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IMPORTANT BACTERIAL HAZARDS IN PORK PRODUCTION

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Abstract – There are a number of foodborne diseases affecting humans that can be related to consumption of pork and traced back to pigs. These hazards include parasites, bacteria and some viruses. Within the foodborne outbreaks linked to consumption of pork and products thereof, according to EFSA in EU, the most prevalent are *Salmonella* and etc. The relevant hazards related to pork vary among regions in accordance with the epidemiological situation and food consumption habits. Contamination of pork with bacterial hazards can occur at multiple steps along the food chain, e.g. in the primary stages by feed, people and rodents, during transportation by contaminated lorries or at the slaughterhouses by cross contamination of animals and/or carcasses. Therefor, for an effective control, the entire supply chain must be involved.

Key words –bacteria, health hazards, meat, pigs.

I. INTRODUCTION

Foodborne diseases continues to be a common threat to public health all over the world, and large numbers of illnesses/incidence appears to be increasing. Most foodborne illnesses are mild and are associated with acute gastrointestinal symptoms such as diarrhea and vomiting. Sometimes foodborne disease is much more serious and is life-threatening. In recent years, the increased awareness of food safety, changes in regulatory and educational measures and changes in practice in food production led to implementation of proactive food safety control along the food chain [15, 16]. All foods have some degree of risk and it is not possible to eliminate all risks e.g. in pork, pork products, or any food in general. The goal of the pork production chain is to provide a low risk and safe product to consumer.

Pork food safety begins in primary production on farm by providing adequate good management/hygiene practice of facilities and personnel, controlling rodent and other pests, enforcing farm biosecurity, providing good quality feed and water and delivered to pig in hygienic manner. Healthy, properly housed pigs, can become contaminated/infected during transportation and lairage, with potential food pathogens during this phase of pork chain. The microflora that is usually found on pork originates from both the production environment of the live animal and associated with the transportation and slaughterhouses environment e.g. processing equipment. It is generally consist of a mixed microflora of bacteria, yeast, fungi, and possibly swine viruses.

From a public health perspective, the primary focus is on bacteria, in terms of pathogenic microflora. If the animals are raised with good animal husbandry practices and processed with application of hygienic standards, the populations expected on chilled pork carcasses should be quite low. Potentially pathogenic bacteria which can contaminate fresh pork include, but are not limited to, *Salmonella*, *Campylobacter*, *Yersinia*, as well as *Clostridia*, and etc. These bacteria occur randomly on fresh pork and are commonly associated with the animal production environment and cross contamination during processing.

The aim of this paper is to present some of the important bacterial hazards in pork like *Salmonella*, *Yersinia* and *Campylobacter*.

II. SALMONELLA

Salmonella has long been recognized as an important pathogen in animals and humans. Human salmonellosis is usually characterized by the acute onset of diarrhea, abdominal pain, nausea, and sometimes vomiting. Symptoms are often milds and most infections are self limiting, lasting a few days. However, in some patients, the infection may be more serious and the associated dehydration can be life threatening. The common reservoir of salmonella is the intestinal tract of a wide range of domestic and wild animals which results in a variety of food of animal and plant origins. In the EU, *S.* Enteritidis and *S.* Typhimurium are the serovars most frequently associated with human illness. *S.* Enteritidis are most commonly associated with consumption of contaminated eggs and poultry, while *S.* Typhimurium are mostly associated with the consumption of contaminated pork and poultry meat. In Serbia, *Salmonella* Enteritidis are considered the most important foodborne *Salmonella* causing illness in humans, following by *Salmonella* Typhimurium [10, 22].

Pigs are an important reservoir of *Salmonella* Typhimurium [4]. In animals, subclinical infections are common, and *Salmonella* may easily spread between animals in a herd without detection [6]. There are several routes of transmission for salmonellosis, but the majority of human infections are transmitted to humans through consumption of contaminated food of animal origin. Pork and products, have been implicated in a number of human salmonellosis, where *S.* Typhimurium is the predominant isolated serotype [3]. Pig and pork may be responsible for 10 to 20 % of all human cases of salmonellosis in the EU in 2009 [7]. A total of 108,614 confirmed cases of human salmonellosis were reported in EU in 2009, and the number of cases continuing decreasing trend for the few past years [6]. In 2010, total of 99,020 confirmed cases of human salmonellosis were reported in EU, and this represents a decrease of 8.8% over the previous year [5]. Distribution of 10 most frequent serovars of confirmed salmonellosis cases in humans in 2010 (EU): *S.*Enteritidis (45%), *S.*Typhimurium (22,4%), *S.*Infantis (1,8%), *S.*Typhimurium, monophasic 1,4,[5],12:i:- (1,5%), *S.*Newport (0,9%), *S.*Kentucky (0,8%), *S.*Virchow (0,7%), *S.*Derby (0,7%), *S.*Mbandaka (0,5%), *S.*Agona (0,5), Other serotypes (25,3%).

