

COMPARISON SEROPREVALENCE OF *SALMONELLA* SPP. IN LARGE FARMS AND INDIVIDUAL PRODUCERS IN SERBIA

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Abstract: *Salmonella* is one of the most frequently reported food-borne (alimentary) infections in the world. The study objective was to evaluate seroprevalence of *Salmonella* spp. in the farrow-to-finish farms and individual producers. Examined fattened pigs were divided into two groups: the first group was comprised of fatteners from 4 large farms in northern Serbia, and fatteners from the other group originating from individual producers from northern Serbia and the region of eastern Serbia. Individual blood serum samples were collected from 100 pigs per farrow-to-finish farms and 300 fattening pigs from individual producers and analysed for the presence of *Salmonella* antibodies. A blood serum sample from each pig was frozen, and blood serum was examined for specific antibodies against *Salmonella* spp. using an indirect ELISA. *Salmonella* seroprevalence ranging from 0% to 56% was found in 4 farrow-to-finish farms. Seroprevalence of 79% was found in individual producers (300 blood serum samples). This study shows that the results of serological tests for *Salmonella* were different ($p < 0.01$) for slaughtered pigs from farms and from individual producers. Pig production in Serbia is under better supervision on large farrow-to-finish farms than in the individual sector. This study is an introduction to reducing of public health risks associated with *Salmonella* in pork.

Keywords: pig, production system, *Salmonella*, seroprevalence, food safety

Introduction

Salmonella in normal situations doesn't cause clinical diseases of pigs, but subclinical *Salmonella* infections are an important issue in food safety around the world. From the consumer standpoint, there are constant efforts to reduce the incidence of *Salmonella* in pork. In order to achieve this, information on the

dynamics of *Salmonella* infection in a herd of pigs over time (e.g., duration of infection and disease transmission patterns) can be a useful tool. *Salmonella* is identified at all stages of pig production. This means that efforts to reduce *Salmonella* have a task to target different stages of the production chain. A growing number of European countries are focusing on the first phase of pork production. One of major challenges of this approach is identification of effective risk reduction strategies that can be implemented at the herd level. For that reason, it is important to examine all factors that can increase the risk of introduction and transmission of *Salmonella* (Lo Fo Wong et al., 2004). On-farm intervention to reduce the prevalence of *Salmonella* is difficult to perform; nevertheless, this is important in reducing the risk of this pathogen's presence on pig skins and consequently pork carcasses at abattoirs (Blagojevic et al., 2011). The presence of antibodies indicates that the pigs were exposed to the enteric pathogen in a period of development, but on the other hand the time needed for seroconversion suggests that pigs are carriers of *salmonella* while still seronegative, and also different immune responses can affect the serological tests (Miller et al., 2011; Šišak et al., 2011). *Salmonella* seroprevalence differences between different systems of pig production have been investigated. In some studies, individual producers (outdoor production systems) had a higher seroprevalence than the farm production (Bonde and Sørensen 2012). The aim of this study was to investigate the effects of different systems of pig production on the presence of *Salmonella* antibodies, in order to assess the pathogen transfer risk into the food chain.

Materials and methods

Sampling

Samples for analysis were collected at the slaughterhouse with slaughtering capacity of 200 pigs per hour. This study was conducted in the period from April to November 2012. All pigs spent 24 hours on livestock depot before being slaughtered. Examined fattened pigs were divided into two groups: the first group was comprised of fatteners from 4 large farms in northern Serbia, and fatteners from the other group originating from individual producers from northern Serbia and the region of eastern Serbia. In the first group testing was carried out on 400 fattened pigs (100 from each farm), while in the second investigation was carried out on 300 fatteners (over 70 individual producers).

A blood serum sample from each pig was frozen, and blood serum (harvested after thawing) was examined for specific anti-bodies against *Salmonella* spp. using an indirect ELISA (Nielsen et al., 1998).

Data analysis

Data were entered into an Excel spreadsheet (Microsoft Excel 2007) and imported into Stata (Stata 8 Intercooled for Windows 9x) in which data were analyzed. Descriptive analysis was done in MiniTab version 14 (MiniTabR14b) and Excel (Microsoft Excel 2007). The data were processed by ANOVA and Post Hoc Test was used for comparison of the means of treatments. Statistical significance of differences between means was determined at the level of $p < 0.01$.

Results

The sera from 700 fattening pigs, originating from 4 different farrow-to-finish farms and 300 fattening pigs from more 70 different individual producers, were examined by ELISA test for the presence of *Salmonella* antibodies. The seroprevalences of *Salmonella* in the different farrow-to-finish farms are illustrated in Table 1.

Table 1. Distribution and presence of *Salmonella* spp. in blood samples from 4 farrow-to-finish swine farms

Farm	Number tested	Number positive	Prevalence estimates (%)
I	100	23	23.00
II	100	56	56.00
III	100	36	36.00
IV	100	0	0.00
Total	400	115	28.75

Salmonella seroprevalence in the 4 farrow-to-finish farms were 23 (23/100), 56 (56/100), 36 (36/100) and 0 (0/100). Seroprevalence in the individual producers was 79 (237/300) (Table 2).

