ROSS

Ross Tech 01/40

leg health in broilers

Good leg health in broilers ensures optimum performance and is integral to maintaining a high standard of bird welfare.

Flocks of broilers with good leg health grow faster, have better FCR and produce fewer processing downgrades. Good carcase quality is paramount when the final product is marketed fresh and as portions.

This Ross Tech identifies the types of leg problems which may be seen in broilers and describes ways to reduce their incidence and thereby improve leg health. It reviews new research including important work demonstrating how good hatchery hygiene can improve leg health in broilers.

Within Aviagen there has always been a commitment to improving the skeletal quality of broilers.

The knowledge gained from scientific research has been combined with the practical experiences of stockmen over many years to produce a comprehensive system for classifying leg defects.

HISTORY

Lameness can be attributed to non-infectious conditions, infectious conditions, a combination of both, and on some occasion a synergistic interaction of both. Surveys by government bodies in Europe during the 1980's indicated that bone deformities and tibial dyschondroplasia were the main cause of lameness. These non-infectious causes of lameness were tackled by intense genetic selection. The success of the selection programme is demonstrated by the more recent published surveys of lameness in broilers which show a marked reduction in the incidence of skeletal disorders. The most common causes of lameness are of infectious or nutritional cause.

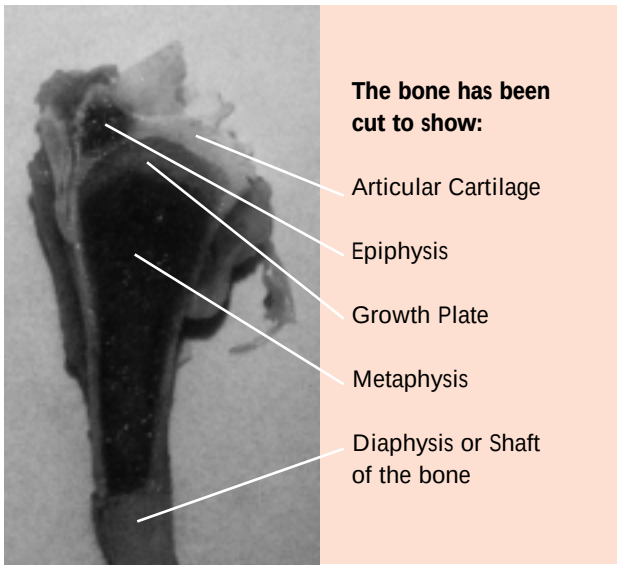
STRUCTURE AND GROWTH OF BONES

A knowledge of the basic structure and normal growth of bones is necessary for an understanding of how leg problems develop in broiler chickens.

A long bone consists of a shaft or diaphysis. At each end there is a metaphysis, growth plate and epiphysis covered in articular cartilage. See Diagram 1.

Long bones grow by a process known as endochondral ossification. Bone-forming cells proliferate in the growth plate. They enlarge and the cartilage becomes mineralised and is replaced by bone. The normal growth plate is about 0.5-1mm thick.

DIAGRAM 1: Proximal Tibia from a 42 day old broiler.



ABNORMAL DEVELOPMENT

There is variation in leg structure and shape as a result of normal growth and development. Birds at the extremes of this variation can be described as having leg problems. Occasionally, the mechanisms involved in controlling growth may fail and abnormal development can occur. The incidence of these types of abnormality is increased as a result of environmental or nutritional stress (eg. high stocking density or rickets).

Listed below are some of the abnormalities which together with less common defects are detectable on live birds and have been used to identify those individuals and families susceptible to leg weakness. Aviagen breeding programmes incorporate this type of classification system to ensure continued leg health in Ross broiler stock.

INDIVIDUALS WHICH ARE PREDISPOSED TO DEVELOPING LEG PROBLEMS ARE NEVER USED FOR BREEDING PURPOSES

VALGUS/VARUS DEVIATIONS OF TIBIA OR FEMUR

The leg is deformed such that the limb or part of the limb deviates laterally or medially which, in severe cases, makes walking difficult. The tibia or femur may bend inwards or outwards. The leg may deviate to such an extent that injury results when the bird is caught and handled at depletion. This causes the carcase to be downgraded or even rejected.

