Monitoring of Salmonella, Campylobacter, Yersinia enterocolitica, E. coli O157, and Listeria monocytogenes on a subset of Canadian swine farms

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Abstract

The objective of the present study was to investigate the occurrence of major bacterial foodborne pathogens in swine on a subset of Ontario swine farms between 2005 and 2007. In total, 359 samples from manure storage tanks and fresh pooled feces obtained from finisher pigs, sows, and weanlings were collected and tested. Campylobacter, Salmonella, Y. enterocolitica, E. coli O157 and L. monocytogenes were isolated from 36.5%, 31.5%, 5.8%, 3.3%, and 3.3% of samples, respectively. All E. coli O157 isolates were tested but none were determined to be E. coli O157:H7. Salmonella and Campylobacter were more likely to be detected from stored manure rather than fresh fecal samples. Y. enterocolitica tended to be detected more commonly from fresh samples than from manure pits. L. monocytogenes was not recovered from manure pits or from sow fecal samples and only infrequently found in the feces of weanling pigs and finisher pigs. The four most common Salmonella serovars were Typhimurium var. Copenhagen, Derby, Typhiurium, and Agona. Of 131 Campylobacter isolates, 118 isolates were C. coli and 13 isolates could not be speciated. The most common Y. enterocolitica sero/biogroups was O: 3 / biotype 4. All 12 E. coli O:157 isolates were tested but none were determined to be E. coli O:157:H7. L. monocytogenes isolates belonged to two serotypes; serotype 1/2a and serotype 1/2b. These findings provide baseline information on the distribution of important zoonotic pathogens in swine and indicate that pigs should be considered as a possible source of foodborne diseases in humans.

Introduction

Gastrointestinal diseases continue to be an important public health issue globally (Kosk et al., 2003) with a significant economic impact (Mead et al., 1999). Infection with Campylobacter, Salmonella, Yersinia enterocolitica, and E. coli O157:H7 represent important causes of enteric illness in Canada (Public Health Agency of Canada, 2005). In order to reduce foodborne illness in Canada, the C-EnterNet surveillance program was initiated by the Public Health Agency of Canada in 2003 to conduct surveillance on farms and in retail meats for the major enteric zoonotic disease agents (C-EnterNet 2006 Annual Report, 2007). The aim of the present study is to describe the distribution of Salmonella, Campylobacter, Yersinia enterocolitica, E. coli O157, and Listeria monocytogenes in stored manure and among pigs in different stages of production on a subset of Ontario swine farms between 2005 and 2007.

Material and Methods

As part of the C-EnterNet surveillance program, 31 swine farms located in the Regional Municipality of Waterloo, Ontario, Canada were visited between March 2005 and November 2007. On each farm, pooled-fecal sample were collected from finisher pens, weanling-pens, and from 6 randomly selected sows, as well as one pooled-sample from the manure storage pit. In total, 359 fecal samples from manure storage tanks (91) and fresh pooled feces (268) obtained from finisher pigs (110), sows (78), and weanlings (80) were collected and tested. A Generalized Linear Latent and Mixed Models (GLLAMM) with farm as a random effect was used to compare the distribution of pathogens among different samples.
Results

*Campylobacter, Salmonella, Y. enterocolitica, E. coli* O157 and *L. monocytogenes* were isolated from 36%, 31%, 6%, 3%, and 3% of samples, respectively. *Salmonella* [OR=1.9 (1.1, 3.3)] and *Campylobacter* [OR=2.9 (1.4, 6.0)] were more likely to be detected from stored manure rather than fresh fecal samples (Figure 1). On the other hand, *Y. enterocolitica* tended to be detected more commonly from fresh samples than from manure pits [OR=7.3 (1.0, 55.4)]. No *L. monocytogenes* was recovered from manure pits or from sow fecal samples and only infrequently found in the feces of weanling pigs and finisher pigs. The 113 *Salmonella* isolates belonged to 23 different serovars. The four most common serovars were Typhimurium var. Copenhagen, Derby, Typhimurium, and Agona. Of 131 *Campylobacter* isolates, 118 isolates were *C. coli* and 13 isolates could not be speciated. Fifteen of 21 *Y. enterocolitica* isolates were detected in finisher pigs and the most common sero/biogroups was O: 3 / biotype 4. All 12 *E. coli* O:157 isolates were tested but none were determined to be *E. coli* O:157:H7. *L. monocytogenes* isolates belonged to two serotypes; serotype 1/2a and serotype 1/2b.

Figure 1: Distribution of *Campylobacter, Salmonella, Y. enterocolitica, E. coli, and L. monocytogenes* among fecal samples collected from manure pits, finishers, sows, and weaners on a subset of Canadian swine farms in Ontario

![Bar chart showing distribution of isolates by source and species](image)

Discussion

The apparent proportion of *Salmonella*-positive samples was higher than in previous reports of Ontario swine farms (Farzan et al., 2008). Although this can be due to the repeated sampling on a subset of farms, a high level of *Salmonella* in the stored manure pits may be another explanation for the increased occurrence in the current study. On the other hand, the relatively low occurrence of *Campylobacter coli* might be due to the use of different culturing methods. The absence of *C. jejuni* on swine farms is an encouraging finding from a public health point of view. However, Harvey et al. (1999) detected *C. jejuni* in the pig cecal contents at the time of slaughter suggesting that *C. jejuni* might be still found on some pig farms in the absence of positive fecal cultures. Prevalence of *Y. enterocolitica* has been relatively high (21%) in slaughter hogs sampled at Canadian abattoirs (Letellier et al., 1999) suggesting that cross-contamination of pigs may occur at slaughters. Pigs have been implicated as the major reservoir of *Y. enterocolitica* strains that are pathogenic for humans (Funk et al., 1998) and serogroup O3 has been reported to be present in most regions of the world (Bottone, 1997). In particular, *Y. enterocolitica* O3/biovar 4, the most frequent biotype in the current study, is pathogenic to humans (Hurrell, 1981). *E. coli* O157:H7 could not be recovered from the pen environment in the current study; however, it has been isolated from the samples obtained from rectum or intact colon (Feder et al., 2003). *L. monocytogenes*
1/2a and 1/2b is important in terms of public health and warrant serious attention. It is possible that the small number of _Listeria monocytogenes_ introduced by infected pigs at slaughter multiplies in the environment resulting in higher levels of contamination in retail pork (Thévenot et al., 2006).

**Conclusion**

The present study provides baseline information on distribution of those microbial agents among pigs in different stages of production. Presence of *Salmonella* and *Campylobacter* in stored manure is a threat to public health and warrants serious attention. It is possible that the surface and ground water are contaminated when spreading pig manure to fertilize agricultural land. The farms included in the present study were not a random sampling and results of prevalence cannot be extrapolated to a larger population of Canadian pig farms. Nevertheless, the findings in the present suggest that *Salmonella*, *Campylobacter coli*, and *Yersinia enterocolitica* commonly occur in pig manure whereas *E. coli* O157:H7 and *Listeria monocytogenes* are less frequent.

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**References**


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