New generation of organic selenium for animal nutrition

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Selenium (Se) is an essential trace element for human and animal health and therefore an adequate level in the diet is crucial. Selenium sources added to the animal diet can be categorised as organic or inorganic. Organic selenium has been proven to be superior in terms of absorption, uptake in tissue and in enhancing antioxidant status compared to the inorganic sources.

Recently, a new type of organic selenium has been introduced in the animal nutrition market. Where selenium yeast, the traditional source of organic selenium, has only part of its selenium in effective organic form, this new type of organic selenium has 100% in effective organic form. This new generation of selenium answers to the demands of the animal nutrition industry for continuous product quality improvement.

Selenium is an essential element for both animals and humans and it plays a crucial role in maintaining an optimal health status. Although the requirement for selenium is very low a shortage can lead to serious health problems.

The biological functions are mediated via specific selenoproteins (enzymes). Selenium is needed for their synthesis and therefore a shortage of selenium in the diet can lead to a shortage of these crucial components.

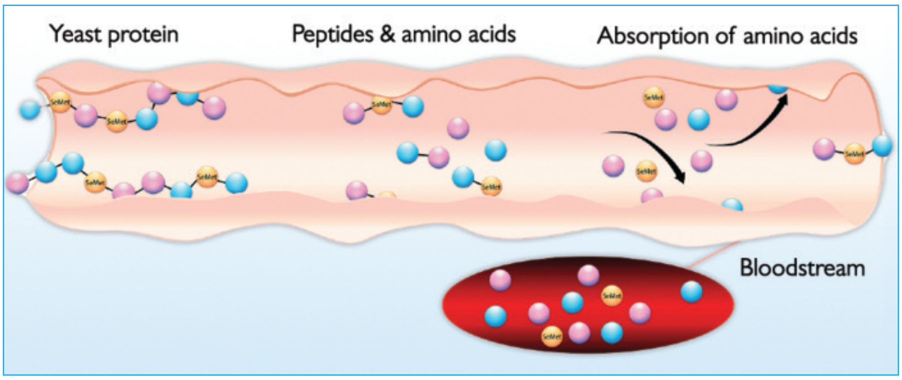

Fig. 1. Digestion of selenised yeast and absorption of selenomethionine.

Some of the most important roles of selenium are related to keeping an optimal antioxidant status and immune function. Selenium has an important function in reducing oxidative stress via the selenium containing enzyme gluthation peroxidase (GSH-Px). This enzyme protects tissue from oxidative damage.

An adequate selenium supply is important for all animal species and in all stages of life. Special attention is given to selenium in diets for breeding animals, young animals, growing and high producing animals and in situations where immune status is deteriorated.

A significant amount of research in different animal species has shown the importance of selenium in animal nutrition.

Selenium in animal nutrition can also be an excellent way of enriching animal products with selenium. Selenium enriched eggs and milk are examples of food products which are focusing on human health.

Sources of selenium supply

Selenium in animal diets can be supplied via raw materials or via additional supplemented selenium.

Selenium from feedstuffs is predominantly in the form of L-selenomethionine, which is the natural form of selenium in plant and animal tissue. The supplemented selenium can be either in an inorganic or an organic form.

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Fig. 2. Metabolism of selenium (adapted from Burk et al, 2006).

