CONTEMPORARY AGRICULTURE / *SAVREMENA POLJOPRIVREDA* 62(3-4)212-217, 2013.
UDC: 63(497.1)-"540-2" ISSN 0350-1205

UDC: 599.731.1:636.09

SEROPREVALENCE OF *SALMONELLA ENTERICA* IN SWINE FARMS IN SERBIA*

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SUMMARY: Salmonellosis in humans, originating from pork, is an important zoonosis and the subject of this study was to investigate the seroprevalence of Salmonella enterica in swine herds. From each of the 10 farms 30 fattener pigs were examined. Selection of farms was based on the willingness of farmers to cooperate. The immune status of pigs was determined using the indirect ELISA test. The results showed a high level of seroprevalence of Salmonella enterica (33%) on the studied farms. General seroprevalence was 90% on the tested farms. Serological surveillance of Salmonella infections in herds of fatteners provides detection of high-risk herds and enables evaluation of the effectiveness of control measures implemented in primary production, and all of this in order to reduce contamination of pig carcasses.

Key words: *pig, seroprevalence, Salmonella, antibodies.*

INTRODUCTION

Salmonella infections can cause clinical signs of disease in various species, but in pigs these usually manifest subclinical or result in only mild transient diarrheas (Davies, 2001). In animals' food, *Salmonella enterica* prevalence estimation can serve for multiple purposes: to estimate the on-farm prevalence for risk factor analysis, intervention assessment and producer feedback, and to predict the food safety risk of products entering the food chain. In pork production, the more *Salmonella enterica* that is carried into the plant, via the pigs, the greater the risk of equipment contamination and final product contamination (Dahl and Sorensen,

Original scientific paper / *Originalni naučni rad*

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*This research was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No. TR31034, 2011-2014.

2001). Positive Salmonella status in fattener pigs on the farm, confirmed either by serological or bacteriological testing, increases the risk of transmission of Salmonella from asymptomatic intestinal presence to carcasses in the abattoir (Beloeil et al., 2004). Although it is impossible to determine the true extent of salmonellosis, pork is considered one of the main sources of salmonellosis in humans.

The main factors affecting the contamination of fattener pigs with Salmonella, according to the reported studies, are: (1) hygiene: washing hands, (2) management of the herd: herd size, the continuous production of pigs, and holding (type of floor and separation by walls), (3) the practice of feeding: granulation and pH of food and feeding type (all or moist), (4) health disorders: infections by parasites, antibiotic use and health status of the herd (Kranker et al., 2001). In the literature there are many factors that can enhance infection with Salmonella, such as *Lawsonia intracellularis* and porcine reproductive and respiratory syndrome virus (PRRSV) (Kranker et al., 2001; Farzan et al., 2006; Stojanac et al., 2013). A better knowledge of the epidemiology of Salmonella in swine herds is needed in order to identify effective control measures and implement a control program. Information on Salmonella infections can be acquired by using a variety of sources, such as the presence of antibodies in the blood or meat juice, or the presence of Salmonella in faecal samples or mesenteric lymph nodes (Bonde and Sørensen, 2012). Studies indicate a link between high seroprevalence and presence of Salmonella in faecal samples from the herd or abattoir (Stege et al., 2000; Sørensen et al., 2004), while serological and bacteriological test may be less correlated at the individual level (Casey et al., 2004; Nollet et al., 2005).

The aim of this study was to describe the seroprevalence of *Salmonella enterica* on pig farms in Serbia.

MATERIALS AND METHODS

Sampling and laboratory analysis

The study involved 10 farrow-to-finish pig farms, located all over Serbia. The farms involved in the study had to be confined farrow-to-finish operations of the intensive type and managed according to the batch-farrowing system (weaning on the same day of a group of piglets born the same week and age-segregated rearing) and an all-in/all-out hygiene policy for farrowing, post-weaning and fattening sections. Farm selection also was based on the farmers' willingness to cooperate.

The blood serum samples were collected during 2011 and 2012 from farrow-to-finish herds. Blood was taken by the puncture of the brachiocephalic plexus of the pigs. A blood serum sample from each pigs was frozen, and blood serum (harvested after thawing) was examined for specific anti-bodies against *Salmonella enterica* using an indirect ELISA (Nielsen et al., 1998). Samples with an OD% > 10 were considered seropositive. From each farm, 30 blood serum samples were taken.

