Understanding nutrition for the longevity of laying hens

Global egg production is estimated to increase by 50% by 2030. Therefore, genetic companies need to improve the hen production period in order to get 500 eggs in 100 weeks. Expanding the production period may bring additional challenges, especially in the later stages of the laying cycle. In this case, the overall performance, the persistency and total egg production might not meet economic expectations.

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The rearing period is key in a hen's life and it has a huge impact over the laying period. The rearing period becomes crucial after genetic selection, increasing the production cycle until 100 weeks. An holistic approach, including nutritional knowledge, feeding techniques and farm management improvement, are essential tools to tackle this period.

Pullet nutrition

Optimal layer nutrition starts immediately after hatch. This means we must fulfil the nutritional rapid growth demand during the first half of the rearing period followed by slow growth in the second half of the rearing period (see Fig. 1). The feeding programme during the first half of the rearing period needs to focus on an optimal supply of digestible amino acids and minerals to ensure the basic growth of the inner organs, muscles, and skeleton.

During the second half of the rearing phase, the physiological development of the pullet continues at a slower rate, which offers the chance to train the pullet's feed intake behaviour, which is critical for the egg production cycle.

During the second half of the rearing phase, the reduced demand for protein and amino acids gives us a chance to include raw materials with a lower density and a higher crude fibre content.

Suitable raw materials are available on the market. Wisium recommend around 6.0-6.5% crude fibre during this phase to develop a good gizzard. Birds change from pullets to laying hens at the end of the rearing period. Almost all their metabolic process changes to egg production. Medullar bones develop and extra protein is needed for the ovaries, oviduct, and liver. Prelay feed is needed for higher calcium (2.2-2.5%) and higher protein levels (17.0-17.5%).

This prelay period takes 10-12 days. Higher levels of protein and amino acids have a positive effect on flock uniformity, and the calcium content prevents bone decalcification of early maturing hens.

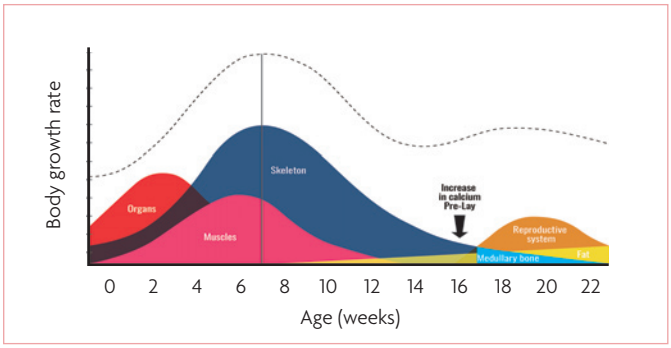

Fig. 1. Pullet body weight and composition (Novogen).

Nutrition in the laying period

In the laying period the daily feed intake should be increased. Hen's consumption can vary depending on feed nutrients composition from prelay to the peak period. The energy needed for growth, production, and maintenance increases until 30 weeks of age. This energy level can vary, depending on the production system (see Table 1). For example, aviary and free-range production needs higher energy than cage systems. Managing energy demands is crucial in this period in different production systems. Furthermore, essential amino acids should meet their expectations during the first production period.

Well balanced amino acids can be provided minimising indigestible protein. Digestible protein knowledge is a key factor for more precise nutrition. Hens do not like fine particles in the feed and the particle size distribution can affect performance.

Liver health

The liver is the most important organ of the hen, especially after 40 weeks of age. At the onset of lay, reaching the correct bodyweight is key and it is recommended to use a feed with higher ME if needed (depending on feed intake). After reaching the adult stage, the target is to keep a stable bodyweight.

Fat birds will result in higher maintenance and higher production cost and will be more susceptible to develop a fatty liver. The liver is responsible for fat, carbohydrate and protein metabolism besides vitamin and mineral metabolism. Nearly all basic nutrients provided by the liver are used for the yolk and albumen development as well as eggshell support. Adding fat or oil to layer diets is a well-known tool to reduce the incidence of fatty liver syndrome.

Replacing dietary carbohydrates with supplementary fat, maintaining the energy content of the diet is helpful to keep a healthy liver.

Lipotropic agents like vitamin B1, B12, folic acid, and vitamin E, help to catalyse the breakdown of fat during body metabolism and prevent excess fat buildup in the liver. The use of additional choline and/or betaine is highly effective in the production period.

