

# Intestinal spirochaete infections in commercial, captive and wild birds

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## Introduction

The purpose of this article is to draw to the attention of Avian Veterinarians a group of fastidious anaerobic bacteria that are becoming increasingly recognised as pathogens of birds. Whilst nothing is known of their significance in caged birds, intestinal spirochaetes of the genus *Serpulina* are emerging as common and important pathogens of broiler, breeder and layer hens. They also frequently colonise wild water birds, and some other species. Wild birds may act as reservoirs of infection for other species, including human beings.

## The genus *Serpulina*

The genus *Serpulina* is currently considered to include six named species, as well as other groups. *Serpulina hyodysenteriae* is the agent of swine dysentery, a major endemic disease of pigs in Australia, and elsewhere. Although day-old chicks can be experimentally infected with *S. hyodysenteriae*, natural infection of poultry with this species has never been recorded. In the US, however, farmed Rheas (*Rhea americana*) in several states recently were reported to have developed a severe typhlocolitis, and this was eventually shown to be due to infection with *S. hyodysenteriae* (Jensen *et al.*, 1996).

The other named species in the genus include *S. innocens*, *S. murdochii*, *S. intermedia*, *S. alvinipulli* and *S. pilosicoli*. The first two species are thought to be non-pathogenic commensals, but, as discussed below, the latter three species are now all considered to be potentially pathogenic in poultry. *S. pilosicoli* is particularly important since, besides birds, it is also a pathogen of pigs, dogs and human beings, causing a condition called intestinal spirochaetosis (Hampson and Stanton, 1997).

All the species can be cultured at 37 - 41°C under anaerobic conditions on selective Trypticase Soy Agar supplemented with 5% blood, 400 mg/ml spectinomycin and 25 mg/ml each of colistin and vancomycin. A thin haze of growth is apparent after 3 - 5 days, although negative plates should be rechecked after 10 days. *S. hyodysenteriae* is strongly beta haemolytic, whilst all the other species cause only weak haemolysis.

## Intestinal spirochaetes in poultry

Over the last 10 years there have been a series of reports of intestinal spirochaetes being a cause of production problems in laying hens and pullets in Europe and the USA (Davelaar *et*

*al.*, 1986; Griffiths *et al.*, 1987; Swayne *et al.*, 1992; Trampel *et al.*, 1994). Problems reported in infected birds have included wet droppings, increased faecal fat content, diarrhoea, pasty vents, reduced growth rates, delayed onset of egg laying, faecal staining of eggshells, reduced egg weight, and reduced carotenoid content of eggs (Davelaar *et al.*, 1986; Griffiths *et al.*, 1987; Swayne *et al.*, 1992; Dwars *et al.*, 1990, 1992a, 1992b, 1993; Trampel *et al.*, 1994).

Unfortunately all these studies were limited by a failure to adequately identify the bacteria involved. This was the case even where spirochaetal isolates from diseased birds were used experimentally to reproduce disease in layers (Dwars *et al.*, 1992a). To try to clarify this situation we therefore undertook a study to identify these organisms. Using the technique of multilocus enzyme electrophoresis (MLEE) on a large collection of spirochaetes we had isolated from commercial laying hens and broiler breeders in Australia, as well as isolates from the previous studies in Europe and the USA, we were able to show that these actually included representatives from six species groups in the genus *Serpulina* (McLaren *et al.*, 1997). Isolates that had been identified as being pathogenic by overseas workers belonged to the species *S. intermedia*, *S. alvinipulli* or *S. pilosicoli*.

Strains of *S. intermedia* and *S. pilosicoli* were found amongst both the European and Australian isolates. *S. alvinipulli* was only found amongst the US isolates. Although *S. intermedia* was the most common of the three pathogens overall, it was not identified amongst the US isolates examined.

