Nutrition of laying hens plays a major role in maintaining egg quality

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When trying to improve egg quality, we should pay close attention to the mechanism of egg production and the health condition of the layers.

Nutrients such as vitamin D, calcium, phosphorus, manganese, copper and zinc are of particular importance. Any imbalance may lead to shell quality issues. For example, an excess or a lack of phosphorus or chlorine, or a mycotoxin contamination, will affect the availability of calcium and vitamin D.

Albumen quality is mostly influenced by the age of the hen although there is some evidence that some compounds, such as trace minerals, vitamins (ascorbic acid) and amino acids in the diet may also play a vital role.

Climate can also impact egg quality. High temperatures may affect feed intake with up to 20% reduction, for example, leading to a reduced supply of energy and trace minerals, required for the production and formation of the shell.

To combat the heat, hens activate heat-regulating mechanisms and increase water consumption, altering the ionic balance in both the blood and the oviducts.

This affects the bicarbonate buffer system, impairing the shell formation since this process requires the reaction of bicarbonate and calcium in the uterus.

Apart from the main causes discussed above, other factors may play a minor role in maintaining a good shell quality and profitability. For instance, mechanical damage can occur.

It is favoured by poor shell strength, rough handling and infrequent egg collection.

In conclusion, although there are many factors to consider, even a single cause is sufficient enough to affect egg quality. One should also not forget that shell quality determines the extent to which bacteria penetrate the inside of the egg: the greater the quality, the lower the penetration.

Nutrition of the laying hens plays a major role in maintaining egg quality, especially that of the shel and some ingredients can improve egg quality.

Parameter	Control	Qualitegg	Difference (%)
Mortality (%)	0.19	0.16	-15.8
Feed intake (g)	102.21	110.80	8.5
Laying rate (%)	91.60	94.50	3.2
Broken eggs (%)	0.91	0.82	-9.9
Egg weight (g)	62.50	63.70	1.9
FCR	2.47	2.29	-7.3
Albumen quality (Haugh units)	69.32	75.22	8.5
Specific gravity	1.123	1.225	9.1

Table 1. The effect of supplementing with 1.5kg Qualitegg/t on the performance of hens from 16-48 weeks old.

Organic trace elements

Trace minerals are directly related to the structural characteristics and the quality of the egg shell. They are frequently fed as supplements to laying hens to reduce eggshell breakage.

Supplementing hen diets with trace minerals from organic sources provided lower egg loss, higher thickness and increased strength of the shell in laying hens. Broiler breeder hens consuming organic amino acid complex plus inorganic minerals produced embryos and hatching chicks with improvements in selected bone mineralisation parameters. Another study suggested that the addition of organic and inorganic sources of combined zinc, manganese and copper does not significantly influence the amount of eggshell material that is deposited during shell formation but can improve some of the mechanical properties.

Ascorbic acid

Ascorbic acid (vitamin C) is essential for the synthesis of the organic matrix (proteins and polysaccharides rich in sulphated molecules) in the eggshell. This matrix serves as a foundation for the deposition of calcium carbonate.

Table 2. Effect of supplementing with 2kg Qualitegg/t and/or reducing protein in feed on performance of 77 week old hens.

Parameter	Control		Qualitegg (15% CP)	Significance
	(17% CP)	(15% CP)		
Hen day (%)	49.13[a]	43.09[b]	51.18[a]	P<0.001
Egg weight (g)	68.25	68.67	67.99	NS
FCR	2.726[b]	3.099[a]	2.647[b]	P<0.001
Haugh unit	72.75	72.48	72.23	NS
Yolk colour	10.66	10.58	10.55	NS
Eggshell thickness (mm)	0.362[ab]	0.366[a]	0.360[b]	P<0.05

Vitamin C is also necessary for efficient hydroxylation of vitamin D3 to its active form, 1,25(OH)2D3 and for hydroxylation of proline and lysine, involved in collagen synthesis.

Therefore, vitamin C helps to optimise intestinal calcium absorption. Vitamin C supplementation has been reported to have beneficial effects (especially under heat stress), resulting in higher production, better shell and albumen quality, as well as heavier eggs.

Vitamin D3

Vitamin D3 is involved in the mechanism of calcium absorption in the intestine and calcium mobilisation during egg shell synthesis.

Inadequate levels of vitamin D3 result in reduced egg production and shell quality. It has also been reported that diets deficient in vitamin D3 or calcium result in reduced 17 β-oestradiol and progesterone concentrations in laying hens, which leads to a drop in ovulation.

Sodium butyrate

Butyrate is produced in the caecum and colon of animals via the fermentation of carbohydrates, such as dietary fibre. Sodium butyrate is known to play a vital role in the development of the gut membrane, can induce absorption of water and sodium and proliferation of intestinal cells, be used as energy resources, and stimulate intestinal blood flow and the synthesis of gastrointestinal hormones.

Other studies found a significant increase in host defence peptide gene expression in the intestinal tract of chickens when feed was supplemented with 0.1% butyrate. Also, when sodium butyrate reaches the intestine, it will favour the development of lactic flora and reduce the harmful bacteria, thus diminishing diarrhoeal episodes. Microbial control leads to a better health condition which is translated into better productive results and bacteriological quality of the final product.

