

The chilling process of pig carcasses in slaughter houses reduced the rate of culturable campylobacters on the carcass surface significantly.

Genotyping of *C. coli* revealed heterogeneous patterns among the human and porcine *C. coli* pool. It shows that different sources of infection in humans are most probable.

In minced meat we did not detect *C. coli* bacteriologically, but by the use of paramagnetic beads combined with PCR-technique we detected *C. coli* positive samples. This shows, that the meat was contaminated with *C. coli*. It is not clear what importance the presence of *C. coli* DNA in minced meat has for human infection, even though the presence of viable and culturable *C. coli* cells could be ruled out by bacteriological investigation. We could not distinguish between dead cells and VBNC forms of *C. coli* cells. The role of VBNC form of *C. coli*, a specific phenomenon of campylobacters (Lazaro et al., 1999) and certain other bacteria, has to be investigated further.

**Conclusion:** Porcine strains as sources of human *C. coli* infection can not be ruled out. Further research is needed to evaluate the *C. coli* findings in minced meat and the role of VBNC for human infection.

#### References:

Duim, B., Wassenaar, T.M., Rigter, A., Wagenaar, J. (1999): High-resolution genotyping of Campylobacter strains isolated from poultry and humans with amplified fragment length polymorphism fingerprinting. *Appl. Environ. Microbiol.* **65**, 2369-2375.

Linton, D. Lawson, A.J., Owen, R.J., Stanley, J. (1997): PCR detection, identification to species level, and fingerprinting of *Campylobacter jejuni* and *Campylobacter coli* direct from diarrheic samples. *J. Clin. Microbiol.* **35**, 2568-2572.

Lazaro, B., Carcamo, J., Audicana, A., Perales, I., Fernandez-Astorga, A. (1999): Viability and DNA maintenance in nonculturable spiral *Campylobacter jejuni* cells after long-term exposure to low temperatures. *Appl. Environ. Microbiol.* **65**, 4677-4681.

O 37

## Pathogenic bacteria and indicator organisms for anti-microbial resistance in pork meat at retail level in The Netherlands.

H. VAN DER ZEE\*, B. WIT AND E. DE BOER

Inspectorate for Health Protection and Veterinary Public Health. PO Box 202, 7200 AE Zutphen  
Tel. +31 575588143, Fax +31 575788200, E-mail: [henk.van.der.zee@kvvw.nl](mailto:henk.van.der.zee@kvvw.nl)

**Summary:** Slaughter pigs and pork carcasses are often contaminated with pathogenic bacteria. Consequently raw meat on sale in retail stores may also contain these bacteria. In The Netherlands the calculated contribution by pigs to the relative occurrence of human salmonellosis in the period 1994-1998 was 25.2 % (van Pelt, 2001). Survey and monitoring data on the contamination of raw products with pathogens like *Salmonella*, *Campylobacter*, *Listeria monocytogenes* and *Escherichia coli* O157 are essential for making risk estimates, and the results of surveys carried out in 1990/2000 and 2002 are presented here. In 2002 also a surveillance of anti-microbial resistance among indicator bacteria (*Escherichia coli*, *Enterococcus faecium/faecalis*) isolated from pork meat was started. The results show that pork meat was contaminated with *Salmonella* in levels between 6.2 - 10.5 %, *S. Typhimurium* being the predominant serotype, and to a lesser extent with *Campylobacter*, *Listeria* and *E. coli* O157.

**Keywords:** *Salmonella*; *Campylobacter*; *Listeria monocytogenes*; *Escherichia coli* O157; *Enterococcus faecium/faecalis*.

**Materials and methods:** Raw meat products were sampled in the retail trade. Detection of *Salmonella*, *Campylobacter* and *Listeria monocytogenes* was carried out using standard methods. *E.coli* O157

# ORAL PRESENTATIONS

(VTEC) was determined using modified *E. coli* broth with novobiocin, immuno-magnetic separation and isolation on CT-SMAC agar. Isolation of the indicator organisms *E. coli* and enterococci was performed as follows. For *E. coli* 5 g of meat was incubated for 24 hours at 44 °C in 45 ml laurylsulphate broth, streaked on COLI-ID-plates and incubated 24 h at 44 °C, and identified by the AP80 test (Sensititre). Enterococci were isolated by incubation of 5 g meat in 45 ml azide dextrose broth at 44 °C for 24 h followed by streaking on Slanetz-Bartley medium and incubated for 48 h at 44 °C. Presumptive enterococcus isolates were identified by AP90 test (Sensititre). Susceptibility testing was done with Sensititre System (Trek Diagnostic Systems Ltd). Proportions of resistance were calculated based on breakpoints used in DANMAP and the NCCLS