All three species colonise the caecae, and may induce a mild typhlitis. *S. intermedia* and *S. alvinipulli* can be found free in the caecal lumen and colonising the crypts. *S. pilosicoli* characteristically attaches by one cell end to the caecal epithelium to form a dense layer of attached spirochaetes which can appear like a false brush border over the epithelium. In humans, *S. pilosicoli* colonises the large intestine, but has also been recovered from the bloodstream of critically-ill human patients (Trott *et al.*, 1997). Whether similar local and systemic spread occurs in birds and other species is not known.

### **Prevalence of intestinal spirochaetes in Western Australian flocks.**

A study of 37 layer flocks and 30 broiler breeder flocks in Western Australia, involving selective culture of 567 faecal samples, showed evidence of intestinal spirochaetes in 35.1% and 53.3% of these flocks respectively (McLaren *et al.*, 1996). Flocks with signs of diarrhoea or reduced production were significantly more likely to be colonised than were healthy flocks. Overall, 38% of the W.A. isolates that were characterised were identified as *S. intermedia*, with the rest belonging to non-pathogenic species. A single isolate of *S. pilosicoli* was obtained but this came from a flock in Queensland.

### **Experimental infection with *S. intermedia*.**

Experimental infection of laying hens with one of these Western Australian strains of *S. intermedia* significantly increased their faecal moisture content (from a mean of 77.1% to 80.3%), and significantly reduced their daily egg production (from a mean of 0.69 eggs/hen/day to 0.51) and their average egg weight (from 45.67 g to 44.56). These results were consistent with those reported in the Netherlands in experimentally-infected layers (Dwars *et al.*, 1992a), in that case using a spirochaete strain that we later identified as also being *S. intermedia* (McLaren *et al.*, 1997).

### **Intestinal spirochaetes in avian species in zoological collections.**

In a survey involving culturing cloacal swabs from 122 captive birds from eight Orders held in Columbus Zoo, Ohio, intestinal spirochaetes were isolated from only five birds (Stoutenburg *et al.*, 1995). These included isolates from two species of duck, a black swan, a flamingo and a rhea. In a more recent survey in Perth Zoo, involving faecal culture of 113 birds from 15 Orders, only a single pink duck was culture positive (S.L. Oxberry, 1996, unpublished data). In both these studies, apart from the Rhea, only water birds were colonised.

### **Intestinal spirochaetes in wild birds.**

In a 1993 survey of feral waterfowl shot in Ohio, intestinal spirochaetes were observed in 50 of 57 caecal smears from nine species of Anseriformes (Swayne and McLaren, 1997). Again this demonstrates that water birds are often colonised with spirochaetes. To investigate this further, and especially to investigate the possibility that water birds may serve as a reservoir of infection for other species, particularly human beings, we cultured faeces from 43 feral water birds present around the lake at Perth Zoo. We also cultured seven samples of water from sites around the lake (Oxberry and Hampson, 1997).

Spirochaete-like bacteria were seen in 32 of the 43 faecal samples, although spirochaetes were only isolated from 20 samples (46.5%). Most of these isolates were not identified to the species level, but eight (18.6%) were positively identified as *S. pilosicoli*. Similarly, *S. pilosicoli* was isolated from three (42.8%) of the lake water samples.

These findings confirm that intestinal spirochaetes, and particularly *S. pilosicoli*, commonly colonise wild water birds. Their faeces also may contaminate water supplies, so that directly or indirectly such birds may act as a source of infection for commercial poultry, other animals and human beings.

### **Conclusions**

Infections with intestinal spirochaetes are now known to be common, and a cause of economic loss to the poultry industry in Europe, the USA and in Australia. There are at least three different pathogenic species involved; *S. intermedia*, *S. alvinipulli* and *S. pilosicoli*.

In the US, farmed Rheas have also developed severe typhlitis following natural infections with *S. hyodysenteriae*. Most birds in zoological collections do not appear to be colonised, but intestinal spirochaetes colonise both captive and wild water birds. It is not known if these infections are detrimental to the health of the birds, but feral ducks may be a source of infection for other species. The possible zoonotic spread of *S. pilosicoli* from ducks to humans, either directly from faeces or via faecally-contaminated water, deserves further investigation.

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