Selenium – the CEO of antioxidant defence

by Dr Jules Taylor-Pickard, Technical Team Manager, Europe

Selenium (Se) is considered to be one of the most controversial trace elements. Not only is it toxic in excess, but the environmental impact of Se contamination has been well documented. However, Se deficiency is a global problem which manifests itself in the increased susceptibility of animals and humans alike to diseases and a decrease in the productivity and reproductive performance of farm animals.

Selenium aids the regulation of some of the body's major physiological functions and is an essential part of at least 25 selenoproteins. Of these, glutathione peroxidase (GSH-Px) is perhaps the best known.

Important role in defence

Selenoproteins play an important role in antioxidant defence. They also regulate the redox status of the cell and are involved in the regulation of gene expression.

Selenium controls thyroid hormone metabolism and semen quality is very much dependent on its status.

We could say that all of the body's antioxidants work together as a team called the 'antioxidant system' and that each team player has his own role, with Se as the so-called 'chief-executive officer' of antioxidant defence.

Vitamin E activity in the body is very much dependent on Se status and without Se, vitamin E is ineffective. Se is also involved in the prevention of protein oxidation and this could be the mechanism behind the positive effect of Se on the Haugh units of eggs (measure of egg freshness) and the reduction in drip loss of meat. It is interesting to note that vitamin E does not prevent protein oxidation.

Recent research shows that Se's efficiency is very much dependent on its form. The natural organic form of Se has been proven to be the most effective for poultry and production animals. One such source Se-Yeast, in the form of Sel-Plex, organic selenium produced by Saccharomyces cerevisiae CNCM I-3060, has been shown to be effective for poultry, pigs, dairy and beef cows, sheep, goats, horses, companion animals and fish.

The principal advantage of organic Se is due to the accumulation of Se reserves in muscles which can be effectively used during times of stress, when the requirement for antioxidants increases, but typically feed intake is reduced. Therefore, Sel-Plex improves the adaptive ability of birds under stress.

As there are a multitude of stressors in commercial poultry production, increased adaptability to these stressors enables birds to overcome them without compromising immuno status, growth, reproduction and productivity.

When Se is supplemented in organic form, more Se is delivered to the egg providing better antioxidant defence of the developing embryo and improved hatchability.

Furthermore, more Se is transferred to the spermatozoa improving semen quality. In eggs, spermatozoa, colostrum and milk the principal form of Se is selenomethionine (SeMet) however, animals cannot produce it and therefore only organic Se is effective in the diets of all aforementioned cases.

Immunomodulating properties

In particular, Se is considered to have immunomodulating properties, helping the immune system to react to pathogens adequately: not too high (this causes a redistribution of nutrients and affects FCR and body maintenance); and not too low (this does not protect against pathogens).

Communication between different types of immune cells is considered to be a basis for immunocompetence.

In this regard, Se protects receptors (the cell's communicating devices) from the damaging effects of free radicals, which are produced under stress conditions.

Furthermore, Se deficiency is shown to be an important factor in virus mutation which is relevant to avian influenza. Recent research has shown that Sel-Plex has a protective effect on the integrity of the chicken intestine, in the case of reovirus infection. ■

Performance without compromise

by Dr Jules Taylor-Pickard, Technical Team Manager, Europe

Selenium (Se) plays a very important role in poultry nutrition and its optimal balance is crucial for breeders, broilers and layers.

The hatching process is considered to be an oxidative stress; therefore, by increasing the antioxidant defence of the embryo, hatchability can be improved. Sodium selenite added to the diet is poorly transferred to the egg, limiting the nutritionist's ability to achieve optimal Se status.

In contrast, organic Se, in the form of Sel-Plex (organic Se produced by Saccharomyces cerevisiae CNCM I-3060) is effectively transferred from the feed to the egg yolk and albumen, and further to the developing embryo. Analysis of international data indicates that by replacing sodium selenite with Sel-Plex in the diets of broiler breeders, hatchability is improved, on average, by 2%.

Furthermore, organic Se is more effectively transferred to semen, which enhances the antioxidant defence of spermatozoa, resulting in improved fertility. These beneficial effects mean that in total about 3-4 extra chicks per breeder hen can be obtained during the reproduction period.

Similar data were reported in experiments with turkeys, geese, guinea fowl and other avian species.

Advantages of organic Se

The advantages of organic Se for broilers include improvement of growth rate and FCR and decreased mortality and drip loss during meat storage.

In addition, broiler meat produced from birds fed Sel-Plex could be marketed as Se-enriched meat. The positive effects of Sel-Plex on broilers may be related to antioxidant Se action, the activation of thyroid hormone, as well as improvements in intestinal integrity and immunity. It is very nutritionally 'expensive' to maintain the immune system and many nutrients are directed away from growth and development in order to achieve this.

By supplying Se in an organic, more bioavailable form, it is possible to ensure that there is enough of this micro-nutrient to support the immune system during a challenge, as well as for growth and normal body maintenance.

Improvements in gut integrity have been reported when the diets of both experimental reovirus-infected birds and commercial broilers were supplemented with Sel-Plex.

In these cases, better absorptive capacity of the small intestine is thought to be responsible for a better utilisation of nutrients and, therefore, improved gut structure. It is also thought that specific selenoproteins, responsible for the prevention of protein oxidation are also responsible for the effect that Se has on decreasing the drip loss of meat, during storage.

Improved shell quality

The advantages of feeding organic Se to commercial laying hens relate to improvements in shell quality and egg production.

Organic Se, when incorporated into the organic matrix of the egg shell, can improve its breaking strength and has also been shown to maintain egg production at peak.

An additional benefit of organic Se for commercial layers can be seen in egg freshness during storage, as Se has an antioxidant effect when transferred from the diet to the egg.

By stimulating glutathione peroxidase (GSH-Px) in the egg yolk, white and probably perivitelline membrane, Se acts to decrease lipid and protein oxidation. This, in turn, increases the shelf life of eggs, as shown by the maintenance of Haugh units during storage. As in the case of meat, the use of Sel-Plex for laying hens is an effective method for the production of Se-enriched eggs.

Recent research has shown that organic Se (in the form of Sel-Plex) helps birds to adapt to, and overcome, various commercially relevant stressors, without reducing growth, development, immunity, production and reproductive performance.

Sel-Plex is a natural solution available to poultry producers who wish to improve the quality of newly hatched chicks, meat or eggs. ■