Maximising table egg quality with organic minerals

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The nutritional content of poultry products is important for human health. In the last decade, food marketing has focused on the attributes of certain foodstuffs and how these can be used to address particular consumer requirements. A main player in this area is the humble table egg.

The quality of a table egg can be defined on several levels. Firstly, there is the appearance of the egg and the strength of its shell, which is important for ensuring fewer breakages during transport, display and purchase by the consumer.

The internal quality of the egg is another attribute that consumers pay close attention to. On breaking the egg open, they expect to see a firm, well coloured yolk and defined albumen – as defined by the Haugh units measured in egg quality experiments.

The third and perhaps most important attribute is the nutritional quality of the egg. Although the consumer cannot see this, there are now numerous eggs marketed worldwide that have been produced to deliver certain nutritional benefits for people.

Eggs are very useful vehicles for delivering specific nutrients to consumers. As well as naturally being a very good source of digestible protein and the 'good' fats that are required by, for example, pregnant women and the developing embryo, eggs can also be produced that contain other useful nutrients such as omega oils. These are currently marketed in many countries and are sometimes linked with benefits to heart health.

Another opportunity to use eggs as a delivery system for vital nutrients is with antioxidant minerals, such as organic selenium (Se). Insufficient mineral nutrition in the human population has become a major problem in recent years and intake of essential minerals has declined in many regions.

For the important antioxidant minerals like Se, this is a particular problem as deficiencies in these trace elements is known to have an impact on immunity, development, poor fertility, the risk of developing degenerative diseases, DNA damage (initiation of tumours) and generally low antioxidant status. In order to produce mineral enriched eggs, the hen must be fed certain dietary minerals at higher levels and some forms of these are more efficiently used and transferred into eggs than others.

Parameter	Control	Selenite (inorganic)	Sel-Plex (organic)
Consumption (mg Se/hen/day)	5	34	36
Egg content three weeks (mg Se/egg)	2.6[c]	9.9[b]	13.0[a]
Egg content six weeks (mg Se/egg)	3.3[c]	10.9[b]	13.5[a]

Means not sharing a superscript differ significantly (P<0.05)

Table 1. Effect of Se form on transfer into eggs from hens fed inorganic or organic Se supplemented feed.

Mineral sources for poultry

Scavengers, such as chickens, naturally obtain the minerals they require in their diet from the leaves and grains they consume. In plants, these minerals are bound to small peptides, and this form is preferentially taken up in the gut via the same systems that absorb amino acids.

Traditionally in agriculture, where animals are given specific diets to consume, feeds have been formulated to include inorganic ore-containing minerals, such as oxides and sulphates.

These have a different bioavailability compared to the plant-based forms, and are absorbed and excreted in different ways.

Relative bioavailability

Several research trials have confirmed these differences in bioavailability by comparing uptake from inorganic sources of minerals versus commercial mineral products that are chelated to small peptides, mimicking those seen in nature.

Trials run in 2006 compared the bioavailability for different zinc (Zn) sources in 1-21 day caged broiler chickens. Zn was added at 0, 20, 40 and 80ppm in both experiments, as either ZnSO4 or Bioplex (chelated; Alltech Inc) Zinc.

The relative bioavailability (based on bone deposition, as assessed via tibia samples) of

