

A comparison of *Salmonella* occurrence in pork meat and meat products

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Abstract

Swabs taken from slaughtered pigs, raw porcine meat, liver, and ready-to-eat meat products from the retail market were analysed for the presence of *Salmonella* spp. Of 163 swabs from slaughtered pigs 8 were positive, of 122 samples of raw pork and minced meat none were positive, and of 72 liver samples 5 were positive for the presence of *Salmonella* spp. Seven of 1,326 meat products from the retail were positive for *Salmonella*. While the serotype Typhimurium was predominant in slaughtered animals, raw meat and offal, the serotype Enteritidis was the most frequent in ready-to-eat meat products. The results of this study show that ready-to-eat meat products may be contaminated during processing and also at the retail level, particularly during slicing and packaging.

Slaughtered pigs, raw meat, ready-to-eat products, retail market, serotype

Introduction

Salmonella is one of the commonest causes of food-borne infections both in the Czech Republic and other countries around the world. The most frequently detected serotype causing infection in the human population is *S. Enteritidis*. In the Czech Republic, this serotype is responsible for approximately 90% of cases of human illness. The main source of this pathogen is poultry farming, and the farming of laying hens in particular. Important vehicles of infection are foodstuffs (ready-to-eat products) containing insufficiently cooked eggs or poultry meat. The second commonest serotype is *S. Typhimurium*, which accounts for around 5% of human illness in this country. Pig farms are the main source of this serotype, and the vehicle of infection generally insufficiently cooked pork meat. 10–23% of human salmonellosis in Europe are said to be caused by the consumption of contaminated pork meat (Hald and Wegener 1999).

The undesirable contamination of meat and meat products may occur at any time from primary production (food animals), slaughtering, meat portioning and the production of meat products, right up to their distribution and sale in the retail market. The danger of contamination by undesirable bacteria is highest in unpacked foodstuffs. Cross-contamination between high-risk food-stuffs and other food plays an important role in the transmission of salmonella. Contamination may occur as a result of a failure to observe the principles of proper production and hygiene practices during the production, distribution and sale of food-stuffs.

The aim of this study was to compare the occurrence and serotypes of salmonella isolated from slaughtered pig carcasses, porcine meat, liver, and meat products, and to determine possible sources of contamination of meat products in the retail market on the basis of the information obtained.

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Materials and Methods

Collection of swabs from slaughtered pig carcasses

The collection of swabs took place at two slaughterhouses in the South Bohemian Region from March 2010 to May 2011. Samples were taken from the surface of the bodies with sponges moistened in buffered peptone water (NOACK, CZ); swabs were taken from the nasal cavity with cotton swabs and stored in Amies transport medium with active carbon (DISPOLAB, CZ). After collection, the samples were transported in a refrigerated state to the laboratory and processed at once.

Collection of samples of meat and meat products from the retail market

Samples of pork meat, liver and meat products were purchased in years 2005–2011 from the retail market and transported in a refrigerated condition to the laboratory for testing. Some of the samples were collected as part of the project MSZO MZ (<http://www.chpr.szu.cz/monitoring.htm>), others as part of the Research project of the Ministry of Education.

Bacteriological analysis of the samples

Detection of bacteria of the *Salmonella* genus was obtained in accordance with the guideline ČSN EN ISO 6579. Non-selective enrichment took place in buffered peptone water (OXOID, UK), selective enrichment in a Rappaport-Vassiliadis medium with soya and a Muller-Kauffmann medium with tetrathionate and novobiocin (OXOID, UK). This was followed by inoculation on Rambach medium (MERCK, D) and agar with xylose lysine and deoxycholate (OXOID, UK). Suspect colonies were confirmed by serotyping with antisera from the company BIO-RAD (France). Strains were ascribed to individual serotypes according to the Kauffmann-White-Le Minor scheme (Popoff 2001). The serotypes *S. Enteritidis* and *S. Typhimurium* were characterised by phage typing with sets of phages prepared by the HPA in London (Calow 1959; Ward et al. 1987).

Results

Testing of swabs taken from slaughtered pig carcasses

A total of 163 swabs were taken from slaughtered pig carcasses from eight farms in six districts of the Czech Republic. With the exception of one organic farm, the farms concerned employ traditional rearing methods. 76 swabs were taken from the surface of pig sides, and 87 from the nasal cavity. The frequency of occurrence of salmonella at the individual farms ranged from 0 to 16.7%. Positive findings of salmonella were confirmed only from swabs taken from the nasal cavity, and came from two farms. *S. Typhimurium* was detected in 7 samples. Positive findings for the monitored salmonella on the individual farms and the proportion of serotypes and phage types are given in Table 1.