Reduction in salmonellosis is mainly attributed to successful implementation of national *Salmonella* programmes in fowl populations, but other control measures along the food chain may have also contributed to the reduction. In food stuffs, *Salmonella* was most often isolated in fresh broiler, turkey and pig meat, on average levels of 4.8 %, 9.0 % and 0,9 % respectively. Data obtained, for pig meat, in 2009 (0,7%) and 2008 (0,8%) were at a similar level like in 2010, although the number of samples reported fell substantially (from 109,174 in 2008 to 69,005 in 2010)

There is a lot of risk factors related to Salmonella infections in pigs, and one of the main risk factors for Salmonella farm positivity is the introduction of subclinically infected pigs [7]. Also, application of good management/hygiene practise is of major importance to minimise the risk of *Salmonella* spread within a farm. These include all in / all out systems, rodent control, no access of pets and birds, stuff and visitor hygiene and etc. The control of *Salmonella* contamination of feed is essential because of the high potential for spread to a large numbers of farms. Duration and condition of transport can significantly increase the risk of *Salmonella* shedding from pigs, as well as lairage time in slaughterhouses. High hygiene standards at all slaughtering steps are also essential to control the risk of Salmonella contamination within the slaughterhouse [14].

There is a strong correlation between the number of live animals that carry Salmonella in their faeces and the number of contaminated carcases at the end of the slaughter line [2]. Of the total number of examined swabs samples from pig lairages, 12.5% (9/72) were positive for *Salmonella* [22]. Swabs samples from pig stunning box were positive for *Salmonella spp.*in 61.1% (11/18). *Salmonella* was isolated from 46.7% (42/90) of examined carcasses immediately after stunning [16]. The contamination rates for the different carcass areas were: brisket 30.0% (27/90), flank 23.3% (21/90) and rump 13.3 (8/60). The percentage of carcasses where *Salmonella* was isolated in only one swab sample was 34.4 % (31/90), two swab samples 8.9 % (8/90) and in all three swabs tested 5.0 % (3/60). The percentage and prevalence of *Salmonella* serotypes isolated from different surfaces in lairage, stunning box and from carcasses were as follows: *S.*Typhimurium 68.6% (48/70), *S.*Mbandaka 17.1% (12/70), *S.* Senftenberg 8.6% (6/70), *S.* Bredeney 4.3% (3/70) and *S.* Menston 1.4% (1/70) [13]. The 8 trucks, 3 abattoirs and 128 pigs yielded 133 *Salmonella* positive samples encompassing 153 isolates from a total of 911 samples taken (some positive samples yielded multiple isolates) [18]. In total, *Salmonella spp*. was isolated from 71/177 (40.1%) of environmental samples and 62/734 (8.5%) of all pig samples. Salmonella spp. was isolated from the ileocaecal lymph nodes of 19 (14.8%) pigs, caecal contents of 15 (11.7%) pigs and from 13 (10.2%), 5 (3.9%) and 2 (1.8%) carcass swabs pre wash, post wash and post chill, respectively, as well as 8 (7.2%) belly-strips.

Bacterial resistance to an increasing number of antimicrobial drugs is human health issue because reduces the efficacy of antimicrobial treatment. Strains of *Salmonella* resistant against various antimicrobial agents have become a public health concern. Intensive animal production can be favorable environments for long term establishment of *Salmonella* „*in vivo*“ and/or „*in vitro*“. The common use of antimicrobial agents in human and veterinary medicine and animal production caused the increase in the cases of antimicrobial resistant pathogens. Among 88 isolates analyzed from ileocaecal lymphode samples of pigs, 31 showed resistance to one or more antimicrobials (35.2%) [1]. Multiresistance, defined as the resistance to four or more antimicrobials, was identified in 7 isolates (19.3%). The antimicrobial resistance was found mainly in *S.* Typhimurium isolates, while was less common among non-*S.*Typhimurium isolates.

III. YERSINIA

Human enteropathogenic *Yersinia* belongs to the zoonotic bacteria and humans are mostly infected by contaminated foodstuffs. The most important species is *Y.enteroclitica* and much less *Y. pseudotuberculosis*. *Y. enterocolitica* biotype 1B, 2, 3, 4 and 5 are pathogenic for human. The number of confirmed human cases of *Yersinia* infections in the EU was 7,533 in 2009 [8] and in 2010, 6,776 cases, wich is slightly lower than in previous year [9]. Yersiniosis is the third most common of bacterial zoonoses in the EU. Most of the human infections are caused by *Y.enterocolitica*. Among animals and food, *Yersinia enterocolitica* were mainly reported from pigs and pig meat. On average, 4,8% of pig meat samples were positive for *Y.enterocolitica* in EU. Pigs are considered the most important reservoir for *Y.enterocolitica* in humans. Genetic typing of *Y.enerocolitica* strains indicated that a large number of human strains were undistiguishable from strains present in pig tonsils [17].

