, Parma, Italy

*Giusi Amore, European Food Safety Authority, Largo N. Palli 5/A - 43121 Parma, Italy

Email: giusi.amore@efsa.europa.eu; fax: +39 0521 036052

Abstract

In order to reduce the incidence of human salmonellosis, European Union (EU) legislation foresees the setting of *Salmonella* reduction targets for food producing-animals including breeding pigs. To set such a target, an EU-wide baseline survey was conducted in 2008 to determine the prevalence and diversity of *Salmonella* in holdings with breeding pigs across Member States (MSs). A total of 1,609 breeding holdings and 3,508 production holdings from 24 EU MSs, plus Norway and Switzerland, were included in the survey. In each randomly selected holding, one fresh voided pooled faecal sample was collected from every 10 randomly chosen pens of breeding pigs. All samples were tested for presence of *Salmonella* and the isolates were serotyped. The EU prevalence of *Salmonella*-positive holdings with breeding pigs was 31.8%, all but one of the 24 participating MSs detected *Salmonella* in at least one holding. The EU prevalence of *Salmonella*-positive breeding holdings was 28.7%, varying from 0% to 64.0% among MSs. The EU prevalence of *Salmonella*-positive production holdings was 33.3%, while the MSs' prevalence varied from 0% to 55.7%. *Salmonella* Derby and *Salmonella* Typhimurium were the most frequently isolated serovars. *Salmonella* Typhimurium monophasic isolates 1,4,[5],12:i:- were also found in several MSs. Breeding pigs may be an important source of dissemination of *Salmonella* throughout the pig-production chain. In addition to supporting the setting of the EU *Salmonella* reduction targets and assessing the impact of *Salmonella* transmission originating from holdings with breeding pigs, these results may also be used in the future to evaluate the impact of control programmes.

Introduction

In 2008 an EU-wide baseline survey was carried out to estimate the prevalence of *Salmonella* spp. (*Salmonella*) in holdings with breeding pigs. The aim of the survey was to obtain comparable data for all MSs through harmonised sampling schemes. The specific objectives of this survey were: 1) to estimate the prevalence of *Salmonella*-positive holdings with breeding pigs at EU level and for each MS individually; 2) to investigate the effects of factors potentially associated with the occurrence of *Salmonella* in holdings with breeding pigs; and 3) to investigate the *Salmonella* serovar distribution and determine the most frequently occurring serovars in breeding pigs across the EU. According to Regulation (EC) No 2160/2003 on the control of *Salmonella* and other zoonotic agents (EC, 2003), which aims to reduce the incidence of food-borne diseases in the EU, results of such a survey will inform the setting of the Community target for the reduction of the prevalence of the infection in breeding herds of pigs. A EFSA's scientific report part A on the analysis of this baseline survey published in December 2009 (EFSA, 2009) included the prevalence estimates at EU level and for each MS as well as the analyses of the most frequently identified *Salmonella* serovars in holdings with breeding pigs across the EU MSs, Norway and Switzerland. A Part B report on the analyses of factors associated with *Salmonella*-positive pens in holdings with breeding pigs is expected to be published by EFSA in July 2011. Main results from Report A are presented and discussed in this paper.

Material and Methods

The survey took place in the EU between January and December 2008 and targeted a population of holdings (preferentially housing at least 50 breeding pigs) constituting at least 80% of the breeding pig population in a MS. In each MS, holdings were randomly selected from the breeding holdings and production holdings group. A total of 1,609 breeding holdings and 3,508 production holdings from 24 EU MSs, plus Norway and Switzerland, were included in the survey. In each selected holding, samples were collected from 10 selected pens of breeding pigs over six months of age. One

pooled faecal sample was collected from each of the 10 selected pens. Samples were tested by the National Reference Laboratory (or an authorised laboratory) using the latest ISO 6579 Annex D method (ISO, 2007). At least one isolate from each positive sample was to be typed according to the Kaufmann-White Scheme. Further details on survey design are described in the Commission decision 2008/55/EC (EC, 2008).

Data on breeding holdings and production holdings were analysed separately, and the following four outcomes were considered: a) positivity for *Salmonella*; b) positivity for *S. Typhimurium*; c) positivity for *S. Derby*; and d) positivity for serovars other than *S. Typhimurium* and/or *S. Derby*. A holding was considered positive if at least one of the 10 pooled faeces samples tested positive, and negative otherwise. Prevalence was estimated for each MS as the proportion of test positive breeding/production holdings out of the total number of holdings tested. At EU level, the prevalence was estimated using only the data from pig holdings with at least 50 breeding pigs. In the estimation of the EU prevalence, MSs were considered as strata and the proportion of sampled breeding/production holdings, i.e. the sampling fraction, was not constant across MSs. In order to account for disproportionate sampling among MSs, the EU level prevalence was estimated as a weighted mean of MSs' prevalences. To this end, each MS' prevalence was weighted by the reciprocal of the sampling fraction for breeding/production holdings. The EU prevalence was estimated using SAS 9.2, PROC SURVEYREG. The estimated prevalences at MS level and EU level do not account for imperfect sensitivity or specificity of the test. A finite population correction was used to calculate a 95% Confidence Interval (CI) for prevalence estimates at MS and EU level.

