OPTIMAL SELENIUM NUTRITION: SAVE COSTS AND IMPROVE PERFORMANCE

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Modern-day animal production is becoming more intensive. The sector aims to maintain optimal performance while facing issues such as high stocking densities, pathogenic pressure, heat stress and welfare problems. This is often associated with high levels of stress. The antioxidant system is important during those periods, therefore, it can be stated that animals require a good antioxidant status, in order to deal with the negative effects of stress. Adequate nutrition is key in supporting the animals antioxidant status, with a major role for selenium.

Selenium is an essential trace element, which is used for the synthesis of selenoproteins, such as glutathione peroxidase (GPx), which can function as antioxidants. The selenium levels in raw materials depend on the amount of selenium in the soil where the crops are grown. Therefore, the selenium levels in feed are often variable and rather low, highlighting the need to add selenium to the diet. Such supplemented selenium can be added in different forms, that can be distinguished as inorganic and organic. Inorganic selenium, usually in the form of sodium selenite, is often supplied as it is cheap, and it will be used for the synthesis of selenoenzymes in the animal. Organic selenium, as L-selenomethionine, can also be used for the synthesis of selenoproteins. However, it also has an important benefit compared to inorganic forms, since organic selenium in the form of L-selenomethionine can be stored into animal proteins. This way it provides a safe deposit of selenium in the body, that can be used during times of stress when selenium demand is increased or feed intake is low. Therefore, L-selenomethionine is considered to be the most effective form of selenium.

There are different sources of organic selenium products on the market. One of such products are selenized yeasts. These are yeasts that have grown on a medium rich in selenium, which caused the yeast to incorporate the selenium inside the yeast protein. On average, selenized yeasts contain approximately 63% selenium in the form of L-selenomethionine, the rest of the selenium is present in other forms such as selenocysteine. These other forms of selenium cannot be stored in animal proteins. The selenomethionine content in selenized yeast is variable and depends on different producers but also on different batches of the same producer. When incorporating selenized yeast in the feed, it is important to consider that the digestibility of yeast protein, and therefore also for the selenomethionine in the yeast, is only approximately 70-80%. In practice, this means that when you have a selenomethionine content of 63%, the total digestible selenomethionine content is approximately 50%, with variation between batches.

Another source of organic selenium is synthetically produced L-selenomethionine. This additive does not have variation in concentration and contains all selenium in the form of L-selenomethionine. It is therefore considered to be an effective tool in supplementing the diet with the optimal amount of selenium.

In a trial by Delezie et al. (2014), the diet of Lohmann Brown laying hens was supplemented with different selenium sources and dosages, in order to compare the results on selenium deposition in serum and eggs. Selenium sources included in the set-up were sodium selenite, selenized yeast and L-selenomethionine, all in the dosages of 0.1 ppm, 0.3 ppm and 0.5 ppm selenium. The results of this study clearly show that selenium from organic sources was more efficient in increasing selenium deposition in eggs, compared to sodium selenite (Figure 1). This is in line with the results shown for selenium in the serum. The highest selenium deposition was found for the birds receiving L-selenomethionine. Also, a dose-dependent effect could be observed, with higher selenium levels in eggs when the selenium inclusion level in the diet increases.

The increased selenium deposition in eggs for the L-selenomethionine-supplemented group, already at low dosages, represents the increased selenium status in the animal, allowing the animal to better deal with stressors.

Another trial, published at the Annual Meeting of the European Federation of Animal Science in Ghent, Belgium, 2019, studying the effects of different selenium sources on selenium deposition, was performed in broilers. This study included 4 treatments, differing in their selenium source in the diet; no added selenium, selenium from sodium selenite, selenium from L-selenomethionine and selenium from L-selenocysteine with all added selenium at the level of 0.2 ppm. The results of this trial (figure 2) clearly show that L-selenomethionine significantly improves selenium deposition in the muscle tissue of broilers, while L-selenocysteine and sodium selenite have lower deposition at day 14. This once again shows that L-selenomethionine is the only form of selenium that can be stored, and that selenium deposition by L-selenocysteine does not have a benefit on selenium deposition compared to sodium selenite.

