

Medium chain fatty acids and their impact on egg shell quality

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The poultry industry is faced with increasing cost prices. This is mainly due to increased feed prices and/or changes in legislation (animal welfare, legislation on zoonoses like salmonella). As the genetic potential of both commercial layers and breeders is still improving, the production cycle can be prolonged in an economic way to compensate partly for these higher cost prices.

Evaluation of field data, from the Benelux over the past 10 years, has shown that from the genetic progress made in terms of egg production only 50% of this can be qualified as first grade hatching eggs.

As production cycles are getting longer, the need to maintain or improve the egg quality after peak production will be higher.

Physiological background

With the ongoing tendencies to grow broilers and turkeys heavier and faster, extra attention is paid to skeleton development and skeleton strength by the breeding organisations. However it is well known from literature that breeding for better skeleton strength or better leg strength indirectly results in more second grade eggs. This can be explained by the fact that the available calcium will either be used for the skeleton development or its maintenance, for the formation of the shell or in the muscular physiology. So changing emphasis in the breeding program can have indirect

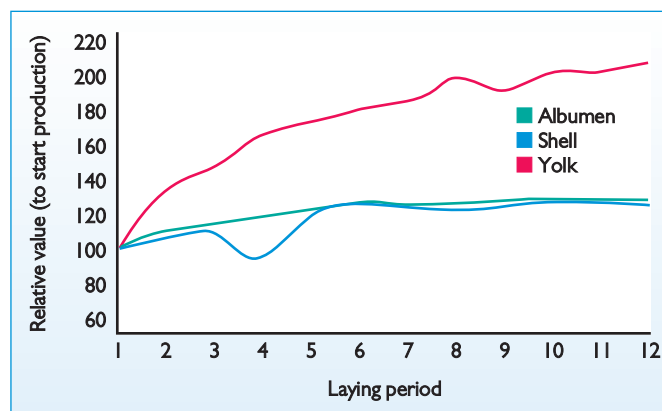


Fig. 1. The effect of age on egg composition (Hy-Line).

effects on other parameters. It should also be taken into account that increasing the available calcium in the blood cannot be done infinitely as this would affect blood pH too strongly, resulting in death.

An egg generally consists of three major parts: firstly, the shell, which is mainly calcium carbonate and about 2% of organic matrix. Secondly, there is albumen, which contains mostly proteins with antibacterial activity. Thirdly, there is also the yolk. The shell and the albumen have a nutritional and a protective value for the developing embryo throughout the whole incubation process.

The yolk has a nutritional value for the embryo in the later incubation period and post hatch. As the quality of the shell is not only determined by the quantity of calcium in the shell but also by the structure of the shell, a lot of research is being undertaken to understand how the structure can be ameliorated.

French research has indicated that 40% of the differences in shell quality can be explained by the organic matrix.

Data from breeding companies indicate that the calcium and the shell deposited around the eggs (expressed as grams) as the hen ages does not decline but reaches a plateau after maximum egg mass production.

However this means that '% of shell' relative to the whole egg declines. Furthermore, as can be seen in Fig. 1, both the relative weight development of the albumen and the shell are very much synchronised and that the relative weight development of the yolk is higher.

Calcium metabolism

In the past, a lot of research in the breeder industry has been dedicated to searching for the right calcium source and the right granule size in order to improve calcium solubility and calcium absorption. Today these effects are well documented and generally implemented but still the problem remains.

The proper calcium source and

the proper granule size should always be in line with the proper feeding strategy. Just increasing calcium and reducing phosphorous in the feed in order to minimise shell problems will not result in the desired effect if, like in broiler breeders, the feed is consumed within two hours and the absorbed calcium is not retained in the bones. The calcium cannot be used later on during the shell calcification process, but is directly excreted.

Most central in the whole calcium metabolism is the blood and blood pH. It regulates the supply and demand of calcium from/to the different elements (Fig. 2).

Another factor which has a significant impact on shell quality is the 'buffering capacity' of the hen to store the calcium, and to mobilise the calcium from the bones, in particular the medullary bone. This capacity is mainly determined during rearing and the first week of the production period.

Albumen and shell quality

Building a good shell is like building a good house with strong foundations. This foundation is the albumen and the surrounding membranes. The better the albumen and membrane quality the better the calcification process can continue from the homogenous distributed mammillary knobs. It is the time available during the calcification process which determines the thickness of the palisade layer and therefore the major part of the thickness of the shell.

However, as with construction of a house, it would not be solid if no structure or no cement were used. The same is true for the eggshell. The organic matrix links all the crystals to each other making it a solid structure.

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Fig. 2. Fluxes of calcium (Nipane et al., 2011).

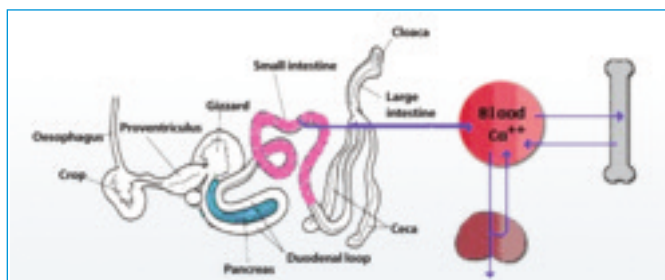


Table 1. Hatchability results.

