RESEARCH REPORT
PORK SAFETY

Title: Serological Analysis of *Toxoplasma gondii*, *Trichinella spiralis* and *Salmonella enterica* among niche market antimicrobial-free and conventionally reared pigs - **NPB-04-108**

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Abstract:

The objective of the proposed project was to determine and compare *Toxoplasma* and *Trichinella* infection in the two swine production systems and evaluate history of *Salmonella* infection based on serological analysis. A total of 675 serum samples from all the three participating states: Wisconsin, North Carolina and Ohio were included. We found significantly higher seroprevalence of *Salmonella* and *Toxoplasma* from antimicrobial-free (ABF) herds (54% and 7% respectively) than conventional (41% and 1% respectively) (p=0.001). Two pigs, both from ABF herds, were found to be positive for *Trichinella*. The results from this preliminary study enabled us to understand that all the three pathogens were more commonly present in pigs that were reared in antimicrobial-free, out-door, niche-market type of environment than the commercial conventional indoor types of herds. This warrants the need for a robust epidemiologic study to determine the role of various production factors in the two production systems on the safety and wholesomeness of pork products, particularly on the persistence of bacterial (*Salmonella*) and parasitic (*Trichinella* and *Toxoplasma*) pathogens.

Introduction:

Swine are implicated as one of the important contributors of foodborne infections in humans. Apart from the common bacterial pathogens, such as *Salmonella*, zoonotic parasitic infestations including *Toxoplasma gondii* and *Trichinella spiralis* are known to have historical significance in swine production. As the trend in pork industry shifted to a more intensive in-door production system complemented with stringent biosecurity measures, the prevalence of these pathogens has also declined.

In recent years, an increasing number of niche market antimicrobial-free swine production units have been developed. In this type of production, pigs are raised outdoors, which may render the environment conducive for proliferation of parasitic larvae including helminthes (*Ascaris suum*, *Trichinella spiralis* and others) and protozoan pathogens (such as *Toxoplsma gondii*) since pigs raised in outdoor environment may have more access to other final hosts such as cats. Therefore, it is crucial to study the role of antimicrobial free (outdoor, niche market etc.) swine production units on the prevalence and dissemination of bacterial and parasitic foodborne pathogens.

Objectives:

The objective of the proposed project was to determine and compare *Toxoplasma* and *Trichinella* infection in the two swine production systems and evaluate history of *Salmonella* infection based on serological analysis.

Materials and Methods:

- A total of 675 serum samples from all the three participating states: at least 200 serum samples from Wisconsin, North Carolina and Ohio each were submitted to the Iowa State University Diagnostic Laboratory for further analysis.
- Serological analysis of the parasitic (*Toxoplasma gondii* and *Trichinella spiralis*) and bacterial (*Salmonella*) pathogens was conducted.
- Seroprevalence of each of the three pathogens between niche-market ABF and conventionally reared productions were compared.
- Statistical analysis using SPSS software package was conducted initially using chi-square univariate analysis. A multivariate logistic regression was also used to determine the potential association of each of the two parasitic pathogens on *Salmonella* seroprevalence.

Results

In this study, a total of 675 sera were sent for serology. The results received were not complete for all the three organisms and we have a complete data for the 616 total specimens. The following are the major results that we found in the current study:

- We found 47% seroprevalence of *Salmonella*. The prevalence of *Toxoplasma* and *Trichinella* were 4.1% (25 of the 616 specimens) and 0.3% (2 of the 616 samples) respectively.
- We found the highest seroprevalence of *Salmonella* from Wisconsin (59%) than the other two states: North Carolina (34%) and Ohio (34%).
- We found significantly higher seroprevalence of *Salmonella* from ABF herds (54%) than conventional (41%) (p=0.001).
- We found a similar trend in *Toxoplasma* as well. Seroprevalence of *Toxoplasma* was significantly higher among samples from ABF (6.8%, n=22) than conventional (1.1%, n=3).
- Both of the two *Trichinella* samples originated from ABF herds and none of the samples from conventional were positive for *Trichinella*.
- While at least one sample from NC and WI were positive for all of the three pathogens, none of the samples from OH were positive for *Toxoplasma* and *Trichinella*.
- We found no significant association between *Salmonella* seropositivity and either of the two parasitic pathogens (*Toxoplasma and Trichinella*).
- There was a significant association between seropositivity for *Toxoplasma* and *Trichinella* (p=0.001). This may be due to the fact that both were more commonly detected from antimicrobial-free herds but none from conventional ones.
- Multivariable logistic regression results also supported the univariate findings that there is no association between the occurrence of the two parasitic pathogens and shedding of *Salmonella*.

Discussion

The higher sero-prevaelnce of *Salmonella* in all the three states has not been a surprise since the findings indicate prior history of salmonella exposure as compared to current infections when prevalence based on culture and isolation method is used. Consistent with our previous reports, the prevalence of *Salmonella* was higher among ABF herds than conventional ones. We found a similar result in all the three states and also when culture and isolation method was used.

Another most interesting finding in the current study was the significantly higher seroprevalence of *Toxoplasma* among pigs raised in antimicrobial-free environment than those reared in conventional settings. Even though we have not done a detailed risk factor analysis in the current study, the extensive nature of the ABF production system could create conducive ground for *Toxoplasma* infestations as compared to the indoor conventional production system.

Though low in numbers, finding of two pigs that were also positive for *Trichinella* (0.3%), both in pigs reared in outdoor environment (ABF) may warrant a serious concern on the safety of pigs reared in an open-air environment with potential exposure to wild and other domestic fauna.

The finding in this preliminary study warrants the need for a robust epidemiologic study to determine the role of various production factors in the two production systems on the safety and wholesomeness of pork products, particularly on the persistence of bacterial (*Salmonella*) and parasitic (*Trichinella* and *Toxoplasma*) pathogens.

Lay Interpretation

Three globally important zoonotic foodborne pathogens including *Salmonella, Trichinella* and *Toxoplasma*, were studied. Serological analysis of these pathogens was conducted on samples collected from two distinct pig production systems: antimicrobial-free, niche market type (ABF) and conventional (indoor-reared). The results from this preliminary study enabled us to understand that all the three pathogens were more commonly present in pigs that were reared in antimicrobial-free, out-door, niche-market type of environment than the commercial conventional indoor types of herds. This was found to be consistent in all the three states that were included in the current study: North Carolina, Ohio and Wisconsin.

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