Maintaining successful performance in the older laying hen

Calcium (Ca) is the most abundant mineral in an organism and up to 95% of it can be found in bones. In birds, Ca additionally plays a crucial role in egg shell formation.

Ca-metabolism in birds has to be in perfect working order, independent of whether the egg weighs 2.5kg (ostrich), 500g (kiwi bird; 15-20% of the female BW) or less than 0.5g (certain hummingbirds).

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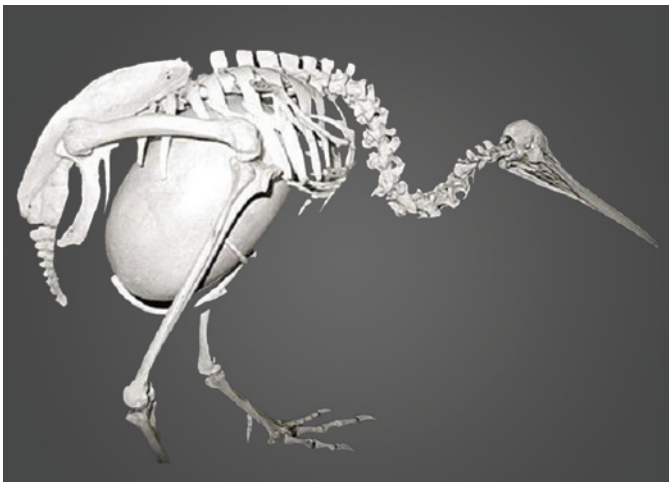
As egg shell formation is so important for these animals, birds have developed additional means to maintain proper egg shell quality. Apart from the usual mechanism of Ca-absorption and -deposition, a special bone structure, the medullary bone, has evolved in these animals since the age of the dinosaurs. This structure acts as an additional Ca-storage and Ca-source in times of egg deposition. As medullary bone is specifically designed for Ca-storage in relation to egg shell formation it is only present in reproducing female birds.

Another challenge for proper egg shell formation is the fact that Ca can only be stored in bone. This is due to the fact that an excess of Ca in the wrong places such as in the blood or within the cells, is toxic for the body. Therefore, the whole process of absorbing, storing and releasing Ca at the right time in the right amount is crucial for the formation of a solid egg shell.

In contrast to wild birds, laying hens are selected and bred to constantly produce eggs. Egg shell quality in layers is not a necessity for the survival of the embryo but of economic importance. As a result, the requirement for a laying hen in regard to Ca output is completely different to wild birds as enough Ca for more than 300 eggs during the production period needs to be provided. To ensure good egg shell quality and to prevent osteoporosis or other Ca-depletion diseases, different approaches are used to support the laying hen. The easiest way is to support egg shell formation with a sufficient amount of Ca throughout the whole laying period. As egg shell formation happens during the dark phase, addition of a long lasting (coarse) Ca-source is one way to support the hen in producing high quality egg shells. Other means include the supplementation of (organic) trace minerals.

In regard to Ca however, the mineral first needs to be absorbed. This is done actively and passively in the gut with the help of vitamin D. Because of this mechanism, another way to maintain egg shell quality is the supplementation of sufficient amounts of vitamin D. However, this molecule needs two conversion steps to become metabolically active in the body: one in the liver, the second in the kidneys. This conversion takes time and properly working liver and kidneys. In older laying hens, this may prove to be a challenge as not only the absorption of Ca in general is reduced but very often also the functionality of the organs. In combination with increased egg weight, egg shell quality rapidly becomes an issue.



Representation of a Kiwi carrying an egg.

The amount of 1,25-dihydroxy-cholecalciferol ($1.25(OH)_2D_3$), the metabolic active form of vitamin D, cannot be increased by increasing levels of vitamin D. Thus, directly supplementing $1,25(OH)_2D_3$ could avoid delays in conversion and the effect is independent of the functionality of the liver and the kidneys. A natural source is the plant waxy-leaf nightshade (*Solanum glaucophyllum*). This plant, native to South America, naturally produces $1.25(OH)_2D_3$-glycosides ($1.25(OH)_2D_3$-gly).

This means, the molecule has sugar residues attached which protect it from degradation. In the body, the glycosides are cleaved by intestinal enzymes and the free molecule can be absorbed, directly influencing the Ca-transporting proteins located in the gut wall. Therefore, providing the hens with $1.25(OH)_2D_3$-gly on top of the usual vitamin D supplementation helps to quickly cover increased needs of $1.25(OH)_2D_3$ and to maintain egg shell quality.

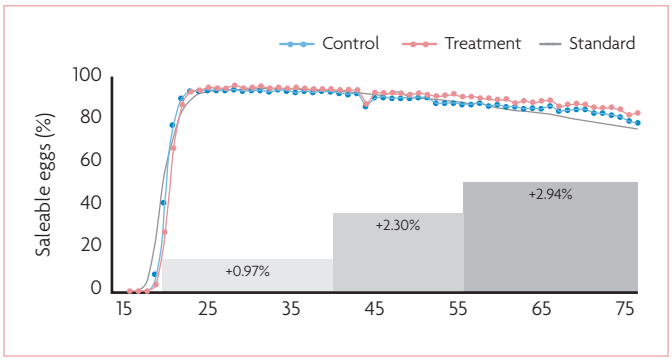
In a field trial with two groups of 12,000 Lohmann Brown hens each, the hens either received a standard commercial diet from week 18-75 or the standard diet supplemented with 100g/t of a standardised mixture of waxy-leaf nightshade.

The results showed that the effect on laying rate was more pronounced the older the laying hens were. Overall difference in saleable eggs was 2.1% in favour of the treatment, being the smallest in the first laying phase and the largest in the final laying phase.

In conclusion, it can be said that the addition of a standardised mixture containing waxy-leaf nightshade meal to the standard feed of laying hens is beneficial for performance. It especially helps older laying hens to maintain their performance and supports them in producing high quality eggs until the end of the laying cycle.

The results are also valid for breeders to mitigate conflict between weight gain and egg production. ■

Fig. 1. Differences in saleable eggs in laying hens given either control diet (blue) or control diet supplemented with a standardised mixture of waxy-leaf nightshade meal (red). The grey line represents the standard values for Lohman Brown layers.



References are available from the authors upon request