In slaughterhouses, slaughter of infected pigs may lead to the contamination of carcasses and offal of these pigs and also cross contamination of carcasses and offal, where important sources for contamination are the intestinal content and the tonsils [17]. Results from a prevalence study, indicated that the medial throat region was the most contaminated site of the carcass (32.8%), followed by the breast region (17.2%), medial site before the sacrum (9.4%) and the pelvic duct (8.3%) [20]. The percentage of positive tonsils were 57.2% and rectum content 20.0% of the examined pigs. Slaughter hygiene practice may influence contamination rate of carcasses and offal. Faecal contamination can be considerably reduced by sealing off the rectum with a plastic bag immediately after it has been freed. Since the oral cavity is frequently contaminated, handling the head during operation of removal of the tongue, splitting the carcass and postmortem inspection, may lead to the spreading of the contamination. *Y.enterocolitica* was recovered from 375 pig tonsils (26.8%) [21]. The average number of *Y.enterocolitica* in tonsil tissue was 4.04 $\log_{10}$

CFU^{-1} (SD 0,97) and a maximum of 5.99 log_{10} CFU g^{-1}.

IV. CAMPYLOBACTER

Campylobacteriosis in humans is caused by thermotolerant *Camylobacter. spp*. The infective dose of these bacteria is generally low. Thermotolerant Campylobacter spp. are widespread in nature, The principal reservoirs are the alimentary tract of wild and domesticated birds and mammals. They are prevalent in food producing animals, such as poultry, pigs, cattle and sheep. The bacteria can readily contaminate various foodstuffs, including meat. In 2010, Campylobacter continued to be the most commonly reported gastrointestinal bacterial pathogen in humans in the EU since 2005. Confirmed human campylobacteriosis cases in the EU increased by 6.7 % in 2010 compared with 2009 [5]. The majority of tested samples were from food of animal origins, primarily from poultry meat, wich is considered to be one of the major vehicles of *Campylobacter* infections in humans. Pig meat is only infrequently contaminated with Campylobacter, at retail (in 2010, 0.6% positive samples). The occurrence of Campylobacter at slaughter and processing was 10.4% and 0.4% respectively in Belgium, and 4.9% and 3.0% respectively in Hungary, while in Spain there is reported higher proportion of positive samples at slaughter 45,4%. Campylobacter was relatively often detected in pigs, but only infrequently from fresh meat of these animals.

V. CONCLUSION

Protection of public health is the top priority objective of meat inspection. Changes in animal husbandry practice have led to an enormous rise in numbers of slaughtered animals. Technology and work practices in modern slaughterhouses have led to an increased pressure on meat safety issues. Slaughter animals may carry contaminants and/or be asymptomatic carriers of pathogenic microorganisms, wich can not be detected at ante-mortem or post-mortem inspection unless specific laboratory tests are carried out. Therefor, for an effective control, the entire supply chain must be involved.

REFERENCES

1. Arguello, H., Sorensen G., Carvajal A., Lau Baggesen, D., Rubio P., Pedersen K.. (2013). Prevalence, serotypes and resistance patterns of Salmonella in Danish pig production. Research in Veterinary Science Article in Press.
2. Berends B. R., Van Knapen F., Snijders J.M.A., and Mossel D.A.A. (1997). Identification and quantification of risk factors regarding *Salmonella* spp. on pork carcasses. International Journal of Food Microbiology, 36: 2-3,199-206.
3. Boyen F., Haesebrouch F., Maes D., Van Immerseel F., Ducatelle R. and Pasmans F. (2008). Non-typhoidal Salmonella infections in pigs: A closer look at epidemiology, pathogenesis and control. Veterinary microbiology, 130, 1-19.
4. Delhalle L., C. Saegerman, F. Farnir, N. Korsak, D. Maes, W. Messens, L. De Sadeleer, L. De Zutter, G. Daube. (2009). *Salmonella* surveillance and control at post-harvest in the Belgian pork meat chain. Food Microbiology, Volume 26, Issue 3, May 2009, Pages 265-271.
5. European Food Safety Authority (EFSA) and European Centre for Disease Prevention and Control (ECDC) (2012). The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2010, EFSA Journal, 10 3: 2597, 442.
6. European Food Safety Authority (EFSA) and European Centre for Disease Prevention and Control (ECDC) (2011). The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2009, EFSA Journal, 9 (3):2090, 378 pp.
7. European Food Safety Authority (EFSA) (2010). Scientific Opinion of the Panel on Biological Hazards on a Quantitative Microbiological Risk Assessment of Salmonella in slaughter and breeder pigs. EFSA Journal, 8(4):1547, 90pp.
8. European Food Safety Authority (EFSA) (2011). Scientific Opinion of the Panel on Biological Hazards on a Contaminant in food chain, and on Animal Health and Welfare on the public health hazards to be covered by inspection of meat (swine). EFSA Journal, 9(10):2351, 198pp.
9. Fredriksson-Ahoma M., Stolle A and Korkeala H. (2006). Sporadic human Yersinia enterocolitica infections caused by bioserotype 4/O:3

