

Starting to unravel the secrets of Black Bone Syndrome

At a recent symposium in the USA, Bob Fleming of The Roslin Institute, The Royal (Dick) School of Veterinary Studies at The University of Edinburgh, Scotland, gave an interesting presentation on Black Bone Syndrome in broilers.

Black Bone Syndrome is a consumer acceptance issue of on-the-bone chicken products that is characterised by meat and bone discolouration.

It appears to be related to redness in fresh poultry meat, which can become a blackness during storage and/or cooking.

It might be as simple as a leakage of blood or bone marrow on to bone surfaces and surrounding meat.

The syndrome is shown in the pictures and much of the information we have on this syndrome is anecdotal from consumers, producers and field scientists.

Meat discolouration

Meat discolouration is nothing new and was reported by Lyon & Lyon in 2002 as 'a discolouration of raw or cooked tissue that can occur from cell disruptions and blood migration caused by slow chilling rates' and 'colour of cooked meat adjacent to the femur that was affected by a combination of chill temperature and other factors'.

Smith & Northcutt in 2004 highlighted the



Examples of Black Bone Syndrome.

bone marrow as the primary cause of meat redness and that 'bone darkening has been shown to be related to the freezing of bone in parts prior to cooking'.

However, they also stated that there was 'a variation in reports regarding the effects of freezing and cooking and even raw bone observations on the development of darkening'.

In 2006 Jennifer Saunders-Blades and colleagues reported that the inclusion of 25-OH D3 in the diet of broilers from 0-41 days of age was shown to increase consumer acceptance of thigh meat.

They felt that this was due to changes (improvements) to bone mineralisation that may have reduced the incidence of black discolouration of the thigh meat next to the

femur. The present studies at the Roslin Institute were set up to:

- Investigate the standardisation of recording of Black Bone Syndrome.
- Examine the prevalence of the condition in market samples.
- Investigate the likely cause of Black Bone Syndrome.
- Examine whether supplemental HyD (DSM Nutritional Products Ltd) could reduce porosity in bones, thereby reducing the possibility of marrow leakage.
- Examine the correlation between Black Bone Syndrome and other bone parameters.

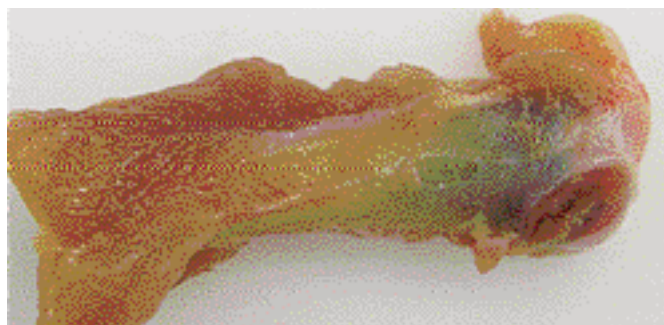
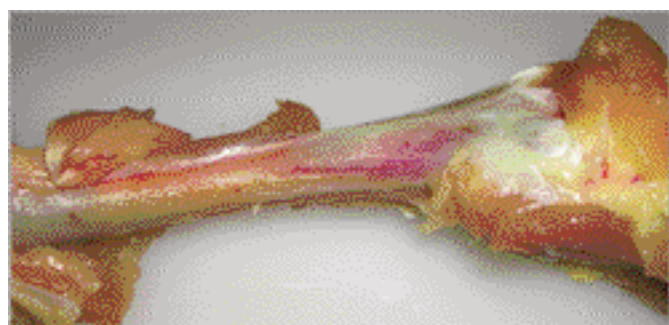
Increased bone porosity

So, what is bone? Bone is a dynamic living material with a 15-20% turnover per year. It is an ion reservoir for the body (for example, over 99% of the bird's Ca^{++} is in bone) and there are three types of bone (see Table 1). As a living tissue it contains bone forming cells or osteoblasts, osteocytes and osteoclasts which resorb and remodel cartilage and bone.

Bone growth and development occurs by endochondral ossification in the growth plates of bones, which increases bone length, and by intramembranous ossification which increases bone width.

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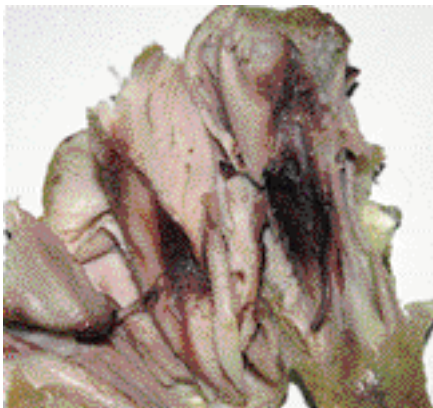
Initial appearance of Black Bone Syndrome.



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The detrimental effect of a rapid increase in bone length is well understood but the detrimental effects of increases in bone width are less well studied. However, it is thought that increased bone porosity, together with reduced mineralisation, are likely explanations for the poorer mechanical properties of tibiotarsi observed in fast growing broilers and this may help to explain the increased fracture risk in such birds. So, if we revert to basics, it is imperative that the calcium:phosphorus ratio is correct and it is very important in determining the vitamin D needs of the broiler.

Black Bone Syndrome in cooked thigh meat.



COMPACT BONE

- 80% of skeletal mass.
- Outer surface of all bone but mainly found in long bones.
- Haversian system arrangement normally present.

CANCELLOUS (TRABECULAR) BONE

- 20% of skeletal mass.
- Forms largest part of vertebral bodies.
- Anisotropic to resist deformational stresses.
- Large surface area – most metabolically active part of the skeleton (except in the laying hen).

MEDULLARY BONE

- A woven bone similar to that in healing fracture callus.
- Presents the laying hen with a labile Ca^{++} store.
- Isotropic and spicular but not structural unless in abundance.
- Largest surface area and rapid turnover.

Table 1. The three types of bone.

Vitamin D can be as high as >5,000 IU per kg, whereas in the grower phase the vitamin D requirement is much lower but should be at least 800 IU per kg.

The results of the Roslin studies can be summarised as follows:

- Photographic and colorimetric techniques provide an acceptable way for assessing Black Bone Syndrome.
- Black Bone Syndrome appears to be common in on-the-bone supermarket samples, particularly if frozen.
- The most likely cause of this condition is

discolouration by bone marrow pigmentation seeping through the highly porous bone.

- It appears that HyD can mitigate the effects of Black Bone Syndrome but cannot entirely prevent it in frozen samples.
- Correlations with other bone parameters were weak.

Bob felt that future work should concentrate on the exact commercial procedures for chilling/freezing and storage of on-the-bone products and further investigate the beneficial effects of HyD. ■