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Control of Johne's disease in dairy cattle

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ABSTRACT

Control of Johne's disease caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) in dairy cattle has assumed significantly greater attention over recent years. The primary reasons are; possible increasing prevalence, an increase in the number of overseas control programmes, the continued scientific debate about the link with Crohn's disease in humans, and the reported presence of MAP in commercial pasteurized milk sold in retail markets. Johne's disease is a chronic wasting disease of ruminants worldwide. Accurate prevalence data does not exist for New Zealand. The best estimates available currently estimate the annual cost in New Zealand for dairy farmers to be between \$3.8 million (based on 12% herd infection) and \$31.7 million annually. It is likely that with the current control technology available the cost of control would exceed the on farm benefits, and therefore significant market access issues will have to be the basis for implementing a national control programme. For New Zealand to achieve control it is essential that the current prevalence be established and an understanding of the epidemiology within the New Zealand farming system be developed. Unlike many other diseases current tests available for Johne's disease have low sensitivity which results in any testing programme failing to detect significant numbers of infected animals. Current areas being examined include test methods, vaccine and management practice modification. Additionally the possibility of genetic selection for resistant animals may be possible with the molecular genetic capabilities that are currently being developed in the bovine.

Keywords: Johnes; Mycobacterium; avium; subspecies; paratuberculosis; milk; pasteurisation.

INTRODUCTION

Control of Johne's disease caused by

Mycobacterium avium subspecies *paratuberculosis* in dairy cattle has assumed significantly greater attention over recent years. A number of reasons exist for this, the primary ones being:

- The possibility that the prevalence is increasing as a consequence of herd size and increased trading of stock occurring within the industry.
- An increase in the number of control programmes being proposed or implemented instituted in dairy industries internationally, especially where they occur in countries where New Zealand exports milk products in competition with local supply.
- Continued scientific debate about the link between *Mycobacterium avium* subspecies *paratuberculosis* and Crohn's disease in humans. (European Commission B3/R16, 2000).
- The suggestion that viable MAP could be present in commercial pasteurized milk sold in retail markets in the UK (Millar, 1996).

THE DISEASE

Johne's disease is a chronic wasting disease of ruminants worldwide. The clinical disease in cattle is characterised by increasing bouts of diarrhoea, lower milk production, loss of body condition and antibiotics are ineffective. After the onset of continuous diarrhoea animals die within weeks. *Mycobacterium avium* subspecies *paratuberculosis* can survive for more than a year in moist conditions. Cows usually become infected as calves by contact with contaminated manure at parturition, by ingestion of colostrum or milk from an infected cow or by ingestion of feed from contaminated pastures (Kallis, 1998). Transplacental infection has also

been recorded (European Commission B3/R16, 2000). Increasing herd size and trading of stock of unknown disease status have also been identified as risk factors (Kennedy 2001).

The following explores these in the context of the New Zealand industry and identifies both constraints and options that exist to both minimise possible food safety concerns, and reduce the economic impact associated with losses due to Johne's at farm level.

BACKGROUND INFORMATION ON THE NEW ZEALAND DAIRY INDUSTRY

Cow population and farm numbers

There are approximately 3.5 million dairy cows in New Zealand (4.3 million including young stock) which has increased from the static 2 million of the 1970s and early 1980s. Much of this expansion has been at the expense of sheep and beef farming with conversion to dairying, particularly in the South Island. The average herd size is now more than twice that of the 1970s and early 1980s (then 110-120 cows/herd) with about 250 cows per herd. Figure 1 shows the overall herd size distribution. The number of herds has reduced from 16,000 in 1980 to under 14,000 currently.

Dairy regions

Traditionally the North Island has been the home of dairy farming in New Zealand and it still supports 85% of the dairy farming (see Figure 2). The greatest concentration of dairy farms occurs in the Waikato and Taranaki regions (Dairy Statistics, LIC. 2001). In recent years, South Island dairying has expanded rapidly to now comprise 15% of the national dairy herd.

