A Literature Review on Feed Fortification for Egg-laying Hens

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HEALTHIER HENS

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INTRODUCTION

This technical informative aims to show results from studies about the importance of the feed's composition that can supply adequate levels of essential nutrients and minerals that will contribute to the health and general welfare of the laying hens. When well feed, hens will also be able to better face the challenges of egg production, relieve possible pain and other problems such as fractures, bone deviations or osteoporosis.

The concern with laying hens is not new, especially because they are kept, according to type of systems or husbandry, in low welfare conditions, and changes in their performance. The ancestors of these birds, for example, naturally produced about 10-15 eggs per year, but in commercial breeding, they underwent genetic improvement and laid over 300 eggs per year. This fact already indicates the importance of feeding birds to meet their needs around egg production.

For the hens, each egg requires a large amount of nutrients such as calcium, phosphorus and vitamin D3. For example, when a hen begins the process of developing an egg, bone constituents can be mobilized to provide roughly 40% of calcium for the eggshell. With factory farmed hens now laying 30 times the amount of eggs than they would naturally, their mineral and vitamin deficiencies may recur. These deficiencies can be observed regardless of the production system and lead to constant pain and increased mortality rates.

INTRODUCTION

According to background research by Healthier Hens, a non-profit organization which aims to improve the welfare of laying hens through the dissemination of information about feed fortification, indicates that feeding patterns of laying hens are inadequate in several producing countries with eggs production (Figure 1). The vertical dotted line represents the optimal levels found according to a preliminary report on hen feed fortification.

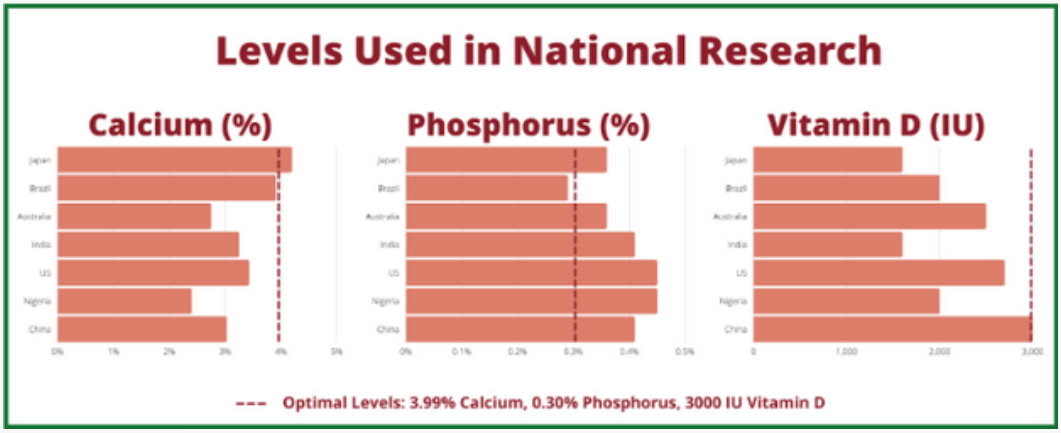


Figure 1: Levels of calcium, phosphorus and vitamin D supplied to laying hens in some countries (Adapted from Healthier Hens, 2021)

HISTORY OF POULTRY NUTRITION

Up to the 1930s, chickens were not getting the best diet possible and were predominantly fed home grown cereals or human food scraps – a practice still in use in several developing countries and subsistence farming systems. A shift from backyard production to confined systems has led to the need for increasingly balanced and complete diets. Through research, feed manufacturers were able to create a diet containing proteins, amino acids, vitamin premix and other elements that met the different stages of growth of the hens.

In 1944, the National Research Council published the first edition of Nutrient Requirements of Poultry describing reference diet formulations. The last edition was published in 1994, establishing a reference value of 3.25% calcium, 0.25% phosphorus and 3000 international units (IU)/kg for laying hens. However, much current work shows that these levels are insufficient for the production and, more importantly, for the welfare of the hens.

Nutrition is not the only contributor to improving the welfare of hens, it is important to rethink the husbandry system and genetics. Cage-free systems provide a greater degree of welfare for birds, but there are challenges that come with these systems and hens need special attention. For example, the transition from caged to cage-free systems requires an upgrade in nutrition and genetics, as both are currently optimized for caged systems.

Unfortunately, many studies are also focused on the performance of the hens and neglect the welfare of these birds. This too must be rethink, due the growing concern of consumers, researchers and legislators in relation to animal welfare.

WHY SHOULD WE CARE ABOUT POULTRY NUTRITION?

Evidence suggests that key nutrients can be optimized to decrease hen mortality, increase bone strength, and decrease fractures and cases of osteoporosis. With the lack of global welfare standards and the absence of an updated nutrient requirement of poultry benchmark, Healthier Hens, through your first review about feed fortification and its project that aims to improve the nutrition of laying hens, has demonstrated the positive impact of an adequate feed on the hens' welfare.

