A research project commenced three years ago in Ireland in order to identify the predominant causes of leg weakness and to suggest possible control methods. Following longitudinal microbiological and histological investigations, bacterial chondronecrosis with osteomyelitis of the proximal end of the femur and/or tibiotarsus (BCF/T) was identified as one of the main causes of lameness in commercial broilers.

Clinical signs and diagnosis of BCF/T

During this study, it was noted that lame broilers, with BCF/T subsequently diagnosed by histology, often used a wing tip for support on the affected side/s (Figures 1 and 2). Affected birds rapidly became dehydrated and lost weight as they were unable to access drinkers and feeders.

At necropsy, the femur was carefully removed from the hip-joint to avoid traumatic damage which could have obscured a small lesion in this region. On macroscopic examination, BCF/T was suspected either in the proximal end of the femur (Figure 3) or tibiotarsus or in both sites of one or both legs, when a small abscess was observed in the region of the growth plate. Approximately 40% of BCF/T lesions were suspected by eye, the remaining lesions were diagnosed by microscopic examination.

Predominant causal agents of BCF/T

Staphylococcus aureus was the predominant bacterium recovered from over 100 cases of BCF/T diagnosed in birds submitted from separate commercial broiler production sites. Escherichia coli, Staphylococcus xylosus, Staphylococcus hyicus, mixed infections of E.Coli and staphylococcal species, Staphylococcus lentus, Staphylococcus saphrophyticus, were also recovered, less frequently, from BCF/T lesions.

Incidence of BCF/T in male broilers

The number of broilers (a) culled due to lameness and (b) found dead were recorded daily throughout 843,000 commercial broilers. In total, 27 houses of male and 18 houses of female broilers were surveyed. The average incidence of lame culls and total mortality in male flocks was 0.5% and 4.7% respectively, and in female flocks was 0.38% and 2.8% respectively.

All dead and lame birds from four male flocks were submitted for skeletal examination on one day/week,
from week one until slaughter (Table 1). The proximal end of the right and left femur and tibiotarsus from a total of 341 birds collected from flocks 1, 2, 3 and 4 were examined by histology. The incidence of BCF/T in the birds examined from flocks 1 to 4 was 3.8%, 10%, 33.9% and 33.3% in lame culls, and 4%, 13.3%, 18.6% and 10% in the mortalities respectively. BCF/T was the main cause of lameness in three out of these four flocks. It is likely that losses due to BCF/T in male flocks are similar throughout the broiler industry thus representing considerable economic loss.

**What factors influence lameness in broiler flocks**

The 45 broiler houses surveyed for lameness were visited and a questionnaire completed by each site manager. Information was obtained on factors such as: breed; hatchery of origin; day of hatch; chick management; diet; lighting patterns; feeding; housing; stocking density; age at thinning; medication; disinfection regimes and vaccination.

The findings were statistically analysed in relation to the percentage of birds culled due to lameness in these houses. A significantly higher incidence of lameness was recorded in birds hatched from eggs collected from the floor (‘floor eggs’) compared to eggs collected from the nest box (‘clean eggs’). ‘Floor eggs’ are likely to have higher levels of faecal bacterial contamination than ‘clean eggs’, this may be a factor in the higher incidence of lameness recorded in birds hatched from floor eggs.

A significantly higher incidence of lameness was recorded in birds fed from pan/tube type feeders compared to trough feeders. Trough feeders may require human intervention to maintain feed availability. Periods of feed absence, resulting in poor growth rate, may decrease the incidence of BCF/T, by limiting bacterial access to cartilage through gaps which develop between endothelial cells in the rapidly elongating blood vessels of the fast growing growth plate. Alternatively, the lay-out of equipment on the floor of the broiler house may also be of importance. Pan-feeders are easily manoeuvred to optimum feeding heights thereby facilitating ease of feeding. Conversely, an outer line of trough feeders may act as a barrier to a trough-feeding line placed centrally, thus requiring increased locomotion to get to available feed. This finding could suggest that increased mobility may be associated with the lower incidence of BCF/T seen in trough-fed broilers.

A significantly higher incidence of lame culls were recorded in birds vaccinated against infectious bursal disease virus (IBDV) compared to birds which were not vaccinated. High standards of site biosecurity are recommended on all broiler premises to reduce the possibility of contact with infectious agents and immunosuppressive agents such as IBDV. Flocks of broilers, vaccinated against IBDV infection following an outbreak of clinical disease, may have had poorer site biosecurity than unvaccinated sites. Therefore poor biosecurity may be a contributory factor to the development of BCF/T. It is interesting to note that the lowest incidence of BCF/T, seen in the four flocks examined by histology, occurred in a flock with no history of disease due to IBDV.