ABNORMAL ROTATION

The leg bones (ie tibia or femur), twist during growth so that the lower leg is held out of normal alignment. In severe cases, walking can be difficult. The abnormal shape of the leg may cause the bird to be injured at catching or when handled at the processing plant, resulting in downgrading.

CROOKED TOES

The toes are bent out of the normal straight alignment. In mild cases walking ability is unaffected, but in very severe cases, birds experience difficulty in walking.

PLATE 1: Lixiscope in use.

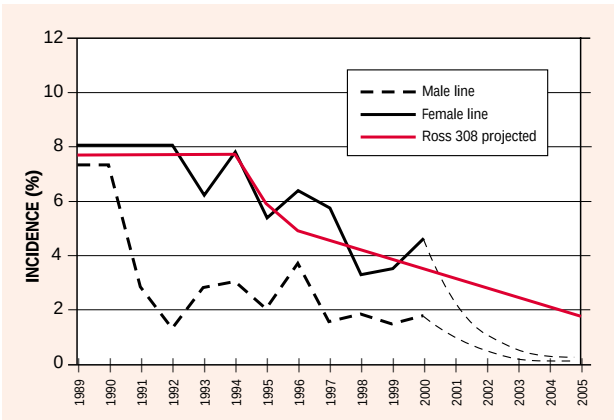
TIBIAL DYSCHONDROPLASIA

Tibial Dyschondroplasia (TD) is a developmental condition of the growing tibia where cells derived from the growth plate fail to develop properly and remain as cartilage instead of becoming bone tissue. The bone is weakened and can become deformed resulting in walking problems and injury at catching or in the processing plant.

Research has shown that X-rays can be used to identify TD and Aviagen has used a portable, real-time, X-ray camera (ie the Lixiscope), for this purpose. See Plate 1.
Diagram 2 shows reduction in the incidence of this condition in Ross pure lines since 1989. TD now occurs only rarely in Ross broilers.

Other systems have been used to identify birds with poor leg health. One of these, a method of assessing the walking ability of individual birds according to a Gait Score, has been reported to give an accurate estimate of leg weakness. Research carried out in Ross breeding stock has shown that there is a significant association between Gait Score and the methods used by Aviagen to assess leg health.

DIAGRAM 2: Graph of reduction in incidence of Tibial dyschondroplasia through time



FEEDING AND LEG STRENGTH

Deficiencies of nutrients can lead to a variety of leg disorders, some of which are described below. In practice marginal nutrient levels will aggravate any predisposition to poor bone development and to abnormalities. Poor growth rate, and in particular poor litter condition, associated with feed will also aggravate the incidence of leg weakness. Some feed ingredients (eg rapeseed meal, sorghum) appear to have a direct effect on leg health although the mechanisms of these effects are not well understood.

Food intake control and diet dilution with whole wheat will reduce the absolute intake of the nutrients necessary for good leg health. Whilst most feeds include generous safety margins, the possibility of inducing a marginal level of supply should always be considered. Actual daily intakes of critical nutrients should be compared with target levels for birds of similar weight and growth. See Ross Broiler Management Manual.

RICKETS

Field occurrence of clinical rickets is now rare although sub-clinical rickets may be present and predispose birds to other leg problems.

Calcium (Ca), phosphorus (P) and/or vitamin D3 deficiency or imbalance cause rickets. Differential diagnosis is sometimes possible by microscopic examination of the rickets lesions. An excess of one mineral (eg calcium) results in a deficiency of the other (eg phosphorus).

In some cases phosphorus availability may be lower than expected especially where novel sources are being used or diets rely on the availability of phytate phosphorus with insufficient phytase present. If phosphorus levels are regulated for environmental reasons, a close check on rickets should be maintained. Availability of calcium may be reduced by the presence of certain fats or by high phytate levels. Available calcium may be approximated using the following equation provided the additional effects of soap formation with saturated free fatty acids are also considered.

Available Ca = Total Ca - 1.1 x (Total P - non-phytate P)

Rickets in broilers may also result from a failure of intestinal absorption and may be associated with runting-stunting or enteritis syndromes.