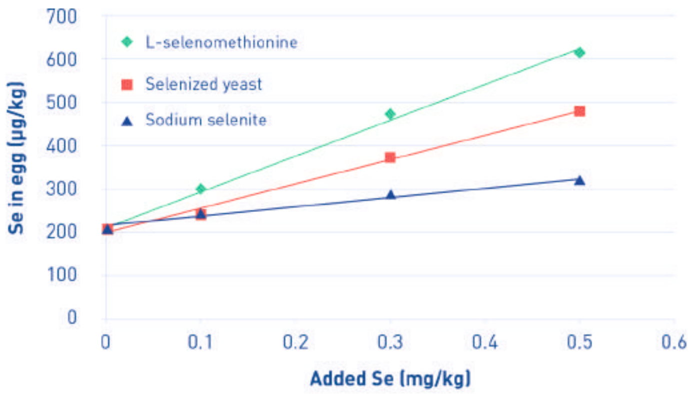


Figure 1: Selenium deposition in eggs for diets supplemented with 0.1, 0.3 or 0.5 ppm selenium in the form of sodium selenite, selenized yeast and L-selenomethionine (Delezie et al. 2014).

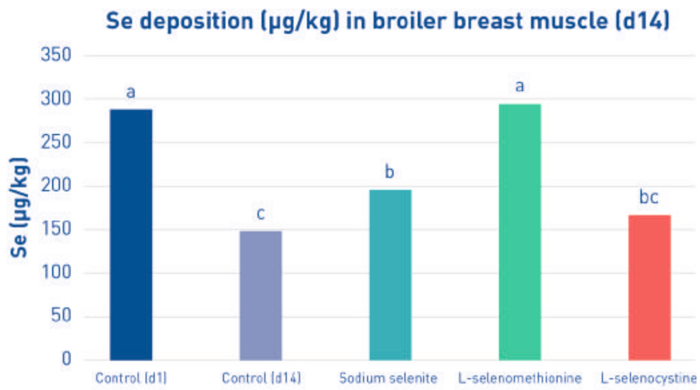


Figure 2: Selenium deposition in broiler breast muscle for diets supplemented with 0 ppm selenium (control) or 0.2ppm selenium in the form of sodium selenite, L-selenomethionine or L-selenocysteine.

The effects of selenium, on reducing the negative effects of stress, for example during heat or high stocking densities, have been shown previously in literature. A recent trial, published at PSA Annual Meeting San Antonio, Texas, USA 2023, studied the effects of selenium on performance during high stocking densities. The trial consisted of a 2 x 3 design; two treatments consisting of sodium selenite supplementation or L-selenomethionine supplementation, both at 0.3 mg Se/kg feed, and this for 3 different applied stocking densities; standard stocking density (29.84 kg/m²), +10% stocking density (32.84 kg/m²) and +16% stocking density (34.63 kg/m²). L-selenomethionine supplementation, in comparison with sodium selenite (Figure 3), showed 2% increase in body weight (P=0.002), a 2.5% better body weight uniformity (P=0.003) and a 2% improvement in feed conversion ratio (FCR) (P=0.04), for all tested stocking densities. Besides performance parameters, meat quality was improved. Tenderness was determined with the Warner-Bratzler method to measure shear force, for which L-selenomethionine showed a 12% decrease in the shear force of breast meat compared to sodium selenite (P=0.05), which indicates an increase in tenderness and an improvement of meat quality.

Another important topic, when considering selenium in nutrition, is the dosage. The right dosage of selenium allows for optimal production, while overdosing can cause toxic effects on the animal.

