Yersinia pseudotuberculosis and venison hygiene

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INTRODUCTION

Pseudotuberculosis or yersiniosis was identified as a significant cause of deaths in farmed deer during the earliest years of deer farming in this country. It was quickly recognised that mere exposure to the causal organism, *Yersinia pseudotuberculosis,* was insufficient to precipitate clinical disease in the absence of other factors which acted to stress the host or to provide a suitable environment for proliferation of the organism. With improved management, large outbreaks of yersiniosis are far less common yet the organism can still be readily detected in the faeces of clinically normal deer and in their environment. Surveys indicate that about 10% of healthy deer presented for slaughter may be shedding *Yersinia pseudotuberculosis* in their faeces.

Yersinia pseudotuberculosis, like other members of this genus, is capable of growing at a wide range of temperatures. Optimal growth occurs at about 29° C but growth still occurs at temperatures from 4° to 42° C. While *Yersinia pseudotuberculosis* does not compete well with other bacteria at temperatures close to 37°C, its growth is preferentially favoured at refrigeration temperatures (around 4°C) which are inhibitory to many other potential bacterial competitors. *Yersinia pseudotuberculosis* is also facultatively anaerobic so it can still grow at low temperatures even in the absence of oxygen.

Bacteria such as *Yersinia pseudotuberculosis* which are capable of growth at low temperatures are referred to as psychrotrophic bacteria. These organisms have come to assume some significance as food-borne pathogens, particularly in association with the consumption of food which has been stored for prolonged periods under refrigeration and then eaten following little or no cooking. *Listeria monocytogenes* and *Yersinia enterocolitica* are also psychrotrophic and well recognised as pathogens which can be associated with food and cause severe human disease. *Yersinia pseudotuberculosis* is increasingly being recognised as a cause of disease in human beings. This may be expressed as a mesenteric lymphadenitis, septicaemia or immunologically based diseases such as erythema nodosum and arthritis. While it has rarely been proved in individual cases, it is frequently assumed that the infecting organism is derived from food.

Over recent years we have developed, in this department, a particular research interest in psychrotrophic bacteria, especially *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* which are both associated with human disease and which may be derived from food or live animals.

We recognised a potential public health risk when we considered the fact that around 10% of healthy deer entering deer slaughter premises (DSP's) were carrying *Yersinia pseudotuberculosis* in their gastrointestinal tracts and coupled this with the fact that much of the exported venison spends some weeks at refrigeration temperature before it reaches the overseas markets.

Exported venison is frequently shipped as a vacuum-packed, chilled product and, from our knowledge of the growth of *Yersinia pseudotuberculosis*, such conditions would favour continued proliferation of this organism even though growth of other bacteria may be inhibited. We reasoned that it was important to determine whether contamination of deer carcases with *Yersinia pseudotuberculosis* was a common event throughout the year and, secondly, whether this organism proliferated to dangerous levels on venison stored at common refrigeration temperatures. Dr Edwin Bosi, a post-graduate student from Sabah Malaysia, undertook this study.

Is carcase contamination a common event?

Over a one year period, a D.S.P. in the lower North Island was visited on one day each month and samples for bacteriological examination were collected from thirty deer at each visit. At the completion of viscera inspection, a sample of caecal contents was collected and, at the point of entry to the chiller, surface swab samples were taken from the neck, flank and rump.

After cold-enrichment, a selective medium was used for the isolation of *Yersinia spp* which were further characterised by biochemical tests and serology.

Of the 360 samples of caecal contents, 19 (5.3%) yielded *Yersinia pseudotuberculosis*. Most of these isolates were made in the winter months ; 8 in May, 4 in June and 5 in July, with only single isolates being obtained in October and January.

None of the surface swabs from carcases yielded *Yersinia pseudotuberculosis*.

These results indicate that, so long as good hygienic work practices are in place, it is possible to produce deer carcases that are free of *Yersinia pseudotuberculosis* even though the same deer are carrying this organism in their intestinal tracts (more than 25% of the deer had the organism in their intestinal contents when sampled in May).

Does *Yersinia pseudotuberculosis* proliferate on venison?

This question was addressed by deliberately inoculating a culture of *Yersinia pseudotuberculosis* onto the surface of samples of venison which were then vacuum-packed and stored at a range of temperatures including those commonly used for commercial storage. At various times after inoculation, samples were recovered and the number of viable *Yersinia pseudotuberculosis* enumerated by titration. The results are illustrated in figure 1 and show that *Yersinia pseudotuberculosis* continues to grow on venison stored at +4°C and, less rapidly, at -1°C. In each case the increase in the count of organisms was around 10,000 fold.