Data analysis

Data were entered into an Excel spreadsheet (Microsoft Excel 2010) 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 2010).

RESULTS AND DISCUSSION

A serological survey within this study supplies us with information on the epidemiology of Salmonella infections on pig farms in Serbia. *Salmonella enterica* was found in 9 out of 10 investigated farms. Out of the 300 blood serum samples 67% were negative and 33% positive for the presence of antibodies specific for *Salmonella enterica* (Table 1). Herd seroprevalence was 90%, and the average seroprevalence within herd was 33% (minimum 0; maximum 63.33), 70% of a herd had a seroprevalence between 30% and 63.33% for an OD-value of 10%. The literature states that the seroprevalence of Salmonella is 93% in Germany, 59% in Denmark, 79% in Greece and 72% in Sweden, evaluated at the test cut-off of OD%> 10, and herd cut-off of 1 or more seropositive animals. Average seroprevalence within the herd is 24% in Germany, 9% in Denmark, 14% in Greece and 10% in Sweden (Lo Fo Wong, 2001). In this study, the average seroprevalence was 33%, which indicates a higher level compared to the results of other authors (Nowak et al., 2007; Bonde and Sørensen, 2012).

Specific antibodies to *Salmonella enterica* have been found in 99 out of 300 blood sera examined. On one farm no antibodies specific for Salmonella were found. This farm implements the liquid feeding system. The connection between the liquid-feeding and the lower prevalence of Salmonella in pigs has been confirmed in several cases (van der Wolf et al., 1999; der Wolf et al., 2001; van Winsen et al., 2002; Lo FoWong 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). This study preliminary suggests a high level of prevalence of Salmonella in pigs on farms in Serbia. The results clearly indicate that the reduction of infection in pigs is one of the key points in the strategy of pork safety.

Table 1. Salmonella enterica seroprevalence estimates provided by blood serum sample collected from swine farms in Serbia

Tabela 1. Seroprevalencija *Salmonella enterica* u krvnim serumima svinja na farmama u Srbiji

Farm	Numberd tested	Number positive	% positive
I	30	4	13,33
II	30	9	30,00
III	30	19	63,33
IV	30	11	36,67
V	30	17	56,67
VI	30	9	30,00
VII	30	0	0,00
VIII	30	12	40,00

IX	30	10	33,33
X	30	8	26,67
Total	300	99	33,00

CONCLUSION

Serological monitoring of Salmonella infections in swine herds enables detection of high risk and evaluation of the control measures effectiveness in primary production, which is a prerequisite for reducing a meat contamination in the abattoir. The results of this study confirmed the literature reports that it is necessary to improve biosecurity and hygiene measures on farms. Good Agricultural Practices should be presented in specific guide to help farmers to control Salmonella on the farms.

ACKNOWLEDGEMENTS

This research was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Project No. TR31034.

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SEROPREVALENCIJA *SALMONELLA ENTERICA* NA FARMAMA SVINJA U SRBIJI

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Izvod

Salmoneloza ljudi poreklom od svinjskog mesa je važna zoonoza i predmet ovog istraživanja je bio da se ispita seroprevalencija *Salmonella enterica* u zapatima svinja. Sa svake od 10 farmi, ispitano je po 30 tovljenika. Izbor farmi je zasnovan na spremnosti farmera na saradnju. Imunološki status svinja je izvršen korišćenjem indirektnog ELISA testa. Rezultati prikazuju visok nivo seroprevalencije *Salmonella enterica* na ispitivanim farmama. Opšta seroprevalencija je bila 90% na ispitivanim farmama. Serološki nadzor infekcija salmonelama u zapatima tovljenika omogućava otkrivanje visokog rizika zapata i procenu efikasnosti kontrolnih mera implementiranih u primarnoj proizvodnji, a sve i cilju smanjenja kontaminacije trupova svinja.

Ključne reči: svinje, seroprevalencija, Salmonela, antitela.

Received / *Primljen*: 22.09.2013.
Accepted / *Prihvaćen*: 29.10.2013.