Even with the increasing transition from poultry farming to cage-free systems, hens are still vulnerable to welfare issues such as hours spent in pain from undetected fractures. Although fractures can also be caused by egg size, traumatic events, type of perch, bone quality, it has been found that in addition to solutions in the environment, improving the hens' feed can reduce the possibility of experiencing this pain.

POULTRY BONE HEALTH

Laying hens are active animals, so proper bone development and bone integrity are vital to their health. According to research carried out with hens in Belgium, the most common problems experienced by these birds were hematomas, wounds, keel bone fractures and deviations.

Once fractures occur, healing is generally seen to be a lengthy process in laying hens, occurring within 6 to 8 weeks for most chickens. However, research also recorded relatively delayed and even lack of healing in up to 16% of the chickens analysed. This suggests that chickens that suffer fractures may be in pain and suffering for a significant portion of their lives. A study that evaluated radiographs found that these hens may suffered from keel bone fractures and also experienced negative affective states similar to depression, lasting at least 3 weeks, in addition to lower concentrations of sodium, phosphorus and calcium. It is clear that the dietary composition of the feed is an important factor that has a significant effect on bone development, health, and layer hen welfare.

FRACTURE EVALUATION TECHNIQUES IN LAYING HENS

The evaluation of fractures in hens (in vivo and ex vivo) can be performed by methods that use portable radiography and ultrasonography equipment, in which fractures are detected with greater precision and in a less invasive way. Unfortunately, the previously mentioned techniques are still considered expensive for the farmers, so palpation is the most commonly used way to detect fractures, but it is considered an imprecise method and depends on adequate training of the evaluator.

HOUSING SYSTEMS

Although access to exercise is shown to increase bone strength, one study indicated that cortical bone, the densely structured part of bone that gives strength to birds, had a lower degree of mineralization, and the mineral bone was less mature and organized in birds specially kept in cages. Development is complex, but exercise provided both opportunity for bones to develop, but also increased the risk of injury, especially when chickens have poor motor skills due to poor facility-related design.

In general, pain caused by bone fractures is seen as a major welfare issue, followed by behavioral restrictions, especially in systems with cages. However, given that we are seeing progress in the transition from cage-free systems, bone health appears to be the next issue to be addressed to increase the hen welfare.

GENETICS

Due the individual variation in mobility of each bird, not all hens are at the same risk for fractures and genetics is one of the main factors involved. One study indicated that 69% of White Leghorn hens had one or more fractures, while only 10% of Red Jungle birds, an ancestral breed not selected for commercial egg production, exhibited bone fractures. This indicates that intensive artificial selection for eggs is not responsible for all cases of bone problems. Roosters, regardless of breed, did not present fractures.

In modern commercial strains, where birds lay eggs over a longer period than in ancestral breeds, hens may resort to extracting calcium from the bones in a process called resorption, used to supplement the calcium needed to form the eggshell formation.

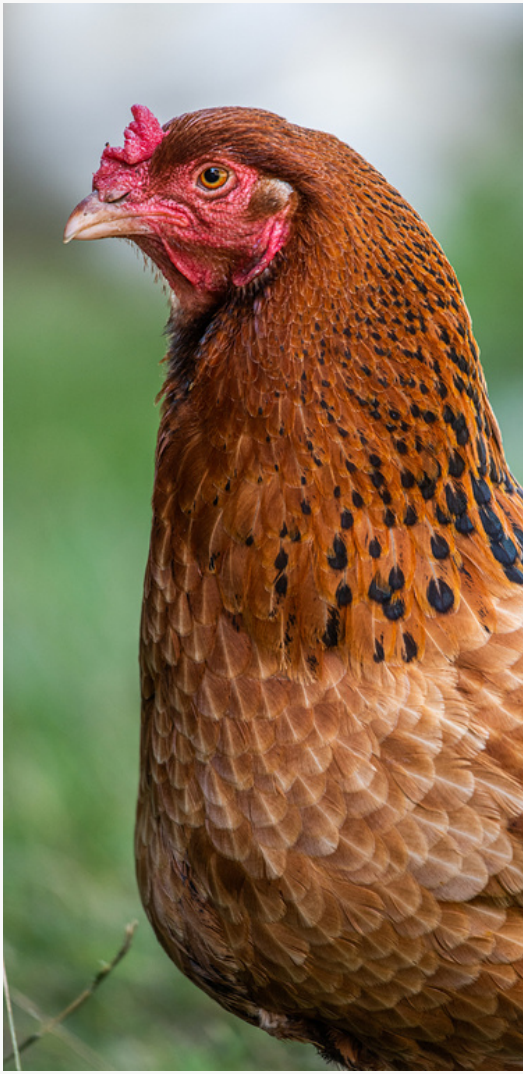
CONCLUSION

Genetic, environmental and management aspects all have an impact on health of laying hens. Three main points are highlighted:

1. The age at which a hen first lays an egg should be closely examined and the bones need to develop properly before the start of lay;

2. Having a well-mineralised medullary bone can also protects the overall quality of the skeleton;

3. Improving bone quality should not necessarily lead to lower egg production or quality.



BIBLIOGRAPHY

Applegate, T. e Angel, R., 2014. Requisitos nutricionais de aves: História e informações para uma atualização. Journal of Applied Poultry Research, 23(3), pp.567-575.

