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THE IMPORTANCE OF FORENSIC ASSESSMENT OF CARCASSES OF PIGS CONTAMINATED WITH SALMONELLA SPP.*

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Summary: The aim of this study was to evaluate causes of contamination of a pig carcasses with *Salmonella* spp. at the slaughter line. During regular control of carcasses at the slaughter line, swabs were taken and existence of *Salmonella* spp. was discovered. All fattened pigs originated from the same farm. Forensic examination of presence of *Salmonella* spp. was carried out at the farm, from which slaughtered fattened pigs originated. At the farm, all of the biosecurity and procedural measures are regularly completed, microbiological control of a pig feed and it was discovered high level of health status of the herd. All samples of pooled feces of the pigs were examined to presence of *Salmonella* spp. and all of the results were negative. Blood serum of the pigs from the farm were seronegative to presence of antibodies specific to *Salmonella* spp. Transportation of fattened pigs is organized due to legal regulative and it lasted for 20 minutes. Based on forensic results, conclusion is that pigs, in this examination, got infected by *Salmonella* spp. at livestock depot in slaughterhouse and/or the carcasses were contaminated at slaughter line.

Key words: forensic examination, *Salmonella* spp., slaughterhouse, pigs

INTRODUCTION

Salmonella spp. is an important cause of foodborne infections in humans and animals worldwide. Studies show that as a result of infection with *Salmonella* spp., 93 million people were diagnosed with gastroenteritis and 155.000 of those cases end with death each year worldwide (Majowicz et al., 2010). *Salmonella* spp. represents a hazard for people who work on farms, especially since animals are often asymptomatic carriers of different serotypes (Hoelzer et al.,

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2011). One of the primary sources of infection for humans is meat contaminated with *Salmonella* spp. during the process of production, in a slaughterhouse, and during manipulation.

In Serbia, meat control is legally regulated by the Ordinance on the general and special conditions of food hygiene at any stage of production, processing and manipulation (Official Gazette of RS, no. 72/10). Important role in the control of occurrence of *Salmonella* spp. is on the prevention of the occurrence and spread of *Salmonella* spp. on farms (De Busser et al., 2013), safe and secure transport (Mannion et al., 2012) and reduction of contamination of meat in the slaughterhouse (Rostagno et al., 2005). In European Food Safety Authority (EFSA) reports pork is the third most commonly contaminated meat after fresh chicken and turkey meat (EFSA, 2012).

In the case of presence of *Salmonella* spp. in the carcasses of slaughtered pigs it is necessary to decontaminate them, and at the same time to examine the source of infection. Presence of *Salmonella* spp. in the pig farm is a potential source of contamination of carcasses at the slaughterhouse. Processing hygiene in a slaughterhouse represents a basic measure to control the contamination of carcasses (Blagojevic et al., 2014) and if there is a failure in the implementation of the same, the risk of contaminated carcasses increases. The application of hazard analysis and critical control points (HACCP) in a slaughterhouse aims to provide secure and safe meat production and processing. In order to implement HACCP in a slaughterhouse as successful as possible, fattened pigs must be *Salmonella*-free.

The aim of this study was to examine the forensic findings regarding *Salmonella* spp. on carcasses of slaughtered pigs, or whether fattened pigs were infected on the farm or the contamination of carcasses occurred in a slaughterhouse.

MATERIALS AND METHODS

During one day 300 fattened pigs originating from the same farm were slaughtered in the slaughterhouse. The pigs were brought to the slaughterhouse immediately before slaughter. At the slaughter line swabs were taken from the carcasses of pigs using the abrasive sponge (according to the Ordinance on the general and special conditions of food hygiene at any stage of production, processing and manipulation (Official Gazette of RS, no. 72/10 Chapter 3).

Fattened pigs originate from a farm with capacity of 600 sows with a closed production cycle. The farm has strictly adhered to the "all in/all out" principle. Fattening facilities have the capacity of 500 fattened pigs. When 300 fattened pigs were delivered to the slaughterhouse another 200 pigs were left at the farm.

After receiving the results of the findings regarding the presence of *Salmonella* spp. in the carcasses, 30 samples of pooled feces were taken on the same day from the remaining fattened pigs and 20 samples from fattened pigs in other facilities. One pooled sample represents a sample of feces from one compartment which contains 10 fattened pigs. Feces samples were collected in sterile bottles and transported to laboratory within 2 hours. Testing was performed using the ISO 6579:2002 method.

Also blood samples were taken from 50 fattened pigs from the facility fattened pigs sent to slaughter originated from and 30 blood samples from other fattened pigs on the farm. Blood was taken from fattened pigs by puncture of brachiocephalic plexus. A serum was separated from the blood and for each head is specially tested for antibodies specific for *Salmonella* spp. using indirect ELISA method (Nielsen et al., 1998).

Transport of fattened pigs from the farm to the slaughterhouse was conducted in accordance with the Ordinance on the method of loading, reloading and unloading of consignments of animals, products, raw materials and waste of animal origin, the conditions to be met by transport vehicle, hygienic and technical conditions to be met by shipment and form of certificate on health status of the shipment ("Off. Gazette of SFRY", no. 69/90). The slaughterhouse is 15 kilometers or 20 minutes drive away from the farm.