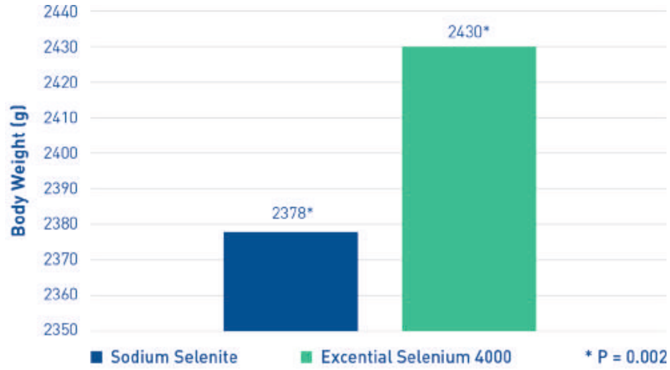
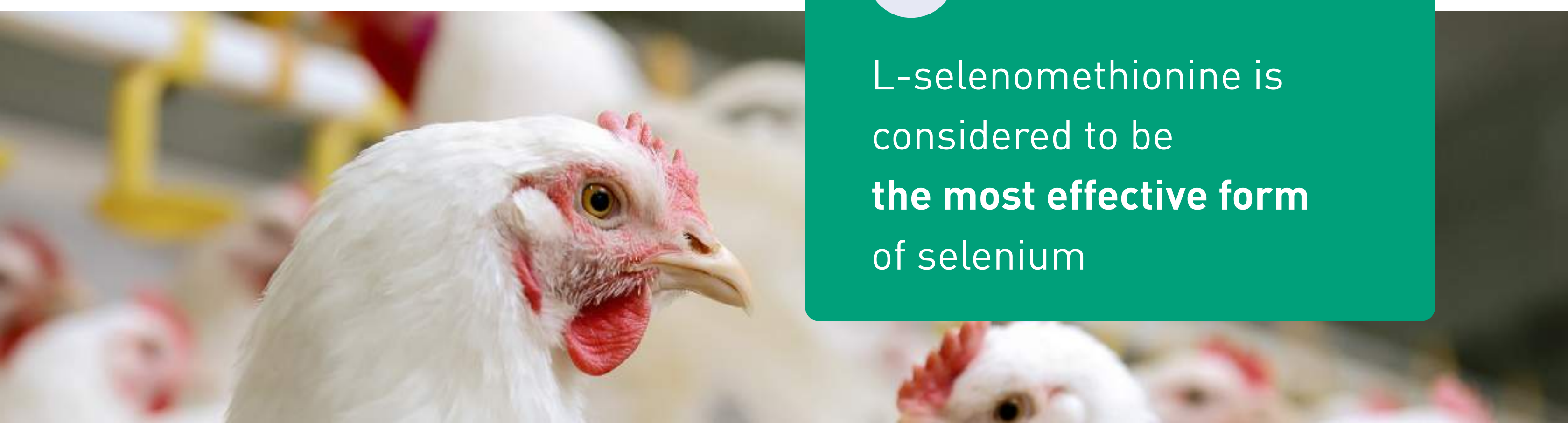


Figure 3: Final body weight of broilers supplemented with sodium selenite or L-selenomethionine at 0.3 ppm selenium.

In Europe, the legislation allows a maximum of 0.2 ppm organic selenium in feed, with a maximum of total selenium at 0.5 ppm. In practice, this means that nutritionists often combine an organic selenium source at 0.2 ppm, with 0.3 ppm selenium as sodium selenite. Outside of the EU, slightly higher dosages of organic selenium can be used, around 0.3 ppm, which have been showing to allow for good results on production. Because L-selenomethionine already obtains such high effects at low dosages, compared to sodium selenite and selenized yeast, an economically interesting choice could be to supplement the diet with lower levels of L-selenomethionine, instead of using higher levels of selenized yeast.



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Conclusion

It can be concluded that organic selenium has the highest bioavailability, compared to inorganic selenium. Within the different organic selenium forms, L-selenomethionine can be considered as the source allowing for consistent L-selenomethionine supplementation to the diet, with optimal results on the animals selenium status. It allows for a better cost-efficiency, with lower supplementation levels, while maintaining similar or higher selenomethionine levels in the diet. This way, you can save costs while improving performance and health status.