In birds with severe rickets the keels are crooked, the legs bowed, the ends of the long bones enlarged and the bones soft and rubbery. Birds may show a stiff-legged gait. The main effect of sub-clinical rickets is a thickening of the growth plates with few other pathological signs. However sub-clinical rickets in early growth may be a factor contributing to bone deformity or fracture. The analysis of the ratio of calcium to phosphorus in ashed bone samples can also assist in the diagnosis of rickets; the normal ratio of Ca:P is approximately 2:1.

TIBIAL DYSCHONDROPLASIA

The effect of nutrient supply on tibial dyschondroplasia (TD) is complex and has been the subject of much investigation. The possibility that certain vitamin D compounds may alleviate TD has been suggested but this research has not yet led to practical application. Electrolyte balance is the most important nutritional factor and close attention should be paid to controlling this and maintaining chloride levels below a maximum of 0.22%.

Occasionally field outbreaks of TD in broilers appear as a result of marginal dietary inadequacy of calcium. This causes mild sub-clinical rickets at 2 weeks of age which is subsequently seen as TD in birds aged 4-6 weeks.

FEED INGREDIENTS AND LEG WEAKNESS

Feed ingredients which result in wet litter (eg barley), will often be associated with an increase in leg weakness. Enzyme supplementation of the feed may be beneficial in such circumstances. Some ingredients appear to induce leg defects directly. Sorghum and rapeseed meal are obvious examples of such an effect. The presence of tannins and/or phytate in these ingredients is the most likely explanation and in the case of sorghum, the adverse effects are seen only in high-tannin varieties. The importance of feed ingredients however, may be more general; even different soyabean meal samples have been shown to influence the incidence of TD. As noted above, the use of dietary fats with high free fatty acid levels may also interfere with mineral absorption and availability and might, in certain circumstances, induce leg weakness.

INFECTIOUS CAUSES OF LEG WEAKNESS

Recent internal trials have confirmed that the Ross Breeders' programme of genetic selection is continuing to improve skeletal quality and leg health. TD is now uncommon in Ross broiler stock and additional advances will be achieved by concentration on reducing the infectious causes of lameness.

Infectious causes of leg weakness are most commonly seen in the hock joint and surrounding tendons (eg tenosynovitis). The joint becomes hot and swollen and the bird is lame. Staphylococcus is the most common infectious agent found, but reoviruses and Mycoplasma may also be identified. All the infectious bone disorders cause irreversible damage to bones and joints, therefore lame birds should not be placed in hospital pens but should be culled.

Effective and early culling of lame birds removes possible sources of infection and may reduce spread within the flock.

INVESTIGATION OF INFECTIOUS DISORDERS

Accurate identification of the cause of any infectious problem usually requires the expertise of the local veterinarian. Background information on general flock health, litter quality and management will be required. Feed samples may be collected for mineral analysis as may serum samples for viral and mycoplasma serology. Lame birds should be culled carefully without introducing further leg damage, and used in post-mortem examinations.

REOVIRUS

Reovirus may cause tenosynovitis and viral arthritis in 4-8 week old broilers, though outbreaks can be seen in broiler breeders at peak production. Although vertical transmission (ie from mother to chick) of reovirus can occur, the main route of spread is by horizontal transmission (ie site contamination resulting in bird to bird contamination within a flock). Early infection is controlled very effectively by good levels of maternal antibody. Vaccination may be used for control of this condition, but vaccine strains may give only limited cross-protection between reovirus serotypes.

MYCOPLASMA

Mycoplasma synoviae (MS) and occasionally *Mycoplasma gallisepticum* (MG) can cause abnormalities in joints and lameness. The Ross biosecurity programme ensures that all Ross parent and grandparent stock are supplied free of mycoplasmal infection. To confirm infection with Mycoplasma, specific antibodies must be demonstrated or the Mycoplasma isolated and identified. Both vertical and horizontal transmission occur and the prevention of the spread of infection in multi-age sites is difficult. The many drugs available tend to suppress mycoplasmal infection rather than eliminate it. Vaccination against Mycoplasma infection is effective in some situations.

PREVENTION OF INFECTION IS THE KEY TO CONTROLLING MYCOPLASMAL INFECTION

BACTERIAL ARTHRITIS

Staphylococci are the bacteria most frequently identified in cases of bacterial arthritis. The pathogenesis appears to be similar to that for Femoral Head Necrosis (FHN) and is discussed in more depth below. The presence of reoviral arthritis or mycoplasmal infection may predispose joints to bacterial infection. To treat bacterial arthritis the sensitivity of the infectious agent must be established. Antibiotic therapy will prevent new cases, but will not cure established arthritis.

