



Housing, Keel bone deformations in Swiss Laying hens and pullets and the influence of perch type and added Vitamin D on Keel Bone Deformations in Hybrids and Breeders

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Key words

Keel bone, laying hen, computer tomography, three-point bending, bone mineral

Aim of the study

Aims of the project were to assess the prevalence of keel bone deformations and fractures of Swiss laying hen flocks during rearing and production. The differences between breeders and hybrids were experimentally investigated as well as the influence of perch material and a vitamin D additive. The potential role of poor bone quality was investigated in this study by comparing damaged and healthy bones using PQCT scans, three-point bending tests of the tibias, and by examining the calcium and phosphorus content in the bone ash. It was tested whether the differences correlated with the severity of damage. We wanted to find out if future studies and efforts should be focused on an improvement of bone quality in addition to adaptations of the environment to prevent keel bone damage in laying hens.

Material and methods

Forty-two Swiss end-of-lay flocks were palpated. The experimental study consisted of 2 experiments. In the first experiment, 4,000 Lohmann Selected Leghorn hens were raised in aviary systems until 18 wk of age. Two factors were investigated: perch material (plastic or rubber-coated metal) and feed (with and without HyD). Afterward, the hens were moved to a layer house with 8 pens with 2 aviary systems. Daily feed consumption, egg production, mortality, and feather condition were evaluated. Every 6 wk, the keel bones of 10 randomly selected birds per pen were palpated and scored. In the second experiment, 2,000 Lohmann Brown (LB) hens and 2,000 Lohmann Brown parent stock (LBPS) hens were raised in a manner identical to the first experiment. During the laying period, the hens were kept in 24 identical floor pens but equipped with different perch material (plastic or rubber-coated metal). The same variables were investigated as in the first experiment. To study bone quality left tibias and keel bones of 120 hens from 10 different flocks were collected and keel bones were palpated. Bones were examined by peripheral quantitative computer tomography (PQCT) and three-point bending test. Bone ash and calcium content were also analyzed.

Results and significance

The prevalence of keel bone deformations and fractures in Swiss flocks was comparable to other countries and there was considerable variation among flocks. No keel bone deformities were found during the rearing period in either experiment. During the laying period, deformities gradually appeared and reached a prevalence of 35% in the first experiment and 43.8% in the second experiment at the age of 65 and 62 wk, respectively. In the first experiment, neither HyD nor the aviary system had any significant effect on the prevalence of keel bone deformities. In the second experiment, LBPS had significantly fewer moderate and severe deformities than LB, and rubber-coated metal perches were associated with a higher prevalence of keel bone deformities compared with plastic perches. The LBPS laid more but smaller eggs than the LB. Again, HyD did not affect the prevalence of keel bone deformities. However, the significant effect of breed affiliation strongly indicates a sizeable genetic component that may provide a basis for targeted selection. Although the presence of keel bone damage was not associated with body mass there was a positive correlation between body mass and the severity of damage. Ultimate shear strength was significantly higher in birds with intact vs. fractured keel bones. Likewise, birds with intact or slightly deviated keel bones had higher mineral and calcium contents of the keel bone than birds with

fractured keel bones. Calcium content in keel bones was correlated with calcium content in tibias. PQCT yielded results opposite to expectations with higher cortical and trabecular contents in fractured than in intact keel bones which might be due to structural bone repair after fractures. Density measurements did not differ between individuals with and without fractures. Although there were some associations between bone traits related to bone strength and keel bone damage, stochastic events related to housing like falls and collisions might be very important for the prevalence of keel bone damage.

Publications, posters and presentations

Käppeli, S.; Gebhardt-Henrich, S.G.; Fröhlich, E.; Pfulg, A.; Schaublin, H.; Stoffel, M.H. (2011) Effects of housing, perches, genetics, and 25-hydroxycholecalciferol on keel bone deformities in laying hens. *Poultry Science* **90**, 1637–1644

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The following manuscript was submitted to Brit. Poult. Sci.: Gebhardt-Henrich, S.G.; Pfulg, A.; Fröhlich, E.K.F.; Käppeli, S.; Guggisberg, D.; Liesegang, A.; Stoffel, M.H. "Relationship between keel bone damage and bone properties measured with computer tomography, three-point bending test, and analyses of minerals in Swiss laying hens".

Poster at 30. Poultry Science Symp. Glasgow 2011. Käppeli, S.; Gebhardt-Henrich, S.G.; Fröhlich, E. Keel bone deformities in laying hens

Presentation at the European Poultry Conference, Stavanger 2014. Gebhardt-Henrich, S.G.; Pfulg, A.; Liesegang, A.; Käppeli, S.; Stoffel, M. Correlation between keel bone deformities and bone parameters in Swiss laying hens

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