When stored at -10°C or -20°C there was no proliferation of the bacteria but, if the samples were moved to +4°C after storage for 8 weeks at the lower temperatures, then proliferation occurred and high numbers of bacteria were demonstrated after four to five weeks at the higher temperature.

This study clearly shows that *Yersinia pseudotuberculosis* is capable of proliferating to high levels on venison at -1°C or +4°C over a time period similar to that involved with shipments of chilled venison to European markets. Whilst frozen venison did not support growth at -10°C or -20°C, proliferation occurred when the venison was thawed and held at refrigeration temperatures, albeit for time periods longer than would be expected in usual circumstances.

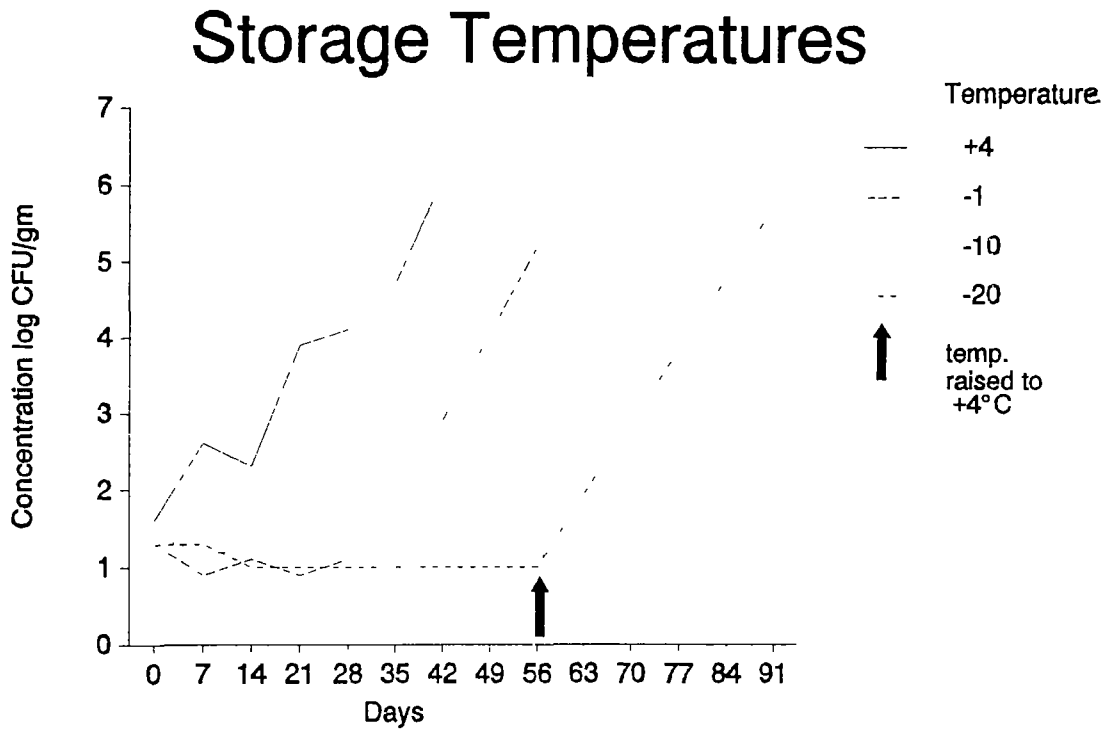

Fig. 1. Growth of *Yersinia pseudotuberculosis* on vacuum-packed venison at different temperatures.

Summary and Discussion

This study demonstrated that, although many deer carry *Yersinia pseudotuberculosis* in their intestinal tracts, carcase contamination can be avoided if good practices are followed. The danger is greatest in the winter and there is probably value in minimising stressors on the animals at this time to reduce shedding at the time of slaughter.

If contamination of venison does occur, even at low levels, *Yersinia pseudotuberculosis* is able to proliferate dangerously under storage conditions commonly employed in the industry. Of particular concern is the fact that such proliferation, in the absence of normal spoilage organisms, can not be detected by smell or appearance of the product.

The first report of food contamination with *Listeria monocytogenes* in New Zealand involved a sample of smoked venison pâté in 1989. Whilst this was probably due to contamination from the environment rather than derived from deer, public perception linking infection with a particular animal species could be extremely harmful. For reasons of both public health and maintenance of overseas markets it is well worth ensuring that the standards of hygiene in the industry are sufficient to avoid the presence of *Yersinia pseudotuberculosis* in products derived from deer. It is likely that prevention of contamination of the carcase with faeces or intestinal contents is the most critical point in the production process.