**Results:** In the survey carried out in 1999/2000 *Salmonella* was found in 33 (6.2 %) of 533 samples pork meat, the predominant serotype being *S. Typhimurium* (14x) of which 3 isolates belonged to phage type D104. Other serotypes isolated were: Derby (2x), Brandenburg (2x), Bovismorbificans (2x), Enteritidis, Lancaster, Goldcoast, Livingstone, Infantis, Mbandaka, London, and *Salmonella* spp.(6x). *Campylobacter* was not isolated from 524 samples pork meat. VTEC O157 was detected in 1 (0.7 %) of 153 samples. In a more recent survey carried out in 2002, *Salmonella* was found in 11 (10.5 %) of 109 pork samples. Also here *S. Typhimurium* (4x) was the predominant serotype of which 1 isolate belonged to phage type D104. Also the serotypes Brandenburg, Infantis, London, Livingstone *Campylobacter* was isolated from 2 samples pork meat (2.1 %), VTEC O157 was not detected, and 2 samples contained more than 100 /g *Listeria monocytogenes*. For susceptibility testing 8 salmonellas, 53 strains of *E. coli*, 40 *E. faecalis* strains and 16 *E. faecium* strains were investigated. The results are shown in Table 1 and 2.

**Table 1.** Number of strains tested (N) and resistance proportions (R%) for *Salmonella* and *E. coli* from pork meat.

Antibiotics	Breakpoint (µg/ml)	<i>Salmonella</i>		<i>E. coli</i>	
		N	R%	N	R%
Amoxicillin	>16	8	0	53	13.2
Cefotaxime	>1	8	0	54	0.0
Cefuroxim	>16	8	12.5	54	3.7
Chloraphenicol	>16	8	0	54	0.0
Ciprofloxacin	>2	8	0	54	0.0
Doxycycline	>4	8	25	54	18.5
Florfenicol	>16	8	0	54	0.0
Flumequin	>4	8	0	54	0.0
Gentamicin	>8	8	0	54	0.0
Imipenem	>1	8	0	54	3.7
Neomycin	>16	8	0	54	0.0
Trimethoprim	>8	8	37.5	54	16.7
Trim/sulpha	>8	8	37.5	54	13.0

**Table 2.** Number of strains tested (N) and resistance proportions (R%) for *E. faecalis* and *E. faecium* from pork meat.

Antibiotics	Breakpoint (µg/ml)	<i>E. faecalis</i>		<i>E. faecium</i>	
		N	R%	N	R%
Amoxicillin	>16	40	0.0	16	0.0
Bacitracin	>128	40	15.0	16	6.3
Ciprofloxacin	>8	40	0.0	16	0.0
Doxycycline	>4	40	25.0	16	18.8
Erythromycin	>4	40	15.0	16	25.0
Flavomycin	>16	40	5.0	16	75.0
Gentamycin	>500	40	7.5	16	0.0
Lincomycin	>4	40	97.5	16	87.5
Pirlimycin	>2	40	12.5	16	37.5
Salinomycin	>16	40	7.5	16	6.3
Strep > 1000	>1000	40	12.5	16	6.3
Strep > 2000	>2000	40	2.5	16	0.0
Quinupristin/dalfopristin	>4	40	15.0	16	0.0
Vancomycin	>16	40	0.0	16	0.0

**Conclusion:** These results confirm that raw meat is contaminated with pathogenic bacteria, mainly *Salmonella* spp., and consequently with these raw products pathogens and resistant strains will enter the kitchen and may lead to food borne diseases and/or transfer of resistant strains or resistance genes to humans. Therefore, the prevention of food borne diseases and resistance transfer is mainly in the hands of those preparing food. These persons should as well be educated on the basic sanitary principles of food preparation as well as be informed on the possible presence of pathogens in raw products, for instance by informative labels.

**References:**

Van Pelt, W. (2001) Relationship between food animals and human cases of salmonellosis. In: Zoonoses and zoonotic agents in humans, food, animals and feed in the Netherlands . Inspectorate for Health protection and Veterinary Public Health, The Hague.

DANMAP 2000 (2001). Consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, foods and humans in Denmark. ISSN 1600-2032.

**O 39**

## PREHARVEST INFLUENCE ON SALMONELLAE HUMAN HEALTH COSTS AND RISKS FROM PORK

Gay Y. Miller\*, Paul McNamara, Xuanli Liu.

\*Univ. of IL, Urbana, IL 61802. Tel:(217)244-3090; Fax:(217)244-7421; email:GYMiller@uiuc.edu.

**Summary:** The purpose of this study is to understand the implications of the prevalence of salmonellae in pigs preharvest for the food safety risks and human health costs for humans. Mean costs from human cases of salmonellae predicted by the model was 77,183,000 \$, with a range of 6,019,000 - 723,777,000 \$. Using sensitivity analysis, on-farm apparent prevalence has an important influence on pork-associated human health costs. Tornado graphs are a poor way to assess model variable importance, and should only be used for preliminary analysis with a flow model of this type. Mismatched data sources, and