Armstrong, E.A., Rufener, C., Toscano, M.J., Eastham, J.E., Guy, J.H., Sandilands, V., Boswell, T. e Smulders, T.V., 2020. As fraturas ósseas da quilha induzem um estado depressivo em galinhas. Scientific Reports, 10(1), pp.1-14.

Baur, S., Rufener, C., Toscano, M.J. e Geissbühler, U., 2020. Avaliação radiográfica do dano ósseo da quilha em galinhas poedeiras – observações morfológicas e temporais em um estudo longitudinal. Frontiers in veterinary science , 7, p.129.

Campbell, D.L.M., 2020. Saúde óssea das aves em todos os sistemas habitacionais e futuras direções de pesquisas para a Austrália. Animal Production Science.

Clauer, P., 2012. A indústria moderna de ovos. Penn State Extension.https://extension.psu.edu/modern-egg-industry.

Dunn, I.C., De Koning, D.J., Mccormack, H.A., Fleming, R.H., Wilson, P.W., Andersson, B., Schmutz, M., Benavides, C., Dominguez-Gasca, N., Sanchez-Rodriguez, E. e Rodriguez-Navarro, A.B., 2021. Não há evidências de que a seleção cause perda persistente da qualidade óssea em galinhas poedeiras. Genetics Selection Evolution, 53(1), pp.1-13.

Healthier Hens. A Literature Review on Feed Fortification for Egg-laying Hens - Volume I. 2021.

Heerkens, J.L.T., Delezie, E., Rodenburg, T.B., Kempen, I., Zoons, J., Ampe, B. e Tuyttens, F.A.M., 2016. Fatores de risco associados a distúrbios do osso da quilha e do coxim plantar de galinhas poedeiras alojadas em sistemas de aviários. Poultry Science, 95(3), pp.482-488.

Kittelsen, K.E., Gretarsson, P., Jensen, P., Christensen, J.P., Toftaker, I., Moe, R.O. e Vasdal, G., 2021. As fraturas ósseas da quilha são mais prevalentes em galinhas White Leghorn do que em galinhas Red Jungle - um estudo piloto. Plos One, 16(7), p.e0255234.

National Research Council, 1944-1994. Necessidades nutricionais das aves: 1994. National Academies Press.

Nys, Y. e Le Roy, N., 2018. Homeostase do cálcio e biomineralização da casca do ovo em galinhas. Vitamin D, pp.361-382.

Rodriguez-Navarro, A.B., McCormack, H.M., Fleming, R.H., Alvarez-Lloret, P., Romero-Pastor, J., Dominguez-Gasca, N., Prozorov, T. e Dunn, I.C., 2018. Influência da atividade física nas propriedades ósseas da tíbia em galinhas poedeiras. Journal of structural biology, 201(1), pp.36-45.

Rufener, C., Baur, S., Stratmann, A. e Toscano, M.J., 2018. Um método confiável para avaliar fraturas ósseas da quilha em galinhas poedeiras a partir de radiografias usando uma escala visual analógica marcada. Frontiers in veterinary science, 5, p.124.

Schuck-Paim, C., Negro-Calduch, E. & Alonso, W.J. Mortalidade de galinhas poedeiras em diferentes sistemas de criação internos: uma meta-análise de dados de propriedades comerciais em 16 países. Sci Rep 11, 3052 (2021).

Toscano, M.J., Dunn, I.C., Christensen, J.P., Petow, S., Kittelsen, K. e Ulrich, R., 2020. Explanações para fraturas ósseas da quilha em galinhas poedeiras: existem explicações além da elevada produção de ovos? Poultry Science, 99(9), pp.4183-4194.

Wei, H.D., Chen, Y.J., Zeng, X.Y., Bi, Y.J., Wang, Y.N., Zhao, S., Li, J.H., Li, X., Zhang, R.X. e Bao, J., 2021. As fraturas ósseas da quilha estão associadas a diferenças de qualidade óssea em galinhas poedeiras. Anim. Welf. 30, pp.71-80.

Whitehead, C.C. e Fleming, R.H., 2000. Osteoporose em camadas de gaiola. Poultry Science, 79(7), pp.1033-1041.