Are keel bone fractures a growing problem for the layer-hen industry?

Discusses the skeletal health of layer hens, using keel bone fractures as an indicator.

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Introduction

Several important issues must be taken into consideration when assessing layer-hen welfare. These include food, shelter, freedom from pain and disease, and the degree to which hens can express natural behaviours and cope with sometimes stressful environments (Lay *et al.*, 2011). In layer hens, skeletal health issues are of growing welfare concern due to their violation of two of these principles, causing severe debilitation and pain in those affected (Richards *et al.*, 2011). The most common problems include osteoporosis and bone fractures, of which up to 90% involve the keel bone (Lay *et al.*, 2011: Käppeli *et al.*, 2011).

Discussion

Avian osteoporosis, a disease characterised by a decrease in mineralised structural bone, is associated mainly with conventionally caged layer hens (Lay *et al.*, 2011). However, Wilkins *et al.* (2011) showed that these layer hens have the lowest levels of bone fractures, despite having very fragile bones and a consequently increased susceptibility to bone fractures. Their research suggested that increasing levels of floor space and hen activity could significantly improve bone strength. On the other hand, inadequate housing, genetic factors or nutritional intake of calcium, phosphorus or vitamin D can predispose layer hens to osteoporosis (Lay *et al.*, 2011).

Arguably of more concern are layer hens housed in barn and free-range systems. Although these hens may perform more of their natural behaviours due to increased space and access to diverse resources, they are significantly more prone to keel bone fractures than conventionally caged hens, despite having increased bone strength as a result of increased levels of activity (Lay *et al.*, 2011: Wilkins *et al.*, 2011). Those housed in systems with aerial perches are particularly susceptible (Wilkins *et al.*, 2011). Perches can be advantageous in that they allow hens to exhibit their natural perching behaviours and thus are a great source of environmental enrichment and improved bone strength, but landing failures can result in bone fractures when hens jump off between perches (Wilkins *et al.*, 2011). In a recent Swiss study by Kappelli *et al.* (2011), moderate or severe keel bone deformities could be found in more than 25% of laying hens. This figure increased to 55% when slight keel bone deformities were included. These fractures were detected by palpation along the edge of the keel bone to detect alterations, such as S-shaped deviations, bumps, depressions or proliferations. In a separate study by Wilkins *et al.* (2011), layer hens in furnished cages had the lowest mean level of keel bone deformities (36%) while flocks housed in systems equipped with multilevel perches had the most severely deformed keel bones and the highest levels of keel bone damage (more than 80%). Fracture calluses were evident upon histological examination of moderately and severely deformed keel bones, suggesting a traumatic etiology. Therefore, it is likely that collisions and landing accidents with perches are the cause of these bone fractures.

Furthermore, a layer hen will land with a force four times her bodyweight at a perch height of 30cm, but an increase in perch height to 60cm will result in a landing force seven times her bodyweight. A corresponding increase in poor landings from 2% to 39% can be measured at these heights

(Sandilands *et al.*, 2010). Wilkins *et al.* (2011) also made informal observations that descents to slats or litter from very high perches appeared to result in increased impact velocities and subsequently less controlled landings. This suggests that there is an increased opportunity for trauma, particularly if obstacles are placed at or above ground level in flight paths between perches. As the impact of landing increases, the possibility of keel bone trauma increases; maximum perch heights above both litter and slats corresponded with the highest mean severity and prevalence of keel bone fractures (Wilkins *et al.*, 2011). Thus we can deduce that an anticipated increase in flight velocity during perch descent may result in a higher risk of keel bone damage.

Gross skeletal damage has major welfare implications. Bone fractures are likely to result in extreme pain, especially given chickens are known to possess sensitive pain perception mechanisms (Hocking *et al.*, 2005). Moreover, most hens survive the immediate trauma of a keel bone fracture and undergo a six-week period of healing thereafter, when they are not only subject to the debilitating pain and discomfort caused by the keel bone fracture, but are also restricted in their access to food, water, nest boxes, range and perches (Richards *et al.*, 2011). This is a serious violation of the five freedoms of animal welfare.

Fortunately, there are a number of methods that may improve the skeletal health of layer hens without compromising their welfare. Direct measures to improve bone strength and thus decrease the occurrence of osteoporosis include dietary supplementation with Vitamin D and the selection of genetic lines with better mineralised bone (Kim *et al.*, 2011). On the other hand, keel bone fractures could be minimised by lowering the heights of perches and strategically arranging them to reduce the overall number of obstacles between perches (Käppeli *et al*., 2011). Lowering stocking densities could also lower the risk of keel bone trauma by increasing floor space for landing, but may reduce the economic efficacy of extensive systems (Wilkins *et al.*, 2011).

Conclusions

Skeletal health is a major animal welfare issue in extensive systems. Poultry farmers are faced with the ethical dilemma of having either conventionally caged layer hens with very weak bones due to osteoporosis, or non-caged hens with massive incidences of keel bone fractures. It must be noted that while provision of facilities, such as perches and floor space, in barn and free-range systems are hugely beneficial for bone strength and expression of normal behaviours (both of which are comprehensively reduced in battery cage systems), these benefits come at a trade-off for severely debilitating and painful keel bone fractures. More research must be conducted on the sustained improvement of skeletal health by looking at animal husbandry requirements and management of these different housing systems to uphold the five freedoms of animal welfare.

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