Data on holding- and at pen-level factors potentially associated with *Salmonella*-positivity of pens in breeding and production holdings were collected during the survey using a mandatory questionnaire at the time of sampling in the holdings. The following factors were considered: date of sampling, type of breeding/production holdings, holding size, gilt/boar replacement policy, and delay between the sampling date and testing date at the laboratory, number of pigs per pen, age category of the pigs, sex of the pigs, production stage, indoor/outdoor production, individual housing, floor type, all in/all out and cleaned production, origin of the feed, type of diet, and feed/water supplement. Two factors potentially associated with the sensitivity of the sampling and testing method were also considered (type of sample and delay between sampling and testing). Results of the analysis of the factors potentially associated with pen positivity will be presented in a Report part B to be published by EFSA in July 2011.

Results

In this survey, the EU prevalence of *Salmonella*-positive holdings with breeding pigs (all holdings, including both breeding and production holdings) with at least 50 breeding pigs was 31.8% (95% CI: 30.0; 33.7). The EU prevalence of holdings with breeding pigs positive to the other *Salmonella* serovars or groups of serovars was: 7.0% (95% CI: 5.9; 8.0) for *Salmonella Typhimurium*; 9.0% (95% CI: 7.9; 10.1) for *Salmonella Derby*; and 19.8% (95% CI: 18.3; 21.3) for serovars other than *S. Typhimurium* and/or *Derby*. One MS (Finland) and the Norway did not detect any *Salmonella* in their surveyed holdings. Figure 1 illustrates the prevalences of *Salmonella*-positive breeding holdings (left) and production holdings (right) for each participating country and at EU level (dashed lines).

The association between *Salmonella* prevalence in breeding and in production holdings is illustrated graphically in Figure 2. The scatter diagram shows that the prevalence of *Salmonella*-positive production holdings increases as the prevalence of *Salmonella*-positive breeding holdings increases, indicating that there is a positive correlation. This observation is notably clearer for countries with a prevalence above 5 % for either breeding or production holdings.

In total 1,303 *Salmonella* isolates originated from 452 *Salmonella*-positive breeding holdings, while 2,699 *Salmonella*-positive isolates originated from 950 *Salmonella*-positive production holdings. The frequency distribution of top five isolated *Salmonella* serovars in the survey, ranked by the number of positive holdings, is presented in Table 1.

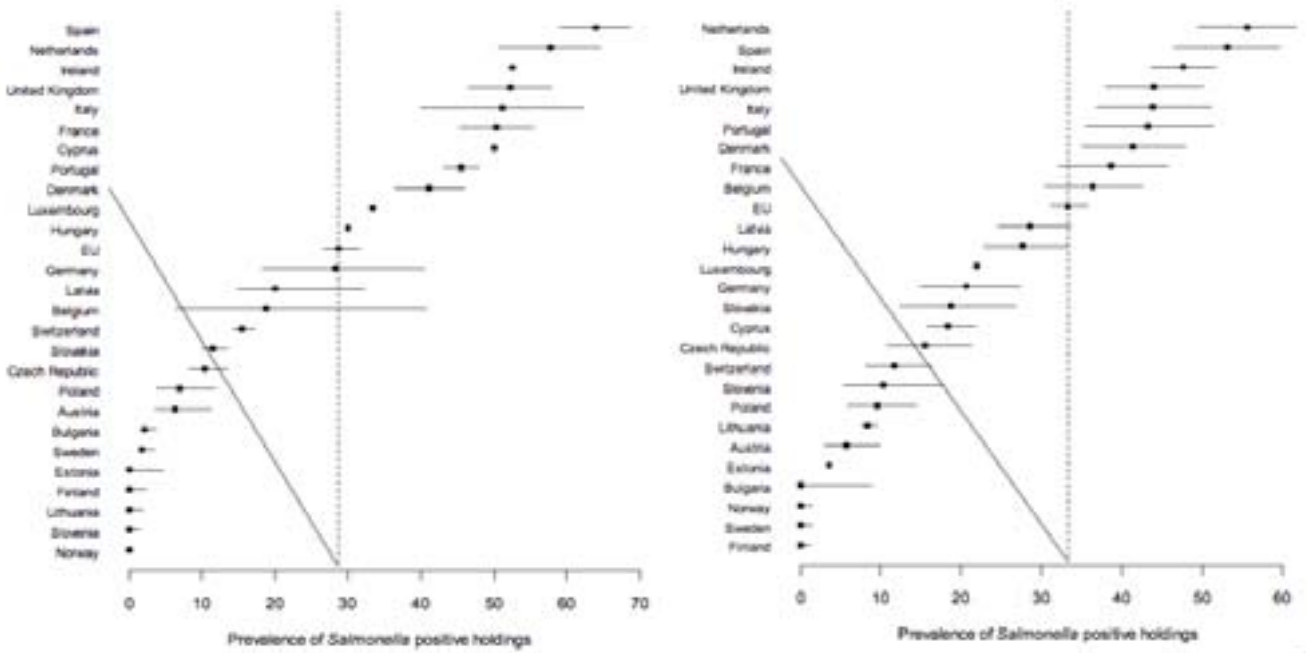


Figure 1 Prevalence of Salmonella-positive breeding holdings (left) and production holdings (right), with 95% CIs (horizontal lines), Salmonella EU baseline survey, 2008