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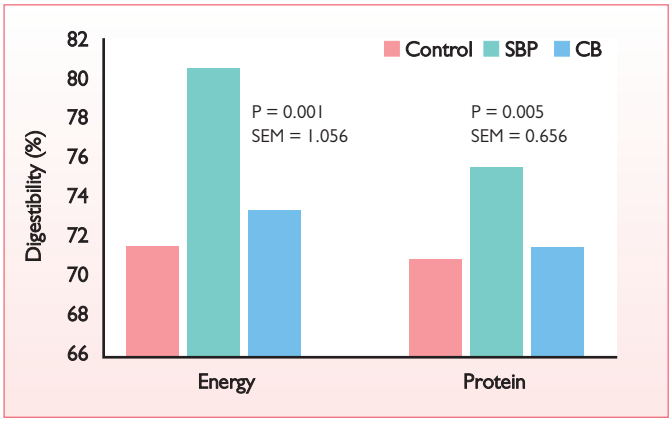

Fig. 1 Effect of feeding SBP (sodium butyrate protected) and CB (calcium butyrate) on digestibility (%) of energy and protein.

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However, the efficiency of butyric acid predominantly depends on the form of salt and protection from degradation in the acidic environment by using appropriate coating material.

Therefore, an experiment was conducted to study the effect of supplementing two forms of butyric acid with expected similar release of the active principle (sodium butyrate protected with palm stearine, SBP, that releases the butyrate after the fat digestion, and non-protected calcium butyrate, CB, that releases the butyrate slowly due to low solubility) in layer diets on egg production (EP), feed efficiency (FE), egg mass (EM), egg weight, egg shell quality, Haugh unit score and digestibility of energy and protein.

Supplementation of sodium butyrate in protected form (SBP) significantly improved the digestibility of energy ($P<0.001$) and protein ($P<0.005$) compared to those fed the CD or CB supplemented diet.

The improvement in layer performance observed in this study could be due to the beneficial role of protected sodium butyrate.

The non-protected calcium butyrate (CB) was found ineffective in improving these parameters. The supplementation of sodium butyrate was reported to enhance the development of intestinal epithelium and reduce the pathogenic bacteria count in the chicken's intestine.

From the obtained data it can be concluded that sodium butyrate protected with fat supplementation increases egg shell quality, nutrient digestibility and layer production.

Organic acids and salts

Organic acids (propionic and formic) and their salts will also help in reducing the growth of pathogenic micro-organisms, when included in the feed, and along the gastrointestinal tract.

Choline chloride

Layers and breeders have an essential requirement for choline, which is required for the formation of a phospholipid lecithin, a component of egg yolk. Besides, as a constituent of phospholipids, it is essential in the building and maintenance of cell structure, as well as ensuring normal maturation of the cartilage matrix of bone, including the prevention of porosis (porous condition of the bones).

Choline is also involved in fat metabolism in the liver, through utilisation and outward transport of fat, therefore preventing abnormal accumulation of fat within the hepatocytes (the so-called 'fatty liver' syndrome).

Effects of Qualitegg

Qualitegg, a combination of organic trace minerals, sodium butyrate, organic acids (propionic and formic) and their salts, ascorbic acid, vitamin D3 and choline chloride, stimulates the regeneration of the intestinal epithelium, favouring nutrient absorption, especially increasing calcium and phosphorus availability. By providing vitamins and trace elements (totally bioavailable in organic form) it will also assist in the calcium fixation during egg shell formation. The result of all this is increased egg shell resistance.

Qualitegg also helps to decontaminate the feed, avoiding mould multiplication and the subsequent formation of mycotoxins.

As a bactericide, it inhibits the growth of pathogenic micro-organisms contained in feed and along the gastrointestinal tract. This will help to avoid intestinal disbacteriosis, thereby reducing the presence of dirty eggs. Last but not least, it has been observed in several trials that the addition of Qualitegg results in a denser, thicker albumen.

In summary, Qualitegg contributes to better poultry health, giving increased production and improved bacteriological quality in the final product. This will improve the overall quality of the egg.

Trials

A study was conducted in Thailand to determine the effect of supplementing the diet of hens with Qualitegg on performance and egg quality (Table 1).

A total of 140,000 hens (CP Brown) of 16 weeks old were divided in two homogeneous groups (2 treatments x 3 replicates x 23,334 animals). The feed for both groups was formulated with corn-soya to meet the nutrient requirements of NRC (1994). The trial lasted for 32 weeks. The feed for both groups was similar except for feed additive: control (C) (without additive) and experimental (Q) with 1.5kg Qualitegg per ton.

The percentage of egg produced by the Qualitegg group was higher (+3.2%) than the control (94.5% vs. 91.6%) and the egg weight was higher (+1.9%) (63.7g vs. 62.5g).

There was a reduction of broken eggs (-9.9%) in the Qualitegg group (0.82% vs. 0.91%), 16% less mortality (0.16% vs. 0.19%) and the FCR was reduced by 7.3% (2.29 vs. 2.47).

The albumen quality increased (+8.5) by addition of Qualitegg (75.22 vs. 69.32) and the specific gravity was 9.1% higher (1.225 vs. 1.123). The percentage of calcium in egg shell was increased by almost 5% by the addition of Qualitegg (36.25% vs. 34.55%) and the levels of phosphorus and zinc in plasma were higher (+2.1% and + 37.7% respectively).

The objective of the second trial was to evaluate the performance of laying hens when protein level in feed is reduced and when Qualitegg is added in the low protein diet.

A total of 360 hens of 77 weeks old were divided in three groups (3 treatments x 8 replicates x 15 birds). The feeds were designed as follows: control group 1 (15% crude protein), control 2 (17% CP) and experimental (15% CP and 2kg/t Qualitegg).

As seen in Table 2, the addition of Qualitegg could alleviate the effects of reducing the protein level in the diet, especially for egg production and feed conversion ratio. This is particularly interesting while trying to reduce the cost of production.

Conclusion

In conclusion, through research that has been conducted,it has been shown that Qualitegg acts as an egg quality improver, by having an effect on the albumen as well as on the shell characteristics. Usage of this product will also result in a reduced FCR. ■