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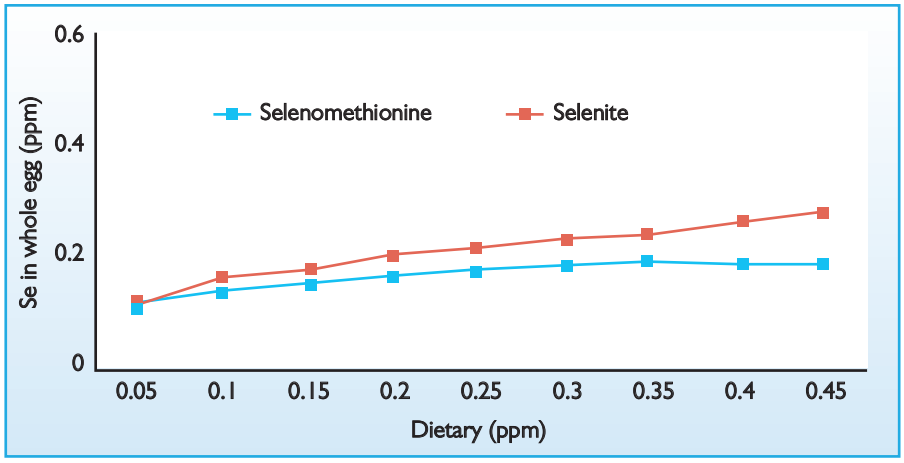
Fig. 1. Impact of increasing level of two forms, inorganic and organic, of Se in hen diets on expression of Se in eggs (Paton et al, 2002).



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the organic Zn versus ZnSO4 was 183% and 157% respectively. In trials where copper (Cu) metabolism was examined in young (1-21 day) chickens, retention was 35% higher (P=0.03) for the birds fed organic Cu compared to those receiving CuSO4, although, in both cases, retention increased linearly with intake.

Birds fed organic manganese (Mn) have been shown to perform better than those fed inorganic forms. Birds fed 90ppm organic Mn had the highest body weights (P<0.05 relative to 30ppm organic Mn or 30 or 60ppm inorganic Mn) and the lowest FCR (P>0.05).

Trials in Russia compared different levels of Zn and demonstrated better weight gain and FCR with organic forms (P<0.05). Further work showed optimum organic Zn inclusion to be 12ppm for 21d chickens, which reduced to 7.4ppm when phytase was included in the basal corn-soy diet.

Work on the major antioxidant mineral, Se has shown that using the yeast derived form is much safer and more efficacious in the animal and has better transfer into tissues and eggs compared to inorganic forms.

For other organic forms of minerals (those chelated to small protein units) these have been shown to have a beneficial impact on the strength of the egg shell as well as some internal egg quality parameters, such as Haugh units. This is due to the improvements in bioavailability of organic versus inorganic minerals.

The fact that organic forms of minerals are also subject to less competition for uptake in the gut means they are also able to be utilised in the bird in a more balanced manner, leading to less problems regarding imbalances between certain minerals that could affect egg quality.

Certainly, it has been found that using organic forms of minerals can help the overall laydown of shell and ensure a more even distribution in terms of the structures that give it its inherent strength. Such improvements can be seen as fewer breakages during transport or within packaging.

Quality and mineral content

Research has shown that the transfer of organic minerals into eggs through organic (chelated) supplementation is much more efficient and effective compared to inorganic minerals fed to laying hens.

Research conducted by Cantor et al. (1996) fed laying hens diets supplemented with either inorganic or organic forms of Se versus an unsupplemented control and monitored the levels of Se expressed in the resulting eggs (Table 1).

The hens receiving the organic Se had significantly higher levels of Se in their eggs compared to those fed the inorganic selenite form. After only three weeks of receiving the supplemented feed, this difference in Se content of the eggs was 31%.

Other work demonstrated the relationship between increasing organic Se levels in the diet of hens and the resulting expression of Se in eggs.

Fig. 1 shows how increasing levels of either inorganic or organic Se both increase levels expressed in eggs, however, the eggs from hens fed inorganic selenite did not increase in Se content after 0.25ppm, whereas eggs from hens fed organic Se continued a linear increase in Se content.

Conclusion

The mineral nutrition of laying hens producing table eggs is not only important for the construction of a good quality egg with a strong eggshell, but can also be used to convey important minerals such as Se, to the person consuming the egg, thereby improving their nutrition and antioxidant status.

In a world where human nutrition is becoming increasingly important as a way of avoiding poor health, especially the degenerative diseases associated with high oxidation exposure, the production of high Se eggs via feeding hens with organic forms of Se derived from yeast is a useful way of ensuring increased intake of antioxidant minerals. ■

References are available from the author on request