RESULTS

Salmonella spp. was isolated from the swabs that were taken at slaughter line from carcasses of fattened pigs. Upon obtaining a positive result a forensic examination of sources of infection was started. All tested samples of feces were negative to *Salmonella* spp. (Table 1), but it was not enough for reliable confirmation that *Salmonella* spp. is not present in the studied farm.

Table 1. The presence of *Salmonella spp.* and an antibody specific to *Salmonella spp.* on the studied farm

	Number of samples tested	Number of samples negative	Number of samples positive
<i>Salmonella spp.</i> in pooled fecal samples	50	50	0
Antibodies specific to <i>Salmonella spp.</i> in blood serum	80	80	0

DISCUSSION

The visit to the farm from which fattened pigs originated on whose carcasses *Salmonella spp.* was found, revealed the following findings: a) biosecurity measures, control of the entry of people and animals, the all in/all out principle, cleaning, washing, disinfection, fumigation, eradication and rest of facilities are conducted regularly, which is a primary factor in controlling the infection (Twomey and al., 2010); b) regular monitoring and microbiological control of food for pigs; c) high level of health status of the herd is in place (immunoprophylactic measures implemented without clinical signs of proliferative enteritis and swine dysentery).

Bacteriological findings may be negative due to the relatively small number of *Salmonella spp.* in feces (Davies et al. 2000) and because of the discontinued secretion of *Salmonella spp.* (Funk et al. 2001). Feed of animal origin was not used on the farm for consumption by pigs. Besides all biosecurity and procedural measures implemented on the farm, it was necessary to examine the serological status of individual animals, in order to obtain reliable conclusions. All of the tested blood sera of fattened pigs for the presence of antibodies specific for *Salmonella spp.* were negative (Table 1). Farms with strictly implemented biosecurity measures, regularly performed serological monitoring of *Salmonella spp.* (Stojanac et al., 2013) and control of the risk factors for the occurrence and spread of *Salmonella spp.* (Hotes et al., 2010; Gotter et al., 2012) have a significantly lower likelihood of occurrence of pigs infections.

The role of the transport of pigs from farm to slaughterhouse, regarding contamination, can be very significant (Magistrale et al., 2008). In this study the transport of pigs was conducted in accordance with legal regulations and procedure prescribed by slaughterhouse, i.e. the truck was mechanically cleaned, washed and disinfected.

Many authors have investigated the impact of the slaughterhouse processes on the spread of *Salmonella spp.* in pork (McDowell et al., 2007; Arguello et al., 2012). The relationship between contaminated carcasses and contaminated live pigs was examined by Arguello et al., (2012) and found an increase of contaminated carcasses of pigs that were carriers of *Salmonella spp.* However, it was estimated that the cross-contamination at several critical points on the slaughter line represents 50% of all contaminated carcasses.

CONCLUSION

It was determined by forensic assessment based on the results of bacteriological and serological tests, biosecurity and procedural measures of production technology that fattened pigs on the farm were free from the presence of *Salmonella spp.* As the transport of fattened pigs was conducted in accordance with legislation and took only 20 minutes, based on forensic findings it was concluded that fattened pigs from this study came in contact with *Salmonella spp.* at the lairage at the slaughterhouse and/or carcasses were contaminated at the slaughter line.

Control of the presence of *Salmonella spp.* in swine production will be mandatory in the near future in the European Union (EU). In countries where this program has not yet been implemented, such as Serbia, accurate information about the status of *Salmonella spp.* infection at farms and contamination of carcasses at different stages of production and processing of pork are essential for the development of programs and strategies to reduce the incidence of salmonellosis.

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ZNAČAJ FORENZIČKE OCENE KONTAMINIRANIH TRUPOVA SVINJA SA SALMONELLA SPP.

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Izvod: Cilj ovog rada je bio da se ispita izvor kontaminacije trupova tovljenika sa *Salmonella* spp. na liniji klanja. Prilikom redovne kontrole trupova na liniji klanja uzeti su brisevi i ustanovljeno je prisustvo *Salmonella* spp. Svi tovljenici su bili poreklom sa iste farme. Pristupilo se forenzičkom ispitivanju prisustva *Salmonella* spp. na farmi sa koje potiču zaklani tovljenici. Na farmi se redovno sprovode sve biosigurnosne i proceduralne mere, vrši se mikrobiološka kontrola hrane za svinje i ustanovljen je visok nivo zdravstvenog statusa zapata. Svi uzorci zbirnih fecesa tovljenika ispitani na prisustvo *Salmonella* spp. su bili negativni. Krvni serumu tovljenika sa farme su bili seronegativni na prisustvo antitela specifičnih za *Salmonella* spp. Prevoz tovljenika je sproveden po zakonskoj regulativi i trajao je 20 minuta. Na osnovu forenzičkih nalaza se konstatuje da su tovljenici u ovom ispitivanju došli u kontakt sa *Salmonella* spp. na stočnom depou u klanici i/ili su trupovi kontaminirani na liniji klanja.

Ključne reči: forenzičko ispitivanje, *Salmonella* spp., klanica, svinje.

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