

Estimating freedom of paratuberculosis in Danish dairy herds



Evan Sergeant¹, Søren Saxmose Nielsen² & Nils Toft²

1) International EpiLab, The National Veterinary Institute, Danish Technical University, Bülowsvej 27, DK-1790 Copenhagen V, Denmark, & AusVet Animal Health Service, Orange, Australia; 2) Faculty of Life Sciences, Department of Large Animal Sciences, Grønnegårdsvej 8 – 1870 Frederiksberg C, Denmark

BACKGROUND

Infection with MAP in dairy herds can lead to significant economic losses.

The prevalence of paratuberculosis in Denmark has been estimated to 85% of dairy herds based on bulk tank milk samples.

Bulk tank milk samples are not sufficiently precise for classification of the paratuberculosis status of Danish dairy herds.

There are no other perfect tests for classification of herds and animals.

Alternatives used in other countries include screening of a sample of the animals within a herd, with subsequent classification of the herd status.

In 2006, a voluntary control programme for paratuberculosis was initiated in Denmark. The control programme aims at reducing the within-herd prevalence of MAP, but there is currently no scheme to classify herds based on MAP status.

Approximately 21% of the Danish dairy farms participate in the programme. A method for establishing the herd status based on existing data would be required if the programme should include a surveillance component.

The programme includes 4 annual whole-herd tests for MAP, using individual antibody milk ELISA tests.

OBJECTIVE

To develop a method for estimation of the probability of freedom from infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP) in Danish dairy herds based on test results from imperfect tests

MATERIALS & METHODS

Model overview

“ParaFree”, a stochastic simulation model was developed to estimate the probability of herd-freedom from MAP.

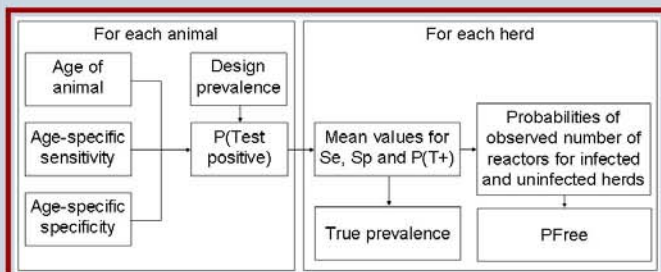
The model included probability distributions of age-specific sensitivity and specificity of two tests, milk antibody ELISA and faecal culture.

A distribution of a realistic Design Prevalence with a mean of 34% and a range of 4% to 85% was included as the threshold for deeming a herd infected.

Calculating PFree and true prevalence

PFree is the probability of a herd having a prevalence of MAP-infected animals lower than the Design Prevalence

The procedure for calculating probability of herd-freedom (PFree) based on age-specific sensitivity and specificity for each animal and design prevalence values is shown in the figure below



Diagnostic Testing

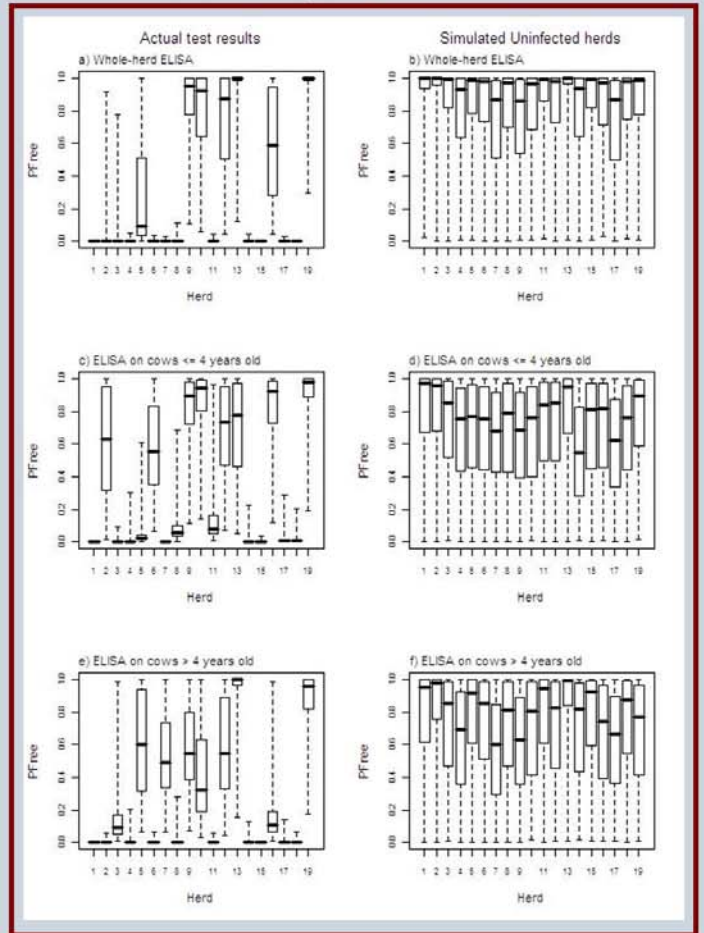
Age-specific sensitivities and specificities of the milk ELISA and the faecal culture methods was obtained from a previous study.

Test results from the first test of 19 infected herds and 19 simulated non-infected herds were used to illustrate the model output

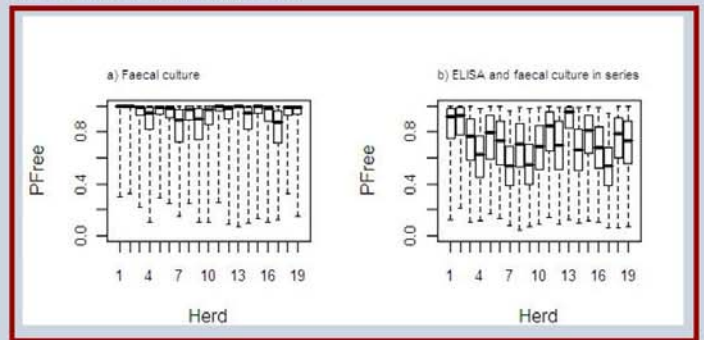
Each cow was tested with a milk antibody ELISA and faecal culture
MAP was isolated from all but one herd (Herd no. 2)

RESULTS

Boxplots of the distribution of values for PFree for ELISA testing in 19 infected and 19 non-infected dairy herds



Boxplots of the distribution of values for PFree for FC testing in 19 infected and 19 non-infected dairy herds



CONCLUSIONS

- Despite imperfect diagnostic tests, it is possible to derive useful PFree and True prevalence estimates
- Among the evaluated strategies, whole-herd milk ELISA provided PFree estimates with less uncertainty than age-stratified samples. Whole-herd milk ELISA was significantly cheaper than whole-herd FC
- None of the strategies had enough power to clearly establish freedom of infection in smaller herds with a younger age-structure
- Repeated testing can be used for updating PFree
- The method can be used for MAP classification of the Danish dairy herds