**An experimental model of BCF/T in broilers**

The lack of a disease model for BCF/T, using a natural route of infection, has hindered research into the control of this condition. Therefore, a series of experiments was carried out with the aim of developing a model of BCF/T in broilers. Day-old chicks were exposed to S. aureus by a natural route. The incidence of S. aureus recovered by bone, and BCF/T diagnosed by histology, was higher when chicks were subsequently infected with (chicken anaemia virus) CAV and IBDV at three weeks. Simultaneous exposure to S. aureus, CAV and IBDV at three weeks of age resulted in a lower incidence of S. aureus recovery and BCF/T. The findings suggest that chicks exposed to S. aureus at day-old may be more likely to develop BCF/T than chicks exposed at three weeks, particularly if day-old chicks are subsequently infected with CAV and IBDV.

**The effect of feed restriction**

The effect of reduced feed intake on the incidence of BCF/T in broilers was examined using the disease model of BCF/T developed by the Veterinary Sciences Division of the Department of Agriculture in Northern Ireland. When feed was reduced to 60% of the recommended breed standard feeding rate after seven days of age, a significantly lower incidence of S. aureus was recovered and/or BCF/T diagnosed in broiler bone tissues. Further studies into the effect of reduced growth rate, at various stages of production, may yield valuable information on the control of BCF/T.

**Hatchery investigation**

Bacteriological examinations of fluff samples collected from inside hatchers revealed S. aureus, other staphylococcal species, coliform organisms, enterococci and fungal contaminants. S. aureus infection of hatchery fluff samples was associated with the hatchings of ‘floor eggs’. Whether hatchers contained a small or large number of ‘floor eggs’ (<3% or >70% of 15,000 eggs), similarly high S. aureus colony counts were present in hatcher fluff samples. Disinfection of the inside of the hatchers appeared to eradicate S. aureus infection from within the hatchers since the organism was not detectable in fluff samples collected from consecutive hatchings.

Experimental studies, using the disease model of BCF/T, compared the degree of bone infection and BCF/T in chicks hatched from ‘clean eggs’ and from ‘floor eggs’. A significantly higher incidence of bacterial infection and/or BCF/T was recovered from bone samples of chicks hatched from ‘floor eggs’, supporting...
an association between the use of ‘floor eggs’ and infectious causes of leg weakness.

**The efficacy of Tylan™ against BCF/T**

Again using the disease model of BCF/T, an experiment was designed to test the efficacy of an antibiotic (Tylan™) to prevent the development of BCF/T in broilers. Groups of chicks in isolators, fed ad libitum, were exposed to *S. aureus* at day-old and infected with CAV and IBDV on day 21. Treatment was administered to one group on days 1, 2 and 3 and on day 21 at the rate of 0.5μg/litre of water, a further group was untreated. *S. aureus* was recovered from untreated birds 13 days earlier than from the treated birds. *S. aureus* was first recovered and BCF/T diagnosed shortly after CAV and IBDV inoculation in the treated group. These findings suggest that the use of an antibiotic such as Tylan™ on day 1, 2 and 3 may delay recovery of *S. aureus* from viscera and bone by 13 days. However, birds may be reinfected, possibly from the environment, despite treatment at 21 days.

**Prevention of BCF/T in broilers**

Maintenance of a high standard of hatchery and production site biosecurity would appear to hold the key to decreasing the incidence of BCF/T. Prevention of infection by bacteria, especially *S. aureus*, and immunosuppressive viruses is likely to result in a reduced incidence of BCF/T in broilers. Since exposure to *S. aureus* at day-old is likely to result in higher levels of bone infection, emphasis should be placed on decreasing bacterial infection of the hatching egg. Fertile ‘floor eggs’ were shown to be an important source of bacterial contamination in the hatchers and, preferably, should be discarded. If used, floor and clean eggs should be incubated and hatched separately. Regular bacteriological examination of hatching eggs and hatcher fluff samples is recommended to evaluate bacterial contamination present. — Perpetua McNamee MRCVS, Veterinary Sciences Division Omagh, Co Tyrone, Ireland.

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