Risk Factors for Swine Infection with *Toxoplasma gondii*

Pyburn, D. G.¹, Patton, S.², Zimmerman, J. J.³, McKeen, J. D.³, Evans, R. B.³, O’Connor, A. M.³, Smedley, K. L.², Faulkner, C.T.² and Zhou, E. M.³

¹ National Trichinae Coordinator, USDA, APHIS, Veterinary Services, 210 Walnut Street, Des Moines, Iowa, USA 50309, Tel: (515) 284-4122, Fax: (515) 284-4191, E-mail: David.G.Pyburn@aphis.usda.gov, ² University of Tennessee, Knoxville, TN, USA, ³ Iowa State University, Ames, Iowa, USA

Summary: The objective of this study was to evaluate the association between the seroprevalence of *Toxoplasma gondii* antibodies in swine in commercial pork production systems in Iowa, USA and the source of water (surface water vs. well water vs. rural processed water) and method of water delivery (surface or trough vs. nipple vs. cup). Also the study evaluated the association between *T. gondii* seroprevalence and other selected potential farm variables.

In this study the following on-farm risk factors had a statistically significant association with swine being seropositive for *T. gondii*:

1. In adult swine those that drank well water were more likely to be seropositive than those that drank pipe-delivered rural water;
2. In grow/finish swine those that had water delivered through surface water or trough water were more likely to be seropositive;
3. Non-confinement housing resulted in a higher likelihood of being seropositive in all groups of swine studied; and
4. Failure to clean facilities between groups of animals resulted in a higher likelihood of being seropositive in all groups of swine studied.

Keywords: Food Safety, *Toxoplasma gondii*, Pork, Toxoplasmosis, Preharvest Pork Safety.

Introduction: *Toxoplasma gondii*, a protozoan parasite capable of infecting all mammals and birds, is the causative agent of one of the most common parasitic global zoonoses (Tenter et al., 2000). Even though *T. gondii* infections in humans are often asymptomatic, the organism still causes an estimated 112,500 cases of foodborne illness in the U.S. annually and, together with two other pathogens, accounts for 75% of the foodborne-illness deaths attributable to known agents (Mead et al., 1999). When *T. gondii* is considered as a foodborne pathogen, pork is often singled out as the most likely carrier food of the organism. This perception stems from past studies which indicate that swine have a high seroprevalence of antibodies against *T. gondii* relative to other food-producing animals (Davies, 1999). The results of the 2000 USDA National Animal Health Monitoring System’s National Swine Survey, the most recent comprehensive study of the U.S. pork industry, found an infection rate of 0.8% for finisher pigs and an infection rate of 5.78% for sows (Bush, 2002). This infection rate is significantly lower than in previous studies of the pork industry. With this knowledge and with the progress that is being made on the Trichinae Certification Program, the U.S. pork industry is considering developing an on-farm auditing system to document good production practices that will decrease swine exposure to *T. gondii*. Initial steps in the development of this system involve the discovery of all on-farm risk factors for swine infection with the *T. gondii*.

Materials and Methods: Fifteen swine serum samples from each of 414 pork production sites throughout Iowa were obtained through the pseudorabies surveillance program. Samples were tested for the presence of antibodies against *T. gondii* using the modified agglutination test (MAT). The MAT uses formalin-fixed tachyzoites as antigen. Antibody titers ≥32 were considered positive, i.e., that the pig had been infected with *T. gondii* at some time during its life. Information about the source and method of water delivery, as well as other relevant production information, was obtained via
Results: A total of 6210 animals were tested in the study, with 422 (6.8%) testing seropositive. Swine from all levels of production were included in this study, but a majority of the swine tested were finishers and sows. Of the 414 Iowa pork production sites in the study, 97 (23.4%) had at least one seropositive animal. The following on-farm risk factors had a statistically significant association with swine being seropositive for *T. gondii*:

1. In adult swine: well water vs. pipe-delivered rural water \( (p = 0.0012) \);
2. In grow/finish swine: surface or trough water vs. all other delivery methods \( (p = 0.0026) \);
3. Non-confinement housing (grow/finish \( p = 0.0063 \); adult \( p = 0.0049 \));
4. Failure to clean facilities between groups of animals (grow/finish \( p = 0.0516 \); adult \( p = 0.0026 \)).