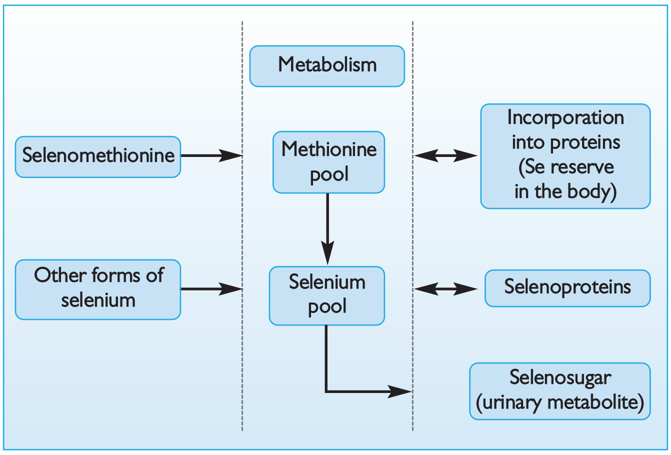
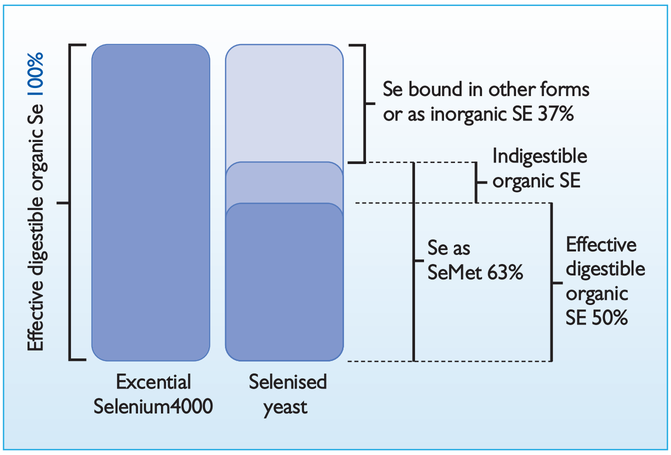


Fig. 3. Effective digestible organic selenium in different selenium sources (expressed as % of total selenium).



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The bioavailability of inorganic selenium is rather limited and therefore, replacing conventional inorganic selenium (sodium selenite) with an organic form has received much attention in recent years. Organic selenium has been proven superior in bioavailability in a large share of animal trials.

The traditional way of supplying organic selenium is in the form of selenised yeast. However, there is a limitation to selenised yeast and this lies in the fact that only part of the selenium is in the form of seleno-methionine, which is the actual effective organic form. Selenised yeast is yeast which has been grown in a high selenium medium. Part of the methionine in the yeast protein is replaced by L-selenomethionine. However, the full replacement of methionine by selenomethionine is not possible. Yeast contains selenium mainly as seleno-methionine but also has a significant amount of selenium in other forms.

Effective organic selenium

In the intestinal tract of the animal, the protein in selenised yeast is broken down into small peptides and free amino acids. The selenomethionine in its free form can be absorbed in the intestine as an amino acid in the same way as methionine (Fig. 1).

However, not all of the protein is digested. The digestibility of yeast protein is typically considered to be around 70-80%. In the metabolism, selenomethionine enters the methionine pool and can be incorporated into body proteins. In this way seleno-methionine is able to build up selenium reserves in the body.

However, all other forms of selenium in selenised yeast follow the same pathway as inorganic selenium. They are reduced to generate hydrogen selenide in the selenium pool, which in turn is converted to selenophosphate for selenoprotein bio-synthesis or is excreted.

Therefore the remaining part of selenium in selenised yeast is not considered to be more effective than inorganic selenium. Only the L-selenomethionine in selenised yeast is the effective organic selenium (see Fig. 2).

Several producers have registered selenium yeast products for the animal nutrition market. In Europe, the minimum level of selenomethionine in these products is set at 63%. If we take into account the digestibility of selenised yeast (estimated 80%), it can be concluded that the amount of effective digestible organic selenium is around 50% (63% selenomethionine * 80% digestibility). In practice the concentration of selenomethionine in selenised yeast is widely variable and even the minimum of 63% is not always achieved.

This has been demonstrated in a review of, in total, 11 commercial products, where an average of 51.7% was found with a range of 24.8-69.7%.

Recently a new type of organic selenium has been introduced into the animal nutrition market and this product tackles the problem of variable concentration. The product Excential Selenium4000 contains only L-selenomethionine and is considered 100% digestible. All selenium in the product is effective digestible organic selenium.

In Fig. 3 this new product is compared to selenised yeast, which contains only 63% of the selenium in the form of L-seleno-methionine with a digestibility estimated at

Overview of research areas related to optimal selenium status

- **Reproduction**
Optimal selenium supply improves reproduction parameters in, amongst others, poultry breeders, ruminants and aquaculture.

- **Immunity**
Optimal selenium status has been associated with improved antioxidant status and improved immune response in several animal species.

- **Performance**
Optimal selenium supply has shown to improve growth and feed conversion in poultry and pigs and to improve meat quality (reduce drip loss) in several animal species.