Table 1. Number of tested swabs from slaughtered pig carcasses and findings of salmonella

Farm	Number of positive tested	Number of samples samples (%)	Serotype	Phage type / number
A	16	0	-	-
B	36	6 (16.7)	<i>S. Typhimurium</i>	U 302/2x DT 206/2x DT120/1x
C	18	2 (11.1)	<i>S. Agona</i> <i>S. Typhimurium</i>	- DT 206/2x
D	18	0	-	-
E	13	0	-	-
F	19	0	-	-
G	13	0	-	-
H	30	0	-	-

Note: farm C = organic farm

Analysis of pork meat and liver from the retail market

A total of 74 samples of pork meat and 48 samples of minced meat (a mixture of pork and beef) were taken from the retail and tested. The presence of bacteria of the *Salmonella*

genus was not proven in any of these samples. Salmonellae of the serotypes Typhimurium (4) and London (1) were isolated from 5 of 72 samples of pork liver (6.9%).

Analysis of meat products from the retail market

In the course of the study, 1,236 samples of ready-to-eat meat products were taken and tested. Bacteria of the *Salmonella* genus were detected in 7 (0.5%) samples. The serotype Enteritidis was proven in 6 samples. Phage type PT 13a was detected three times, phage types PT 1b, PT 8 and PT 13 were each detected once. Serotype *S. Typhimurium* was not detected in these meat products. The number of samples tested and the number of positive samples sorted out by commodity are given in Table 2.

Table 2. Type and number of tested meat products and positive findings of salmonella in the retail market

Group of products		Number of samples tested	Number of positive samples (%)	Serotype	Phage type / number	
cured meat products	sausages	204	0	-	-	
	cooked salami	240	1 (0.4)	<i>S. Enteritidis</i>	PT 8/1x	
	specialities	72	0	-	-	
	smoked meat	168	1	<i>S. Saintpaul</i>	-	
	and cooked hams					
	dry salami	cooked	168	0	-	-
		raw fermented	168	3(1.8)	<i>S. Enteritidis</i>	PT 1b/1x PT 13a/1x PT 13/1x
	cooked meat products		216	2 (0.9)	<i>S. Enteritidis</i>	PT 13a/2x

Discussion

The results of this study show that the serotype Typhimurium predominates among salmonellae in Czech slaughtered pigs and in pig liver. Similar results are described by the annual report of the EFSA for the year 2008 (EFSA 2010); the dominant serotype in pig farms in the member states is *S. Typhimurium* (31.5%), followed by *S. Derby* (13.2%) and *S. London* (3.6%). Although we detected no positive sample in any of the samples of raw packed meat from the retail market that we tested, the EFSA annual report for 2008 (EFSA 2010) states that *S. Typhimurium* (33.1%), *S. Derby* (19.8%) and *S. Agona* (3.9%) occur most frequently in pork meat.

The fact that the serotype Enteritidis predominated in meat products from the retail was a surprising discovery. *S. Typhimurium* was not confirmed once. These results indicate that slaughtered meat, which is the basic ingredient in the production of meat products, is not the only possible source of salmonella. Secondary ingredients, the production environment, and even the staff (Hedican et al. 2009) may be other possible sources. The contamination of ready-to-eat meat products is known to occur not merely during their production, but also subsequently. The cutting of meat products on cutting machines is a critical operation, both at the producer and when on sale at staffed sections in the retail. This is backed up by the results of our study, in which 5 of 7 positive samples involved cut meat products. The largest number of positive samples from the meat products tested was found in fermented meat products (1.8%). These figures do not correspond with the results of the authors Brychta et al. (2009) who tested 200 dry fermented salamis in 2008 and found no salmonella occurrence. The differences in these results can be explained

by the fact that while Brychta et al. (2009) tested piece products taken straight from the producer, the results of our studies are based on the analysis of sliced products taken from the retail market.

Conclusions

The possibility of contamination of meat products during their production and sale can be avoided by means of the thorough observation of hygiene regulations, and the proper sanitation of equipment coming into direct contact with food-stuffs (in particular cutting and slicing tools) and the environment of storage spaces and served sections in stores. Attention should also be devoted to staff education.

Acknowledgement

This work was produced with the financial support of the Research project MSM6215712402 and the project MIKROMON, MZSO MZ.

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