The impact of breeder nutrition and its influence on chick quality

Good breeder hen performance and hatchability does not necessarily translate into high number of good quality chicks. Progeny quality depends on various factors, one of them being breeder nutrition. Nutritional requirements for chick quality are likely to be higher than for breeder production and hatchability.

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The impact of breeder nutrition on progeny in the field is more likely to be greater under conditions of poor breeder uniformity or stress. Feeding for internal and external quality of the eggs should always be considered as they can both have an influence on chick quality.

Internal egg quality

The deposition of nutrients into eggs depends on many factors: total nutrient content in feed, the source of the nutrient, feed consumption, rate of lay, size of the eggs and the age of the hens.

Main constituents of the eggs like protein, fat and most minerals are relatively constant and cannot be significantly influenced by manipulating the layer diet, whereas the amount of many micronutrients, such as fat-soluble vitamins and trace minerals, can easily be increased in egg yolk via layer nutrition.

During incubation, the embryo derives all of its nutrient requirements from the albumen and yolk. Macronutrient depot is both in the albumen and the yolk, whereas micronutrient depot is mainly in the yolk.

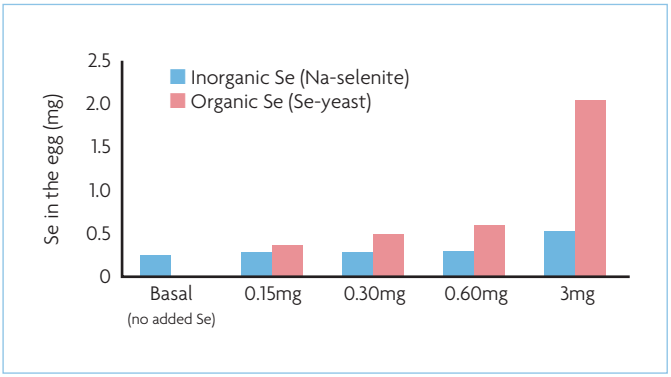
According to current understanding, especially the yolk micronutrient levels needed for chick quality are higher than for laying eggs or hatchability. More research data is needed to define the optimal level of the nutrients in egg yolk for chick quality. The availability and rate of absorption of the nutrients by the developing embryo may vary and more understanding of this is needed.

Organic trace minerals are recommended to be used in breeder diets because they are more bioavailable and more efficiently deposited into the egg than inorganic sources (see Fig. 1).

Maternal dietary selenium is associated with the antioxidant status, immunity and disease resistance of the chicks. The maternal dietary selenomethionine was superior to inorganic selenium in increasing selenium retention, and had long-term effects in improving the antioxidant status and meat quality of 56 day-old progeny.

Hatchlings derived from broiler breeders fed diets containing zinc-L-selenomethionine were heavier when breeders were 29 and 33 weeks old compared to those fed with inorganic selenium.

Fig. 1. Effect of dietary selenium source on whole-egg selenium concentration in laying hens (modified from Payne et al, 2005).



Selenium is an essential nutrient but highly toxic in excessive amounts and, therefore, its use is strictly regulated. High dietary amount (5ppm) reduces hatchability results. Selenium bound to organic compounds is regarded safer than inorganic forms.

In a trial reported by Uni et al. (2012) zinc, manganese, iron, copper and phosphorus levels in the yolk sac were very low during the last few days of incubation, and embryonic mineral enrichment application in ovo elevated mineral consumption. This suggests that the demand of these minerals for embryo development may not always be fully met. Feeding breeders organic forms of these minerals (when available) is a means to increase the amount of them in the yolk.

Organic zinc and manganese in breeder diets have shown to have a positive effect on progeny liveability vs. inorganic forms of these minerals.

Due to the fact that fat digestibility is limited in the early days after hatch, storage of fat soluble vitamins for embryo supplied via breeder nutrition is imperative, and vitamin E is one in this case.

In a trial by Lin et al. (2005), maternal diet supplementation with 120-160mg vitamin E/kg enhanced antioxidant capability and depressed oxidative stress in chicks.

Interaction between vitamin E and selenium may increase the production of the glutathione peroxidase enzyme which is a part of the antioxidant protection system.

High vitamin E in the maternal diet supports progeny growth and their ability to increase immune response.