Hatchability	Control (%)	MCFAs (%)
Trial 1 (Belgium, 2009)	78.63	79.60
Trial 2 (Hungary, 2010)	68.46	69.04

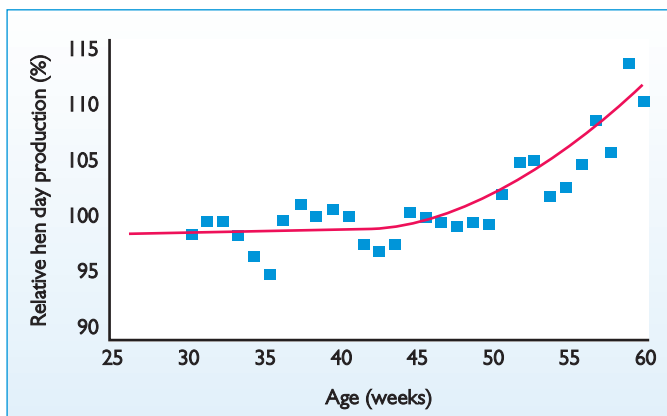


Fig. 3. % hen day medium chain fatty acids / % hen day control (100 = production is equal in both groups).

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Albumen quality is mainly defined and expressed in Haugh units. This parameter is based on the height of the thick albumen surrounding the yolk in relation to the egg weight. The higher this value the better the quality. This albumen quality is a good indicator for the freshness of an egg and for the health of a flock.

Albumen quality commonly declines during storage and with age of the bird. High quality albumen results in a direct improvement of the calcification process. This results in less broken eggs and less hair cracks. Improving albumen quality is not only important to improve shell quality (less second grade eggs) but also directly affects hatchability and chick quality.

Effect of MCFAs

Throughout the years, Nuscience has acquired extensive experience with Medium Chain Fatty Acids (MCFAs). With the knowledge of the different effects of MCFA and their combinations with short chain fatty acids (SCFA) on the metabolism and intestinal health, Nuscience was able to increase the breeder performance.

Shellbiotic should be used after peak production at 1 kg/ton of feed,

feed which is rich in calcium and relatively poor in energy (oils/fat) and protein.

MCFAs have two types of effects: a long term effect by maintaining better laying persistency and a short term effect by improving albumen quality and shell quality. In case of hatching eggs, the latter effects result in a higher hatchability and day old chick quality.

MCFAs have a long term effect on production (Fig. 3). Due to the time necessary for follicles to develop from small into mature ones, the first 4-6 weeks after start of using MCFAs, no effect on hen day production will be noticeable. However once the effect has started the longer the production period the bigger the benefit will be.

Because of the better albumen quality, shell quality, defined as % second grade eggs (Fig. 4) and hair cracks (Fig. 5), are improved.

Because of the better albumen quality and because of the better shell quality, hatchability is improved (Table 1).

Conclusion

With the genetic evolution in recent decades, combined with today's and future economic challenges, production cycles should be prolonged.

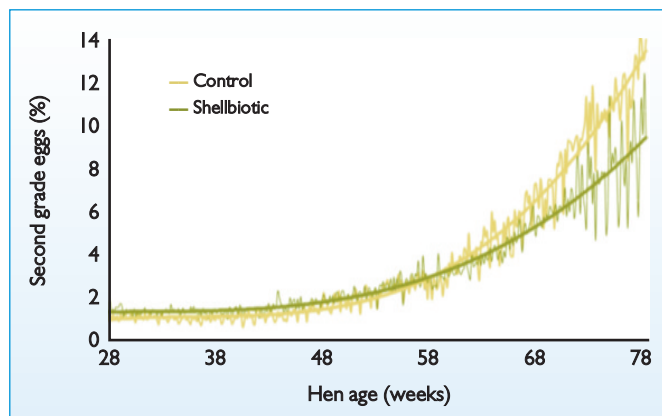


Fig. 4. Increase in second grade eggs can be limited by using medium chain fatty acids.

This implies that the period in which the risk of producing second grade eggs is increasing.

These second grade eggs have a severe negative impact on the profitability of the breeder industry and should always be minimised.

Although both hatchability and day old chick quality are very much related to shell quality and the loss of moisture during incubation, small differences in albumen quality enlarge these differences.

Under normal conditions, MCFAs

are strongly advised to be used. It is best to start when maximum egg mass production is achieved. This is 4-6 weeks before problems with egg quality might be expected.

Under conditions where breeders have problems during their rearing period or onset of production, use is recommended from the beginning of production. ■

References are available from the author on request

Fig. 5. % hair cracks medium chain fatty acids / % hair cracks control (100 = number of hair cracks is equal in both groups).