originated mainly from pigs. Journal of Medical Microbiology, 55, 747-749.

10. Institute of Public Health of Serbia (IOPHOS). (2005). Godišnji izveštaj o teritorijalnoj rasprostranjenosti primoizolata salmonela i šigela iz medicinskih mikrobioloških laboratorija u Srbiji u 2004. godini. Institut za zaštitu zdravlja Srbije, 31. mart 2005.
11. Karabasil, N., Dimitrijević M., Pavličević N., Teodorović V., Lončina J., Nedeljković Trailović J., Baltić Ž. M. (2012a). Nalaz salmonela na površinama u stočnom depou i boksu za omamljivanje svinja. Veterinarski glasnik, 66:3-4; str. 233-242.
12. Karabasil N, Pavlićević N., Galić N., Dimitrijević M., Lončina J., Ivanović J., Baltić Ž. M. (2012b). Nalaz salmonela na trupovima svinja u toku klanja i obrade. Veterinarski glasnik, 66: 5-6, str. 377-386.
13. Karabasil N., Dimitrijević M., Kilibarda N., Galić N., and Petrović J. (2012c). *Salmonella* serotype prevalence in two pig slaughterhouses. Proceedings of the International Conference: Biological Food safety & Quality, BFSQ 2012, Belgrade, Serbia, 4-5 October 2012., p. 64-67.
14. Karabasil N., Dimitrijević M., Kilibarda N., Teodorović V., Baltić Ž. M. (2008): Značaj salmonela u proizvodnji mesa svinja. 2008. Veterinarski glasnik, 62:5-6, 259-275.
15. Karabasil N., Dimitrijević M., Milićević D. (2011a). Welfare of slaughter animals and impact on meat quality. International 56th meat industry conference, Tara 12 th -15th june 2011. Meat Technology, 52:1, 182-187.
16. Karabasil N., Dimitrijević M., Baltić M. (2011b). Primena i provera sistema bezbednosti hrane animalnog porekla. Zbornik predavanja sa XXXII seminara za inovacije znanja veterinara, Fakultet veterinarske medicine Univerziteta u Beogradu, Februar 18, 2011., Beograd, Srbija, str. 77-83.
17. Laukkanen R, MArtinez P. O., Siekkinen K. M., Ranta J., Maijala R., and Korkeala H. (2009). Contamination of carcasses with human pathogenic Yersinia enterocolitica 4/O:3 originate from pigs infected on farms. Foodborne pathogens and Disease, 6, 681-688.
18. Mannion Celine, June Fanning, Joanne McLernon, Lynsey Lendrum, Montserrat Gutierrez, Sharon Duggan, John Egan. (2012). The role of transport, lairage and slaughted processes in the dissemination of Salmonella spp. in pigs in Ireland. Food Research International 45: 871-879.
19. Offerman U, Bodmer T, Audige L and Jemmi T. (1999). Prevalence of Salmonella, Yersinia and Mycobacteria in Swiss slaughter pigs. Schweizer Archiv fur Tierheilkunde, 141: 509-515.
20. Van Damme I and De Zutter L. (2011). Occurence of human enteropathogenic Yersinia spp. in Belgian pigs and contamination of pork carcasses during slaughter. Proceeding book 9th International Conference on the epidemiological and Control of Biological, chemical and physical hazards in pigs and pork, 19-22 June 2011, Masstricht, 126-129.
21. Vanantwerpen G., Kurt H., Van Damme I., Berkvens D., De Zutter L. (2013). Estimation of the within-batch prevalence and quantification of human pathogenic Yersinia enterocolitica in pigs at slaughter. Food Control, 34: 9-12.
22. World Health Organization (WHO). Top 15 lists from a Country parametars, Report: Serbia, Insitute of Public Health of Serbia, 1999-2010 (http://thor.dfvf.dk/pls/portal/GSS.COUNTRY_DATA_SET_REP.show).

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