Cross-sectional risk factor analysis for *Yersinia enterocolitica* O:3 in Danish slaughter pigs based on bacteriological data.

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Abstract: This study aimed at identifying major risk factors for infection with *Yersinia enterocolitica* serotype O:3 (*Y. enterocolitica* O:3) in Danish slaughter pigs. Fecal samples from finishers in 67 herds were cultured for presence of *Yersinia*. Herd informations were obtained from a questionnaire. Risk factors for *Y. enterocolitica* O:3 positive herd status and within-herd prevalence was identified by multivariate logistic regression. Factors indicating low biosecurity (purchase of pigs, conventional and larger herds, no use of separate load-out-room) were major risk factors for *Y. enterocolitica* O:3 infection. Feeding wet feed did not influence the infection. Feeding home mixed feed vs. purchased feed, which is an important risk factor and intervention tool for reduction of *Salmonella*, only influenced the within-herd prevalence. The results indicate that a separate intervention strategy against *Y. enterocolitica* in pig herds might be needed.

Keywords: Biosecurity, management, purchase, feed stuff, control

Introduction: *Yersinia enterocolitica* O:3 is the dominating agent involved in human yersiniosis in Denmark. Internationally, several case-control studies on human yersiniosis has pointed to pork and pork products as important sources for these infections (Ostroff et al. 1994; Satterthwaite et al. 1999). Pigs are considered the primary reservoir for human yersiniosis in Denmark as well, and *Y. enterocolitica* O:3 is commonly isolated from pigs and pork. Despite a declining human incidence since the mid-eighties (Anonymous, 2001), the awareness of the known reservoir in the pork production chain, has led to continued preharvest and harvest research on *Yersinia*. Only few studies have been published on identification of risk factors for *Y. enterocolitica* O:3 in pig herds (Skerve et al., 1998). The present study aimed at identifying major risk factors for *Y. enterocolitica* O:3 infection in Danish slaughter pigs, in particular factors with known influence on porcine salmonella infections.

Materials and Methods: Herd data and fecal samples were collected at herd visits back in the early 1991/1992 where the herd management and feeding strategy was not influenced by knowledge on preharvest control of *Salmonella*.
Faecal samples for culture: Faecal samples were collected from 67 slaughter pig herds from the pen floor among finishers (10-70 samples/herd, in total 2,244 samples). Each sample consisted of 5x5 g of faecal material from one pen. Culture of faecal samples for Yersinia: One g of each sample was submitted to culture by standard methods, including a cold pre-enrichment step. Herd data: were collected by filling in a questionnaire. The explanatory variables shown in Table 1 were selected for the analysis based on hypotheses on *Y. enterocolitica* O:3 epidemiologi and control on herd level. Some potential variables were omitted due to missing values or a skewed distribution. Statistical methods: Associations between yersinia status and herd factors were analysed by multivariate logistic regression. Dependent variables: Model-1: Bacteriological herd status (positive if >= one sample was culture positive for *Y. enterocolitica* O:3), Model-2 and -3: Number of culture positive samples/number of samples (y/n). Model-3 only included herds with a positive herd status. The analysis was initiated by univariate analyses and inclusion of variables with p-values <= 0.25, followed by backwards elimination and examination for confounding and interactions. In Model-1 PROC GENMOD, SAS, was used. In Model-2 and -3 PROC LOGISTIC, SAS, was used. Overdispersion was handled by pscale/scale=p and the variable number of samples/herd by Williams correction.

Table 1. Distribution of the examined explanatory variables on ***Y. enterocolitica*** O:3 herd status

EXPL. VARIABLE	Culture positive herds	Culture negative herds
Slaughter pigs delivered per year	a.m. 2,285, s.d. 1,403	a.m. 1,418, s.d. 727
Log(deliverered/year)	a.m. 7.56, s.d. 0.59	a.m. 7.14, s.d. 0.47
Delivered pigs/year: <= 1,000	N = 52 14	N = 15 1
categorized 1,000 < < 2,000	13	1
2,000 =< < 3,000	16	7
>=3,000	9	6
Conventional (vs. SPF) (1/0)	38/52	8/15
Farow-to-fin. (vs. grow-to-fin) (1/0)	15/52	6/15
Antib. Growth promot. feeders (1/0)	35/51*	11/13#
Purchased feed (vs. home mix) (1/0)	25/52	7/15
Wet feed (vs. dry) (1/0)	13/52	1/15
Use of separate load-out-room (1/0)	46/52	10/14*
Rats observed within 6 months (1/0)	28/52	7715
Dogs/cats with access to herd (1/0)	26/52	9/15
Cleaning of finisher-pens (1/0)	13/52	1/14*
Disinfection of finisher-pens (1/0)	8/52	2714*

*= One obs. missing, # = Two obs. Missing

Results:

Table 2. Odds Ratios for variables in final models for *Y. enterocolitica* O:3 infection in slaughter pigs. -: Variable not kept in final model.

Final models	OR, Model-1 herd status, all herds	OR, Model-2 y/n, all herds	OR, Model-3 y/n, positive herds
Doubling deliverance/year	3,61	-	-
Delivered pigs/year, Categorised	-	Interaction#	-
Conventional (vs. SPF)	5.96*		2.30
Farrow-to-finish	-*	0.37	-
Purchased feed (vs. home mix)	-	-	2.12
Use of separate load-out-room	6.38*	-	0.33
Cleaning of finisher-pens	-	-	0.49
Rats observed within 6 months	-	-	0.51

* Effect of load-out-rooms is primarily in integrated herds and is only measurable in conventional herds. # Risk only in conventional herds (OR highest for herd size 1,000 < < 2,000). Increasing risk with increasing herd size in SPF-herds. Conventional herds: OR is highest for size 1,000 << 2,000.

Discussion and conclusions: An important risk factor for positive *Y. enterocolitica* O:3 herd status and high within-herd prevalence is a conventional health status (Table 2), probably due to biosecurity rules for SPF herds. Farrow-to-finish production systems seem to protect against *Y. enterocolitica* O:3 positive herd status. This might be explained by less introduction via purchase of pigs. This was found also by Skjerve et al. (1998). Similar, increasing herd size (thus possibly more frequent purchase of pigs) increases the risk for positive herd status. Use of separate load-out rooms for pigs going to slaughter is obligatory in SPF-herds for biosecurity reasons, but an influence on within-herd prevalence is hard to explain. Cleaning finisher pens between batches could obviously decrease the in-herd-prevalence. Purchased feed increases the within-herd prevalence but not the herd status, a pattern known from *Salmonella* as well. No effect was found from feeding wet feed. Finally, observation of rats seems to reduce the within-herd prevalence and might just be a proxy for general awareness of the importance of biosecurity.

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