FEMORAL HEAD NECROSIS (FHN)

This condition is also known as Proximal Femoral Degeneration (PFD). Birds may be identified by a trembling gait, in which a wing provides support. The lameness is due to a bacterial infection in the head of the femur. Separation of the cartilage from the bone on dis-articulation of the hip joint can be a post-mortem artefact and histopathology or bacteriology may be required to establish a diagnosis. The infection gets to the bone from the respiratory tract or gut via the blood. Actual infection is often only within a small focus, but the area of tissue damage is far more extensive. Routine bacteriology swabs will not always detect the bacteria and routine histology may fail to identify the lesion. Bacteriological culture requires the proximal femur to be crushed and the bone and cartilage cultured in media. Histological examination will often require interrupted serial section and Gram's stain.

Antibiotics cannot readily penetrate the bone and birds with FHN will not recover even with antibiotic treatment.

IMPROVING LEG HEALTH THROUGH MANAGEMENT

Losses associated with poor leg health tend to be quite variable across sites, but unfortunately, once present are often very consistent within a site. In affected flocks losses of 1-4% of the birds placed can be incurred. These losses can usually be attributed to culling from 21 days of age. Once infectious problems have taken hold in a flock there may be little positive action which can be taken for that flock. Action can be taken, however, to prevent recurrence, and the following section describes what can be done to prevent repeated episodes of FHN.

CONTROLLING INFECTION

Research at Veterinary Services Division of the Department of Agriculture at Stormont in Northern Ireland has demonstrated that birds can be infected with *Staphylococcus aureus* through the lungs, and that infection can result in up to 50% of the infected birds developing FHN. The finding that the aerosol infection route is important has highlighted several possible sources of infection that were previously dismissed.

CONTAMINATED HATCH DEBRIS AND CHICK FLUFF IN THE HATCHERY ARE MAJOR SOURCES OF BACTERIAL INFECTION

The chances of cross-infection are much increased when floor eggs are set in the same machines as nest eggs. These findings emphasise further the importance of hatching egg hygiene. See Ross Parent Stock Management Manual. Cross-infection can be reduced by effective formalin fumigation in the hatchers when the eggs are just starting to pip. See Table 1.

TABLE 1: Guidelines for fumigation in the hatcher.

Duration	Solutions	Volumes
from pipping to 6 hours before take-off.	Formalin solution diluted 1:1 with water (final concentration of 17-18% Formalin).	60ml solution/m3 of hatcher in pans with surface area of 50cm2/m3.

NB All local regulations regarding safe use of Formalin in the workplace should be followed.

Longer term prevention must include careful monitoring in all machines of levels of *S. aureus.* Sources of *S. aureus* can then be identified, and eliminated.

Field observations have shown that on sites where leg health has been a problem, efforts to clean up the water supply for the young chick can be effective. Open bell or cup drinkers rapidly become contaminated with bacteria, including *S. aureus* if it is already present on the site.

IT IS GOOD PRACTICE TO MONITOR THE QUALITY OF WATER COMING INTO THE FARM AND PRECAUTIONS SHOULD BE TAKEN TO PREVENT THE BUILD-UP OF PATHOGENS IN DRINKING SYSTEMS

Chlorination or UV treatment of the water may be found to be beneficial. The most effective way of providing constant supplies of clean water to the chicks is to use a nipple drinker system which does not require a drip cup. Such systems have the additional advantage of improving litter conditions and reducing downgrades at processing.