Properly balanced amino acid nutrition is also important to prevent fatty liver. Amino acids are necessary for fatty acid transport to adipose tissue. Toxic substances of feeds, as well as the toxins produced in the body, are detoxified by the liver. The use of mycotoxin binders that have the capability to support this detoxification process is fundamental in the liver.

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Table 1. Energy needs in different production systems (Novogen).

	Egg production	Bird activity	Temperature variation
Cage	+	+	+
Cage (open house)	++	+	+++
Floor	++	++	+
Floor and free range (outdoor access)	+++	+++	+++
Aviary	++	++	+
Aviary and free range	+++	+++	+++
Impact of housing on energy requirement	+50 kcal at least (vs cage)	Free-range needs more	Huge impact of outdoor weather

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Eggshell quality and calcium

Eggshell quality decreases when laying hens get older. At the beginning of a laying cycle, all hens lay smaller eggs with thicker shells. At the end of the laying cycle, we have larger eggs with thinner shells and the daily need of calcium increases over time.

Egg size can be controlled by optimising nutrients such as methionine, essential amino acids, crude protein, and fat content, and it also contributes to reduce the broken egg rate at the end of the laying period. It is important to know daily feed consumption when we optimise the hen's calcium needs. If not, they may lack calcium, and the broken egg rate might increase.

Usually laying hens consume 40% of their daily feed during the morning and 60% in the afternoon. Feed consumption during the afternoon is important to meet the higher demand for calcium during the night when most of the eggshell formation takes place. Using coarse limestone is fundamental in terms of solubility.

It is also necessary to increase the size of calcium granules to delay solubilisation in the gizzard during the night. At least 40% of limestone must be more than 2mm coarse particle.

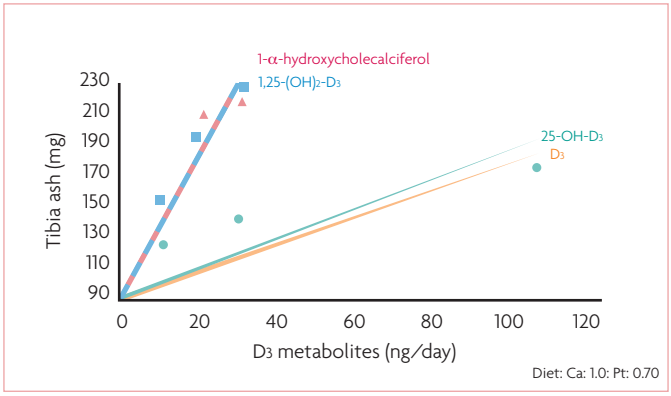

Fig. 2. 1-α-hydroxycholecalciferol effects in tibia ash compared to other vitamin D3 analogues (Boris et al., 1977).

The metabolic route is key to improve eggshell quality

1,25 $(OH)_2$ D_3 is the active form of cholecalciferol or vitamin D_3. Two hydroxylations are required to achieve this active molecule once animals ingest vitamin D_3. The first hydroxylation occurs in the liver through 25-hydroxylase enzyme and the second hydroxylation occurs in the kidney, through the 1-α-hydroxylase.

This last process is regulated by many different agents like hormonal factors, levels of Ca and P, parathormone (PTH) action, calcitonin, oestrogens, and cytokines. All these requirements explain the low bioefficacy of the kidney hydroxylation (20%) compared to the first one at liver level (95% of bio efficacy).

Add via feed the synthetic 1-α-hydroxycholecalciferol – that is already hydroxylated at 1-α carbon – is the most stable and effective way to increase 1,25 $(OH)_2$ D_3 circulating level. Fig. 2 shows the higher bio-efficiency of 1-α-hydroxy-cholecalciferol compared to other sources of vitamin D_3 on increasing tibia ash content – a parameter related to Ca/P metabolism and bone development being comparable with the active form effect.

Conclusion

To feed laying hens for 100 weeks from the rearing period they need to have good body weight and body composition, as well as enough nutrient reserves in the body at the end of the pullet period.

Achieving the daily feed intake target in the early stage of the laying cycle is mandatory to reach peak and a good persistency of the laying percentage.

A nutritional focus on liver health is fundamental for hens' longevity. The amount of coarse limestone with fines must also be adapted to the age of the hens.

1-α-hydroxycholecalciferol is essential to have better eggshell quality. Managing egg weight via nutrition will provide more saleable eggs. Feed particle size distribution also needs special attention for performance optimisation. ■

References are available from the author on request