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RISK INDICATORS FOR THE SEROPREVALENCE OF MYCOPLASMA HYOPNEUMONIAE IN SLAUGHTER PIGS FROM FARROW-TO-FINISH PIG HERDS

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Une étude transversale a été réalisée dans 150 élevages de porcs naisseurs-engraisseurs pour déterminer la séroprévalence de Mycoplasma hyopneumoniae (Mh) et pour étudier la relation entre des indicateurs de risque à l'échelle du troupeaux et la séroprévalence de Mh. Les élevages de porcs ont été sélectionnés au hasard dans une zone regroupant à peu près 54% du cheptel porcin belge. Toutes les données ont été récoltées par le même chercheur, grâce à l'inspection des porcs et des unités de production de porcs, et à travers des entretiens face-à-face avec les éleveurs. Un prélèvement de sang a été réalisé à l'abattoir sur 25 porcs par élevage. La présence d'anticorps Mh a été recherchée avec le test ELISA DAKO Mh. L a relation entre la séroprévalence de Mh et divers indicateurs de risque potentiels a été analysée avec un modèle de régression logistique incluant un paramètre aléatoire pour prendre en compte l'effet élevage.
A l'abattage, 72% des 3750 porcs étaient séropositifs pour Mh. Deux indicateurs de risque significatifs ont été observés. Le premier est le nombre d'élevages dans lesquels ont été achetés des porcs reproducteurs. Les porcs appartenant à des élevages qui ont acheté les reproducteurs dans un seul élevage avaient un risque de séropositivité Mh accru de 1,5 en comparaison avec les élevages n'ayant pas acheté de reproducteurs. Le risque était multiplié par 2,2 en cas d'achat dans plusieurs élevages. Le second indicateur de risque est la saison. Le risque pour les porcs abattus en mars et avril était 3,1 fois plus élevé par rapport aux porcs abattus à d'autres périodes.

INTRODUCTION

Enzootic pneumonia (EP) is a contagious pulmonary disease of the pig caused by *Mycoplasma hyopneumoniae* (Mh) as primary agent, clinically characterized by coughing, unthriftiness and low mortality. The disease is found throughout the world and is an important cause of economic loss, especially when pigs are raised under intensive conditions (Ross, 1992).

Since the clinical outlook of many infectious diseases has changed to a large extent parallel with the intensification in pig industry, serology has become more important and has taken a central position in diagnosis for respiratory disease. The availability of sensitive and specific serological tests to detect antibodies against Mh has stressed the importance of serology in diagnosis of EP (Feld *et al.*, 1992; Le Poitier *et al.*, 1994). Furthermore, serological testing provides objective information, opposed to the quantification of clinical signs and lung lesions which is more liable to subjectivity. The presence and the extent of seropositivity within pig herds may be a reflection of the spread of an infectious agent and can be an important determinant in the population dynamics of the disease.

EP must be seen as the result of a dynamic interaction between infectious agents and the host. This interaction is strongly influenced by both the physical environment in which the pigs are raised and by management practices. Due to the multifactorial nature of EP, it is important to look for potential risk indicators. Previous studies of EP have concentrated mainly on defining the infections and production losses associated with disease (Straw *et al.*, 1989). Analysis of risk indicators for the spread of pathogens has become more important in modern preventive veterinary health care (Hurnik *et al.*, 1994). Besides case-control studies investigating risk indicators for reinfection with Mh for SPF pig herds (Jorsal and Thomsen, 1988; Stärk *et al.*, 1992), little is known about the risk indicators influencing the extent of seroprevalence of Mh. Furthermore, it is difficult to compare different studies because pig environments vary from region to region and over time within the same region.

In order to clarify descriptive and analytical epidemiological aspects of EP under Belgian conditions, a cross-sectional study on slaughter pigs was designed in 150 farrow-to-finish pig herds. The objectives of the study were to:

1. determine the seroprevalence of Mh.
2. describe the distribution of herds depending on the herd seroprevalence of Mh.
3. identify and quantify the relationship between herd risk indicators and the seroprevalence of Mh.

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MATERIALS AND METHODS

One hundred and fifty farrow-to-finish pig herds were selected at random in the North-Western part of Belgium (3314 km^2 or 11% of the country), where 54% of the Belgian pig population (i.e. 2.7 million fattening pigs and sows) was situated. A selection procedure that accounted for herd size was applied. The herds were classified into three categories: herds with 50-100 sows (33%); with 100-200 sows (43%), and with over 200 sows (24%). The number of herds per size category was calculated, based on the proportion of sows represented by these categories. An advance letter was mailed to the farmers introducing the study and explaining the purposes. In addition, herd owners were contacted by phone and asked to collaborate. The participation rate was 87% after the first session. Random sampling was repeated in corresponding strata to replace the non-responders.

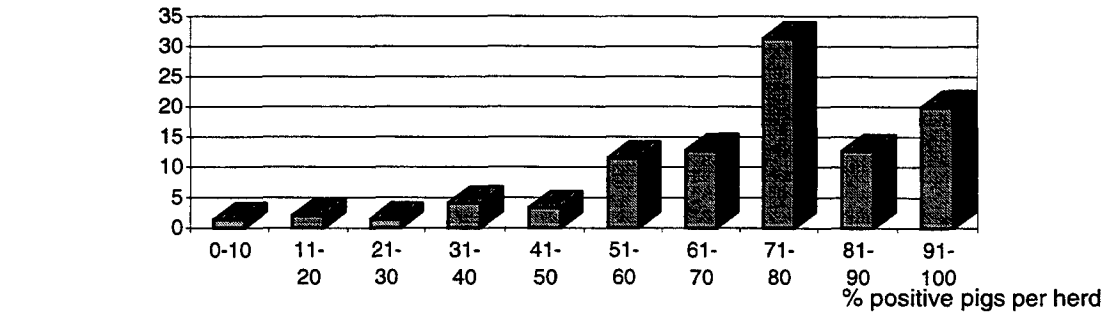
A questionnaire with precise definitions of the data to record was used. The list consisted of potential risk indicators for EP and respiratory diseases in general. General information concerning herd size, season, vicinity as well as information concerning management practices, housing facilities, disease prevention and hygienic measures was collected. The data were obtained by the same researcher through face-to-face interviews of the pig farmers and through inspections of the pigs and the pig units. All data refer to the pigs that were examined at slaughter. From a shipment of 60 to 150 pigs per herd delivered at the slaughterhouse, 25 pigs were blood sampled by systematic selection.