FIGURE 1. Herd size spread for the last 3 seasons

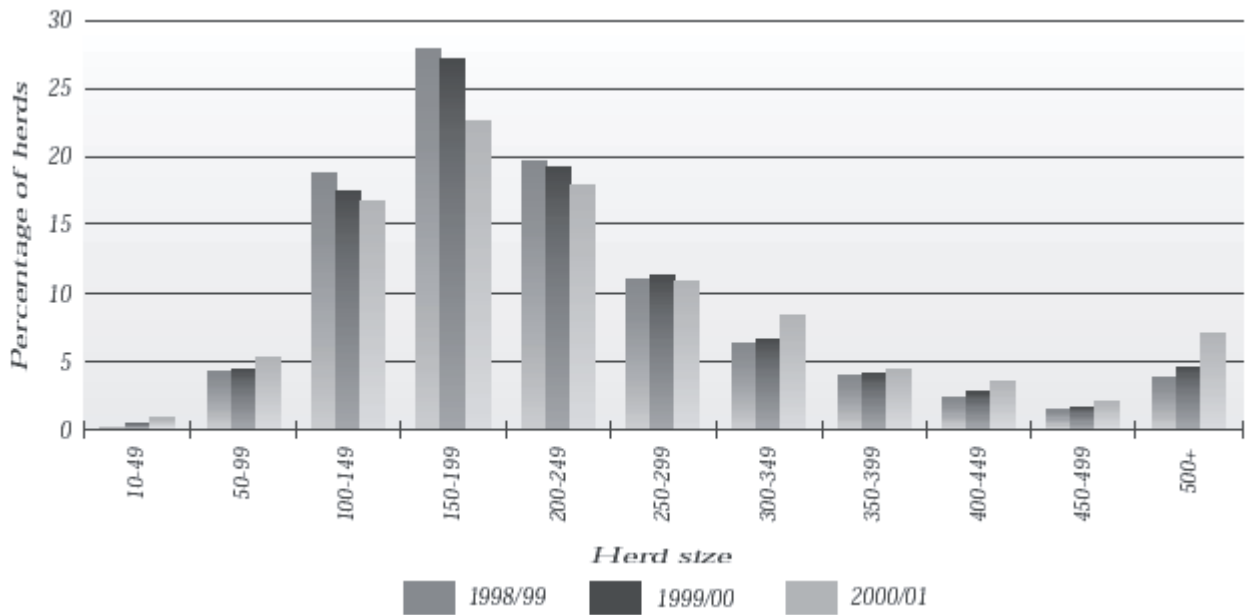
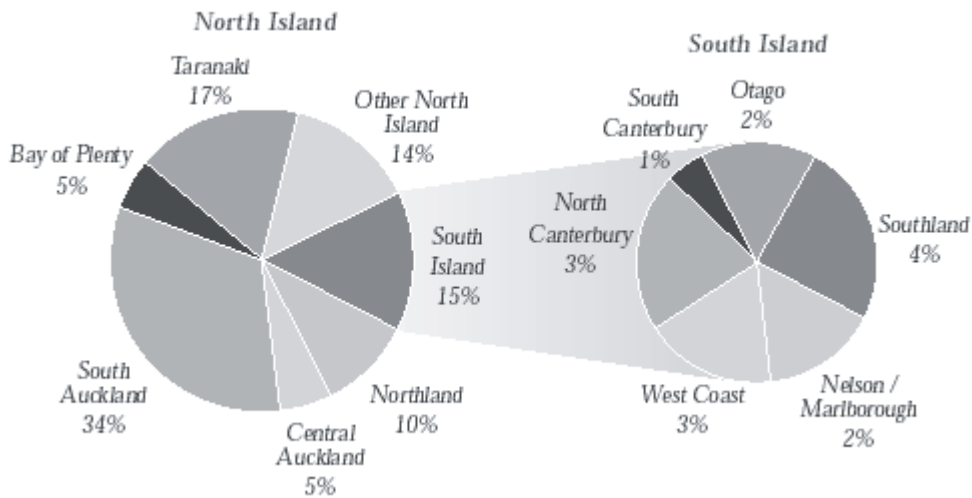


FIGURE 2. Regional distribution of dairy herds in NZ



BREEDS AND COW AGE

The principle dairy breed in New Zealand today is the Holstein-Friesian (56% of the national herd), and together with the Jersey (15%) and H-F x J crossbred animals (21%), these make up 92% of all dairy cattle.

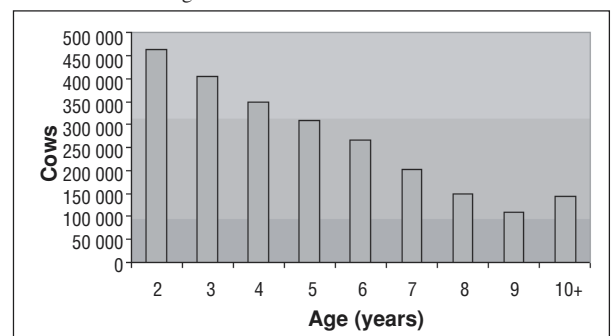
The age distribution of dairy cows in NZ is shown in Figure 3. Mean age is 5 years.