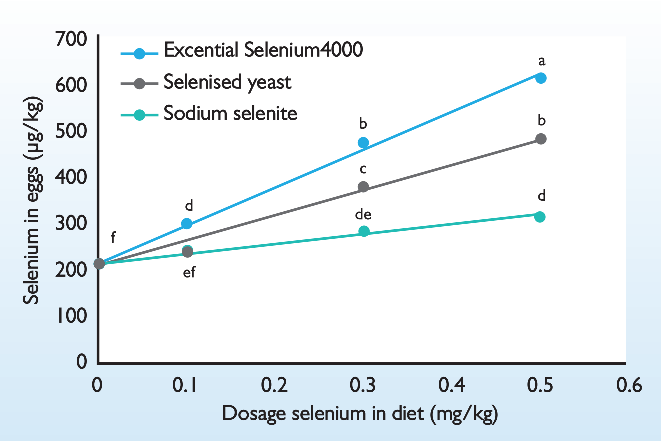

Fig. 4. Selenium in eggs related to the selenium and dosing in the feed (Delezie et al, 2013).

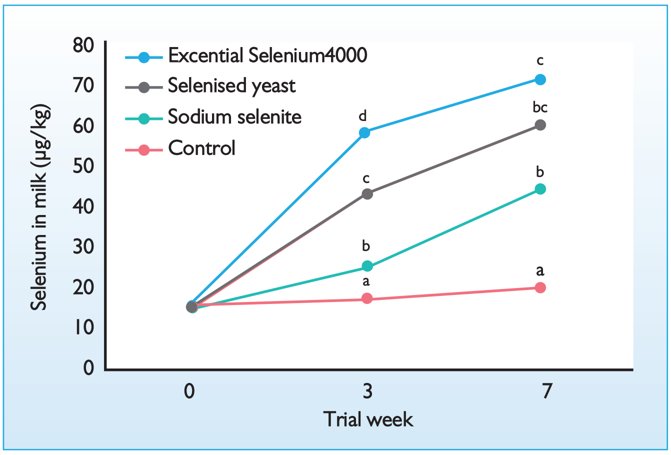

Fig. 5. Selenium in milk related to the selenium source in feed (0.3mg/kg) (Vandaele et al, 2014).

80%, which results in approximately 50% of the total selenium in the product to be effective digestible organic selenium.

Animal trials

The superior effect of organic selenium above inorganic selenium has been demonstrated in numerous trials. Most of these have been performed with selenised yeast as its source of organic selenium.

In selenised yeast only part of the selenium is effective digestible organic selenium. In Excential Selenium4000 all selenium is effective digestible organic selenium and therefore the good effects of selenised yeast in terms of bioavailability can even be outperformed. This has been shown in several trials.

If an animal is able to absorb more organic selenium from the diet, it is able to transfer more to the milk or to the eggs. The amount of selenium in milk and eggs is a good indicator for the selenium status of the animal and therefore the bioavailability of selenium sources can be evaluated by measuring the amount of selenium in animal products such as eggs or milk.

Fig. 4 shows the results of a trial in laying hens in which different sources and dosages of selenium were evaluated. Laying hens that received selenised yeast in the diet were able to deposit more selenium in the eggs compared to laying hens that received inorganic selenium. Moreover, the group that received a diet supplemented with Excential Selenium4000 had the highest selenium in the eggs, which was significantly higher compared to the selenised yeast.

This trial demonstrates the higher bio-availability of selenised yeast above inorganic selenium and the superior bioavailability of Excential Selenium4000 over selenised yeast. The effect of different sources of selenium has also been evaluated in dairy cows. Three different sources of selenium were added to the diet of lactating cows and the level of selenium in the milk was analysed as an indicator of bioavailability. Cows that received selenised yeast had a higher selenium content in the milk in comparison to cows that received inorganic selenium.

The cows that were supplemented with Excential Selenium4000 had the highest selenium content in the milk (Fig. 5). This trial confirms the higher bioavailability of Excential Selenium4000 compared to selenised yeast.

Benefits

With the introduction of this new form of organic selenium, new opportunities arise for animal nutritionists. The new generation of organic selenium guarantees all its selenium in an effective digestible organic form. For the same amount of total selenium this provides the double amount of effective organic selenium in the feed. Not only does this lead to superior effects in terms of bioavailability, it also ensures the lowest cost price per unit of effective organic selenium. ■

References available on request (info@orffa.com)