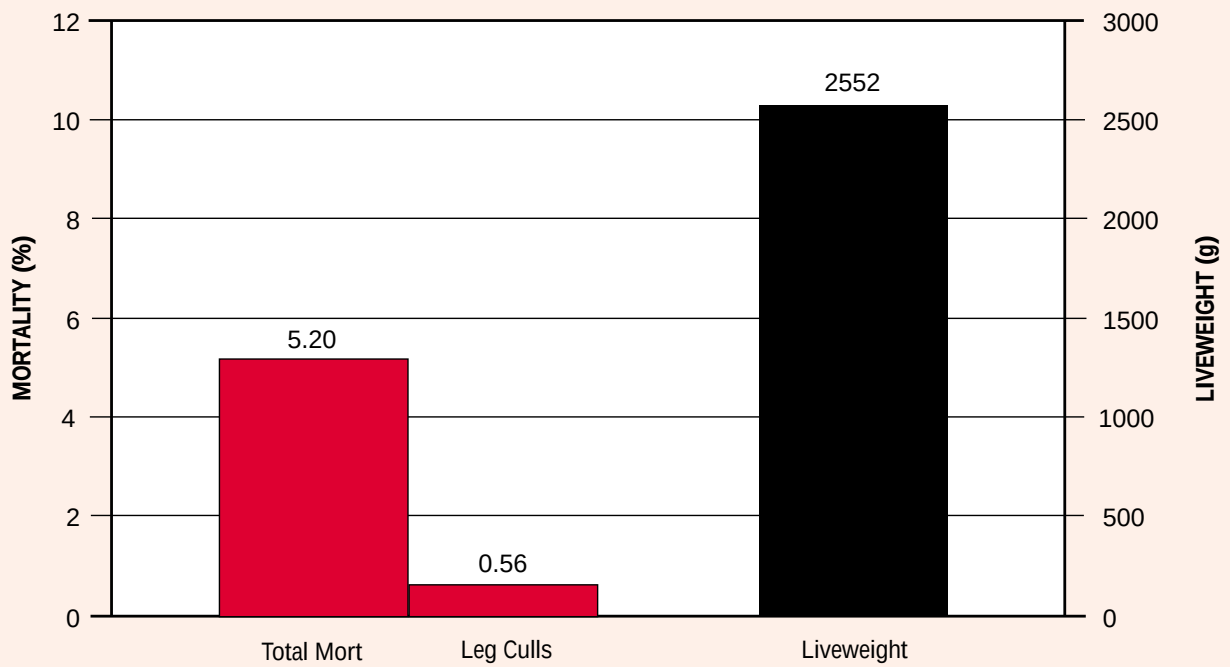
Immuno-suppressive viruses can make birds more vulnerable to infection. Problem sites need special care to make sure that maternal immunity and/or vaccination for IBDV, CAV and Marek's Disease are adequate.

CONTROLLING GROWTH

Programmed feeding and lighting help to limit metabolic disease. However there are some benefits to leg health from exposing the flock to defined periods of darkness each day. Lighting programmes impose distinct patterns of rest and activity on a flock of birds. Both may be important in improving leg health; even simple observation of a flock will highlight the increased activity during periods of light. Lighting programmes for different production situations are described in the Ross Broiler Management Manual. This should be the starting point for individual broiler producers to decide upon the most appropriate programme for their particular situation.

Mortality resulting from leg weakness is monitored routinely by Aviagen in their broiler trials. Trials carried out during 2000 have shown that Ross 308 can achieve liveweights of in excess of 2.5kg at 42 days with total mortalities of 5.2%. Mortalities and culls due to poor leg health account for less than 0.6% of the flock (See Diagram 3). Product trials are carried out on 23 hours light and 1 hour dark with conventional UK stocking densities, without antibiotic growth promoters or coccidiostats. This high level of performance is a result of balanced selection and good biosecurity which allow broilers to express their genetic potential for performance whilst showing improved leg health.

DIAGRAM 3: 42 day Mortality, leg culls and liveweight for Ross 308 (as hatched) in Aviagen internal trials carried out during 2000.*



* no growth promoters, no coccidiostat

Providing broiler producers with the latest information on leg health through this Ross Tech will help them to achieve the objective of optimising the welfare and performance of their birds.

This information comes to you from the Technical Team of Aviagen. Although it is considered to be the best information available at the present time, the effect of using it cannot be guaranteed because performance can be affected substantially by many factors including flock management, health status, climatic conditions etc.

Every attempt has been made to ensure the accuracy and relevance of the information presented. However, Aviagen accepts no liability for the consequencies of using the information for the management of chickens. Data presented in this Ross Tech should not therefore be regarded as specifications but illustrate potential performance.

For further information on the range of technical literature available for Aviagen Stock please ask your local Technical Services Manager or contact our Marketing Department at:

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