Nutrition specifications for Ross (2016) recommend a minimum of 100mg of vitamin E/kg in breeder diets. However, higher dietary levels may be beneficial at least in stressful conditions; chicks from hens supplemented with 300mg/kg vitamin E presented better humoral immunity and more active lymphocytes.

Vitamin D3 is essential for intestinal absorption of calcium and phosphorus, the main constituents of bones. Breeders also require these minerals for egg formation. Vitamin D3 deficiency in breeder diets causes thin-shelled eggs, poor hatchability, deformed embryos and it compromises the bone quality of chicks. Vitamin D3 also has a role in immune function.

In low dietary levels, intermediate product in the vitamin D3 metabolic process, 25-hydroxy-vitamin D3 (25OHD3), has a higher potency than D3. Maternal supplementation of 25OHD3 increases deposition of 25OHD3 into the egg. It has also been shown to increase bactericidal activity of leucocytes in progeny relative to D3, suggesting the

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immune system of chicks may be more mature and better equipped to handle an infectious challenge when placed in the broiler house.

Also, from a leg health point of view, 25OHD3 may be more efficient than D3. In a study reported by Coto et al. (2010), bone development of the offspring improved with the addition of 25OHD3 in the maternal diet, and this effect was independent of increasing levels of vitamin D3 in the breeder diet.

Carryover effects of maternal dietary vitamin D3 (both D3 and 25OHD3) in progeny growth rate and FCR could be seen even three weeks post-hatch. In the current Aviagen nutrient specifications, 3500 IU of vitamin D3 per kg of feed is recommended for breeders. Replacing for example, 50% of this total amount with 25OHD3 may be beneficial.

Heat treatment of the feeds may reduce the vitamin stability and this must be taken into account when planning the premix composition and inclusion levels in the diet.

External egg quality

First quality, clean eggs are the basis for good hatchability and chick quality. It is a common practice to add feed enzymes in broiler diets but not so often in breeder diets. Breeders could, however, benefit from feed enzymes. Feeding laying hens diets containing high amount of soluble fibres (wheat, barley, oats, rye) has been shown to increase digesta viscosity in the gut and consequently impair nutrient digestibility, resulting in a higher number of dirty eggs.

Breeder diets are generally heat treated which may further increase the soluble fibre content of the diet, and consequently the gut viscosity. Adding feed enzymes in the diet reduces viscosity, improves nutrient digestibility and can reduce the number of stained eggs.

Addition of enzyme preparations to layer feed may not only reduce the moisture content of the droppings but also result in improved egg shell quality in wheat and barley based diets.

Practical experience from Aviagen suggests that feed texture may have an influence on the number of first quality eggs, coarse mash being better than crumbles. An explanation to this may be that coarse particles provide sufficient structure to stimulate gizzard development.

This in turn may help regulate the flow of nutrients into the small intestine, optimising digestive processes and nutrient utilisation, and further reducing the water content of the droppings.

Egg size

Egg size naturally increases as the breeder gets older. The increase in egg weight is not accompanied by a proportional increase in shell weight, so the resulting ratio of shell weight to egg weight decreases over time. Larger eggs tend to have thinner shells which may negatively impact hatchability and chick quality. Nutrients which may affect the egg size are protein, amino acids, especially methionine, linoleic acid and the fat content of the breeder diet.

In an unpublished trial conducted by Aviagen (2013) three dietary amino acid densities were compared in Ross 708 broiler breeders.

- Treatment one: 2013 Aviagen recommendations for digestible amino acid content.
- Treatment two: As treatment one plus 10%.
- Treatment three: digestible lysine and other amino acids were reduced below recommendations (except methionine).

The differences in performance between the groups were small but the egg and chick weights from hens fed Treatment three were significantly lower than those from Treatments one and two. In a progeny trial, there were no differences in liveability between the groups, but the live weight of the broilers from breeders fed with treatment three was observed to be smaller.

The newest breeder nutrient specifications from Aviagen (2016) recommend using three different diets during the laying period: Breeder one from 5% production until 35 weeks of age, followed by a Breeder two feed until 50 weeks, and finally a Breeder three feed until depletion.

The protein and amino acid contents are reduced while the calcium content increases along with these diets. The program can help control egg weight and maintain good egg shell quality throughout the production period.

Conclusion

There are several nutritional means at the parent level by which to ensure that the newly-hatched chick stays healthy and gets a good start in life. Nevertheless, more research is still needed to fully understand the nutritional needs of breeders for best quality progeny. ■

References are available from the author on request