Cow movements

Animal and herd movements are not constrained by disease considerations other than those imposed for tuberculosis. Consideration of Johne's disease status or epidemiology is rarely a factor in stock movement. Current analysis show greater than 1500 herds per annum (about 11% of the national average change location either due to herd owner transfers or change of ownership. Additionally 65,000 to 80,000 cows are traded annually. Further to this an estimated 80% of young stock are

relocated to graziers for raising until they join the milking herd near the time of calving. Graziers routinely tend animals from several clients on a single property, often allowing mingling of stock and may also farm other animals including beef cattle, deer and sheep.

FIGURE 3. Cow age distribution



With few exceptions, NZ dairy farmers use artificial insemination on lactating cows with greater than 80% of cows are inseminated every season. Average AI period is 5 weeks followed by natural mating with purchased sires. Most yearlings are naturally mated. The bulls used for mating are usually of beef bred origin.

Calving

Typically calving is seasonal with a total duration of 3 months. Close contact exists between calving cows on pasture. Mismothering is common. Contamination with soils and faecal material is great with an associated high risk of exposure to infective *Mycobacterium avium* subspecies *paratuberculosis*.

Calf rearing

Once calves are separated from their dams they are reared in groups being fed pooled colostrum or milk. Usually calves are kept under roof for the first few weeks, then grazed outside on paddocks also used for adult cattle grazing.

PREVALENCE IN THE NEW ZEALAND DAIRY INDUSTRY OF JOHNE'S DISEASE

Accurate prevalence data does not exist for New Zealand or many other overseas populations but from the information available it is expected to be similar to those studied elsewhere. Recent data from the Netherlands showed the seroprevalence was 54.7% at herd level and 2.5% at animal level (European Commission B3/R16, 2000). Historical monitoring from New Zealand animal health laboratories identified 12% of herds as infected but this is considered to be an underestimate of the actual situation. Current studies are being initiated to establish true prevalence levels and develop a much better knowledge of the epidemiology of Johne's in New Zealand. Given the known risk factors and the management systems prevailing in New Zealand it is reasonable to assume that the prevalence of the disease will increase if no control measures are put in place to limit this.

ECONOMIC COST

The best estimates available currently estimate the annual cost in New Zealand for dairy farmers to be between \$3.8 million (based on 12% herd infection) and \$31.7 million (assuming all herds infected); most likely \$18.9 million (@ 60% herd prevalence) (Brett, 1998) It is likely that with the current control technology available the cost of control would exceed the benefits, and therefore significant market access issues will have to be the basis for implementing a national control programme.

FUTURE CONTROL

Two areas need to be addressed. These are the control of the disease on farm to reduce prevalence, and the treatment of milk to ensure that viable *Mycobacterium avium* subspecies *paratuberculosis* organisms are not present in product for consumption, and therefore meet consumer concerns. The latter has been the subject of

intense research internationally and within New Zealand. The results from this have shown that under normal milking conditions, bulk raw milk from an infected herd may be contaminated with *M. avium* subsp. *paratuberculosis*. A major source is from faecal contamination of the udder. Animals with clinical Johne's disease excrete *M. avium* subsp. *paratuberculosis* at varying levels in their faeces. Levels as high as 10⁸ CFU/g have been reported (Chiodini, 1984). Direct excretion in the milk is likely to be less significant than faecal contamination (Pearce, 2001). Under conditions of validated turbulent flow pasteurization at 72°C for 15 seconds, it was demonstrated that, in commercial milk or in dairy products made from such milk, viable *M. avium* subsp. *paratuberculosis* are highly unlikely to be present.

Control or eradication of the disease within the farming operation however is extremely difficult. A number of voluntary schemes are in operation overseas and further schemes are under development. Results to date indicate the difficulty that exists in making significant progress in reducing prevalence.

For New Zealand to achieve control it is essential that the current prevalence is established and an understanding of epidemiology within the New Zealand system developed. It must be recognised that unlike many other diseases tests available for Johne's disease have low sensitivity which results in any testing programme failing to detect significant numbers of infected animals. Current areas being examined include test methods, vaccine and management practice modification. Additionally the possibility of genetic selection for resistant animals may be possible with the molecular genetic capabilities that are currently being developed in the bovine.

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