Discussion: If *T. gondii* as a food safety issue is to be addressed through the implementation of a preharvest risk mitigation system, all of the on-farm risk factors for swine infection with the organism must be clearly delineated so that risk reduction and/or elimination strategies can be devised. Previous studies have identified most of the on-farm risk factors for swine infection with *T. gondii* (Lubroth et al., 1983, Smith et al., 1992, Assadi-Rad et al., 1995, Weigel et al., 1995, & Dubey et al., 1986). However, the source of water for the herd was not evaluated as a risk factor for *T. gondii* infection of swine. Other research has demonstrated that ingestion of water contaminated with *T. gondii* oocysts is an increasingly common route of infection in humans (Kourenti et al., 2003, Bahia-Oliveira et al., 2003, Hunter et al., 2001, Bowie et al., 1997, & Benenson et al., 1982). The importance of water transmission in swine is unknown. Oocysts can survive in water for long periods of time under a variety of conditions (Dubey 1998), but they have not been recovered from water sources on swine farms (Dubey et al., 1995).

Conclusions: The relative importance of a variety of on-farm risk factors needs to be understood to reduce *T. gondii* infection in swine. This study demonstrates that a variety of risk factors, including the source and method of water delivery, need to be addressed to control *T. gondii* infection on pork production sites. This information is needed before a preharvest risk mitigation system for pork production facilities can be developed.

Acknowledgements: The authors would like to thank the National Pork Board for support of this project.

References:
Individual effect of the steps preceding slaughtering on Salmonella contamination of pigs.

Philippe FRAVALO*, Roland CARIOLET, Maryline QUEGUINER and Gilles SALVAT

*French Agency For Food Safety–BP 53 22440 Ploufragan–France Tel (0)2 96016227, p.fravalo@ploufragan.affsa.fr

Summary: The influence of the different steps preceding pig slaughtering (waiting in the herd, transport and lairage) was studied regarding deep (organs) and surface (carcass) Salmonella contamination, by mixing SPF with contaminated pigs at the different steps. For a lairage of 2 hours and a transport of 1 hour, the caecal contamination concerned the conventional pigs and the long time mixed groups (more than lairage time). The isolated strains were from herd origin according to serotyping. After the slaughtering process, it was not possible to differentiate carcasses contamination rate for the conventional batch from those of the control group pigs (transport and lairage in Salmonella-free conditions). This study showed that without efficient control measures during slaughtering, implementation of control measures in the herd would be inefficient regarding carcass contamination rate.

Keywords: lairage, mixing groups, carcasses and organs contamination.

Introduction: The risk of surface contamination of the pig carcasses is associated with the level of contamination of the digestive tract of the animal (Berends et al., 1997). According to this, many efforts focused on the definition of the circumstances associated with a shedder status for pigs from a given breeding at the end of the growing period. An important difference appeared between the status as they can be described in the breeding and the one obtained after an evaluation after slaughter (Hurd et al., 2002). To obtain benefits of the application of on herd measures taken to control Salmonella, we have to better understand the individual role of the different steps preceding the slaughtering. This was the aim of our study and we proposed to check the following steps for Salmonella contamination: waiting at the herd, transport, lairage and slaughtering process.

Materials and methods: Pigs: 60 conventional pigs (Conv) issued from a farm where Salmonella were found in environmental swab and faecal matter (Table1). 48 SPF pigs (aged of 136 days for an average weight of 102 kg) produced in experimental equipments regularly controlled for the absence