To assess the relationship between seroprevalence of Mh (yes/no dependent variable) and various potential risk indicators (independent variables), a logistic regression model which includes random variation term to account for herd effect (Littell *et al.*, 1996) was used. A forward stepwise procedure (Neter *et al.*, 1990) including first order interaction terms was used to select a subset of variables significantly ($p<0.05$) associated with seroprevalence of Mh. All statistical analyses were performed with the use of generalized linear mixed models (macro GLIMMIX) in statistical programs (SAS version 6.11) provided by the Statistical Analysis Institute.

RESULTS

The overall seroprevalence of Mh was 72%. The distribution of herds depending on the percentage of positive pigs per herd is shown in Figure 1. Seven percent of the herds had a prevalence of 100% and for only 1.3% of the herds, all the sampled pigs were seronegative. The percentage of herds falling between 70 to 80% herd prevalence was 31.4%.

Figure 1
The distribution of herds depending on the % of positive pigs per herd.



The first significant ($p<0.01$) risk indicator was "the number of herds from which breeding pigs were purchased", considered as continuous variable in the logistic model. Pigs from herds which purchased from 1 herd had a 50% risk increase for seropositivity against Mh compared to pigs from herds which didn't purchase. The risk was multiplied by 2.2 for pigs from herds which purchased from more than one herd. The second risk indicator which came out significantly ($p<0.01$) was "the season". The odds ratio for pigs slaughtered in March and April was 3.1, compared with pigs slaughtered in other months. The odds ratios and 95% Confidence Intervals associated with the two risk indicators are shown in Table I.

Table I
Odds ratios and 95 % Confidence Intervals (CI) associated with the number of herds from which pigs were purchased and with the season.

Number of herds	OR	95% CI
0	1	/
1	1.5	1.1-2.0
>1	2.2	1.6-3.0
Season	**OR**	**95% CI**
March-April	3.1	1.5-6.4
Other months	1	/

DISCUSSION

The herds used in this study are considered to be representative for the population of farrow-to-finish pig herds with over 50 sows. Firstly because the herds were selected at random within the selected region and secondly because the herd effect was included as random variation term in the analysis. Moreover, the % of non-responders (13%) after the first selection was acceptable. The shipment of 60 to 150 slaughter pigs per herd was never confounded by many runt or cull pigs nor by the best performers. The process of slaughtering can be considered as a random process and systematic sampling was used to select the fattening pigs out of shipment.

All data were obtained by the same researcher through inspections of the pigs and the pig units and through face-to-face interviews of the pig farmers. The criteria for classifying pigs concerning disease status could be sharply described and characteristics of the DAKO Mh ELISA test matched the preferred standards of sensitivity and specificity (Sörensen *et al.*, 1993). The overall prevalence (72%) is in line with the results of other studies (Wallgren *et al.*, 1993; Yagihashi *et al.*, 1993).

The number of herds from which breeding pigs were bought, was the most significant risk indicator for seropositivity of Mh. Jorsal and Thomsen (1988) found that the number of herds from which swine are purchased significantly increased the risk of reinfection with Mh of SPF herds. Other studies were able to show an association between the purchase of growers and lung lesions (Aalund *et al.*, 1976; Willeberg *et al.* 1978). Since this study concerned only farrow-to-finish pig herds, the influence of purchasing grower pigs could not be investigated. Possibly, purchase of growers is yet a greater risk for seropositivity of Mh than purchase of breeding stock. Purchase of breeding stock mostly involves a smaller number of animals and control for the health status is probably more stringent.

March and April were the months with the highest risk for seropositivity of Mh. July and August were the months with the lowest risk. Since the bi-monthly periods concerned the slaughter date, the fattening period took place in the previous four months. Thus, pigs set up in November and December had the highest risk for seropositivity against Mh in our study. The general monthly variation, however, was not striking. During the fattening period, the mean relative humidity (RH) was highest and the temperature was lowest for pigs slaughtered in March and April. It can be assumed that the seasonal effect was mediated by the RH and temperature. During winter, ventilation is reduced to help maintain temperature. Consequently, the pollution of the atmosphere as well as variations in temperature and RH within the fattening unit are increased. Additionally, cold and moisty weather promotes survival of Mh within the herds and could probably increase the transmission between herds. Indeed, many studies have shown the importance of the season on respiratory disease, particularly on clinical symptoms and lung lesions (Mercy *et al.*, 1988). Reinfection of Swiss SPF pig herds with Mh also showed a clear seasonal pattern, with most reinfections occurring between November and March (Stärk *et al.*, 1992).

In conclusion, it can be stated that Mh infections are very common in Belgian farrow-to-finish pig herds. Additionally, it was shown that purchase policy of breeding stock and the season were associated with an increased seroprevalence of Mh in slaughter pigs. These findings should be considered when implementing preventive medicine strategies to control enzootic pneumonia in pig farms.

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