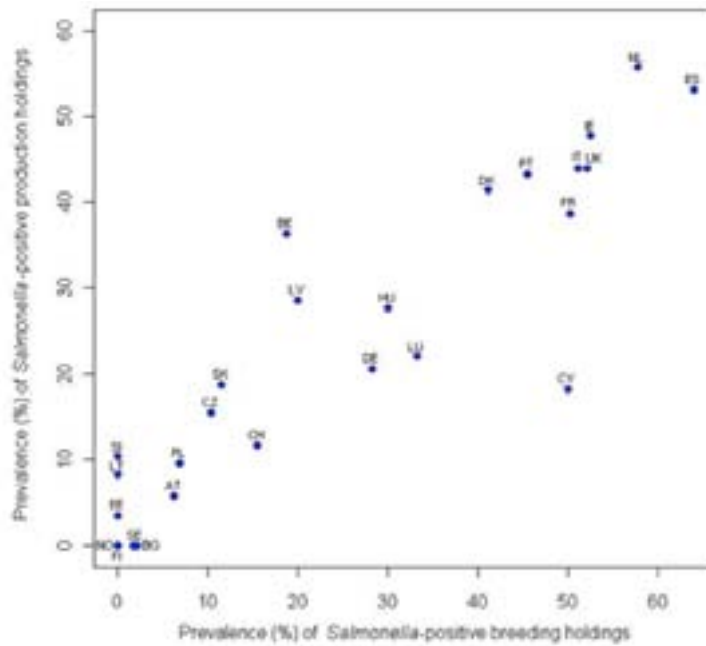


Figure 2 Scatter diagram of the prevalence of Salmonella-positive breeding holdings versus the prevalence of Salmonella-positive production holdings, Salmonella EU baseline survey, 2008

Table 1 Frequency distribution of the top five isolated Salmonella serovars in breeding and production holdings, ranked by positive holdings, Salmonella EU baseline survey, 2008

Salmonella serovars	Breeding holdings with serovars		Countries with serovars	Salmonella serovars	Production holdings with serovars		Countries with serovars
	N	%			N	%	
S. Derby	134	29.6%	18	S. Derby	271	28.5%	20
S. Typhimurium	115	25.4%	17	S. Typhimurium	191	20.1%	16
S. Infantis	35	7.7%	7	S. London	90	9.5%	15
S. Rissen	33	7.3%	5	S. Infantis	58	6.1%	13
S. London	29	6.4%	8	S. Rissen	56	5.9%	6

Discussion

Approximately one third of holdings with breeding pigs were estimated to be infected with *Salmonella* in the EU and they represent a source of infection for other pigs – either breeding herds lower down the pyramid or directly to slaughter pigs. The variation in *Salmonella* prevalence among MSs was large and, overall, the findings of the present survey demonstrate the heterogeneity of the situation between the EU MSs. Explanatory factors for this variability should be investigated further as this may be of value to inform decisions on future control measures. Breeding holdings are at a crucial position at the top of the production pyramid and they may be an important source of dissemination of *Salmonella* infection throughout the whole production chain. Overall, the EU level prevalence of *Salmonella*-positive holdings seemed not to differ between breeding and production holdings.

The higher serovar diversity in production holdings may be due to the fact that more samples were collected in production holdings, but could also be attributed to the fact that breeding holdings typically breed their own replacement pigs whereas production holdings may buy in replacement breeding stocks from a wide range of breeding holdings, each of which may be infected with different *Salmonella* serovars. *S. Derby* was the most frequently isolated serovar at EU level in both breeding and production holdings, followed by *S. Typhimurium*. These two serovars, which were clearly predominating in holdings with breeding pigs, have been closely associated with pig breeding and production for many years (EFSA, 2006, 2007, 2008). *S. Typhimurium*-like strains, such as *S. 1,4,[5],12:i:-*, were reported by several MSs in breeding and production holdings. These strains have been isolated, with increased frequency, over the last 20 years and they have been recently indicated as variants deriving from *S. Typhimurium* (EFSA, 2010). Monophasic *S. Typhimurium* strains have been reported from pigs, cattle, poultry and humans. There have been major food-borne outbreaks involving this strain in humans in MSs and many non-European countries (Agasan et al 2002; Mossong et al 2007).

Conclusion

This baseline survey provided comparable estimates of the prevalence of *Salmonella*-positive holdings with breeding pigs and a description of the distribution of *Salmonella* serovars, across the EU. Breeding pigs may be an important source of dissemination of *Salmonella* throughout the pig-production chain. In addition to supporting the setting of the EU *Salmonella* reduction targets and assessing the impact of *Salmonella* transmission originating from holdings with breeding pigs, these results may also be used in the future to evaluate the impact of control programmes.

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