Table 2. *Salmonella* spp. prevalence estimates provided by blood sample collected from fattening pigs from individual producers

Individual producers	Number tested	Number positive	Prevalence estimates (%)
>70	300	237	79.00

Discussion

This study provided a unique opportunity to compare seroprevalence of *Salmonella* spp. on a large farms (farrow-to-finish) and individual producers. It also allowed comparison presence of *Salmonella* antibodies within 4 different farrow-to-finish farms.

From the four investigated farms with intensive mode of breeding pigs, *Salmonella* antibodies were found in fatteners from three farms, while on one farm all fattened pigs were seronegative. Seroprevalence of 75% (3/4) on examined farms is similar to that in other countries with intensive modes of keeping pigs (*Baptista et al., 2009; Funk 2008; Hernandez et al., 2013; Šišak et al., 2011*). Out of 400 samples tested, 115 (28.75%) were positive, with percents on three positive farms ranging from 23% to 56%. This is a higher level compared to the results of other researchers (*Bonde and Sørensen 2012; Lo Fo Wong et al., 2004; Wachek et al., 2012*) (Table 1). While *Kranker et al., (2003)* found higher level of *Salmonella* spp. seroprevalence in fattened pigs (40-80%).

For all farrow-to-finish farms combined, serology consistently overestimated the 28.75% (Table 1). This finding is not surprising considering that serology reflects the exposure history of pigs, not the current infection status. The seroprevalence estimate obtained in the individual producers was three times higher ($p < 0.01$) than the estimate provided on a large farms (farrow-to-finish), 79.00 vs. 28.75%.

This indicates a higher risk for salmonellosis in pigs in the sector of individual producers, primarily for the following reasons: a) no all-in/all-out pig flow; b) no control feed (can be contaminated with *Salmonella*); c) biosecurity (humans and other animals as vectors).

In the survey we found difference ($p < 0.01$) in *Salmonella* seroprevalences on a large farrow-to-finish farm and at individual production system. Similar results were reported in comparison to the level of *Salmonella* infections in conventional and alternative systems in the UK (*Smith et al., 2010*). A study in Switzerland found a higher risk of *Salmonella* in conventional farms than in animal-friendly systems (*Ledergerber et al., 2003*). The effect of herd size is associated with the manifestation of the shorter presence of high seroprevalence in larger herds. This can be explained by a combination of factors such as the implementation of biosecurity measures in larger herds (*van der Wolf et al., 2001*), and poorer health status and mixing pigs of different ages in small herds. In addition, it is expected from bigger number of individual producers to buy food that has been found to have a higher risk factor for *Salmonella* (*Dahl, 2007*), while large farms mainly use home-mixed feed.

Conclusion

Pig production in Serbia is under better supervision on large farrow-to-finish farms than in the individual sector. This is confirmed by the fact that nearly three times as many *Salmonella* antibodies were found in pigs in sector of individual producers, and therefore there's also a higher risk of *Salmonella* presence in pigs and subsequent contamination and potential human infection.

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Poređenje seroprevalence *Salmonella* spp. u velikim farmama i kod individualnim proizvođačima u Srbiji

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Rezime

Salmonela je jedna od najčešće prijavljivanih alimentarnih infekcija u svetu. Predmet istraživanja ovog rada je bio da se ispita seroprevalenca *Salmonella* spp. u farmama sa zatvorenim ciklusom proizvodnje i kod individualnih proizvođača. Ispitivani tovljenici su bili podeljeni u dve grupe: u prvoj grupi su bili tovljenici sa 4 velike farme sa područja severne Srbije, a u drugoj grupi su bili tovljenici od individualnih proizvođača sa područja severne i istočne Srbije. Krvni serumi su pojedinačno prikupljeni od 100 tovljenika sa svake farme i od 300 tovljenika od individualnih proizvođača i ispitivani su na prisustvo antitela za Salmonelu. Serumi su čuvani u smrznutom stanju i ispitivanje na prisustvo specifičnih antitela na Salmonelu je vršeno indirektnom ELISA testom. U 4 ispitivane farme seroprevalenca se kretala od 0% do 65%. Kod tovljenika od individualnih proizvođača utvrđena je seroprevalenca od 79% (300 uzoraka krvnih seruma). Ovo ispitivanje pokazuje razlike ($p < 0.01$) u seroprevalenci Salmonele zaklanih tovljenika sa farmi u odnosu na individualne proizvođače. Proizvodnja svinja u Srbiji je pod boljom kontrolom na velikim farmama u odnosu na individualni sektor. Ovo istraživanje predstavlja uvod u smanjenje rizika javnog zdravlja povezanog sa Salmonelom u svinjskom mesu.

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