Successfully combating oxidative stress

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The metabolism of warm-blooded species is fueled and regulated through a series of complicated biochemical reactions. The ability to use oxygen for total oxidation of nutrients has significantly improved the energy supply and is one of the essential conditions for the evolutionary emergence of higher life forms.

However, the use of oxygen also bears risks, as oxygen is one of the most reactive elements. It easily leads to the formation of highly reactive oxygen species (ROS) often referred to as free radicals. They are intermediate products of regular cell metabolism, which are constantly produced by the cells. Nevertheless, their production can also be increased or triggered by environmental factors like UV light, pollution, contaminants, and stress.

What are free radicals?

Radicals are highly reactive and aggressive chemical substances which are either oxygen molecules or other organic compounds that contain oxygen, like superoxide, hyperoxide, or hydroxyl. These molecules have an unpaired electron in their outer electron shell, which aims at reaching neutrality by taking an electron from another atom or molecule to become paired again. They so cause the formation of new radicals, which in turn also aim at receiving an electron from somewhere else. This chain reaction is called oxidative stress.

All ROS are known to be cytotoxic, but they differ in their toxicity. The hydroxyl radical is the most reactive one causing the greatest extent of damage (e.g. lipid peroxidation, mitochondrial energization, hyaluronic acid degradation and DNA fragmentation). Most ROS are also related to tight junction disruption and therefore may facilitate or aggravate intestinal disorders. To counteract this damage, all living cells have implemented various enzymatic and non-enzymatic protection mechanisms.

In a state of homeostasis, the metabolism of any animal can break this chain reaction. Substances that neutralize ROS are known as antioxidants. They are necessary for a healthy metabolism. However, in the process of neutralizing radicals, their amounts can get depleted.

The body's defense mechanism:

The animal's antioxidant system is complex and only works in concert. Three levels of protection may be defined:

1. The first level of protection is the prevention of radical formation via several enzymes such as superoxide dismutase (SOD) or glutathione peroxidase, (GSH-Px). SOD expression is

stimulated by zinc and vitamin E. GSH-Px ex-pression depends more on a sufficient selenium supplementation (figure 1).

2. On the second level, electron donating antioxidants, most importantly vitamin E, neutralize free radicals. As vitamin E cannot be synthesized by the animal, both dietary supplementation and restoration via sufficient vitamin C supply are essential (Figure 2). Glutathione (GSH) does the same for vitamin C (figure 1).
3. In the third step, the damage of ROS on lipids, proteins and DNA is curbed by eliminating or repairing damaged molecules. Several enzymes and chaperones are involved in the process, but also the trace mineral zinc plays an important role in the repair process.

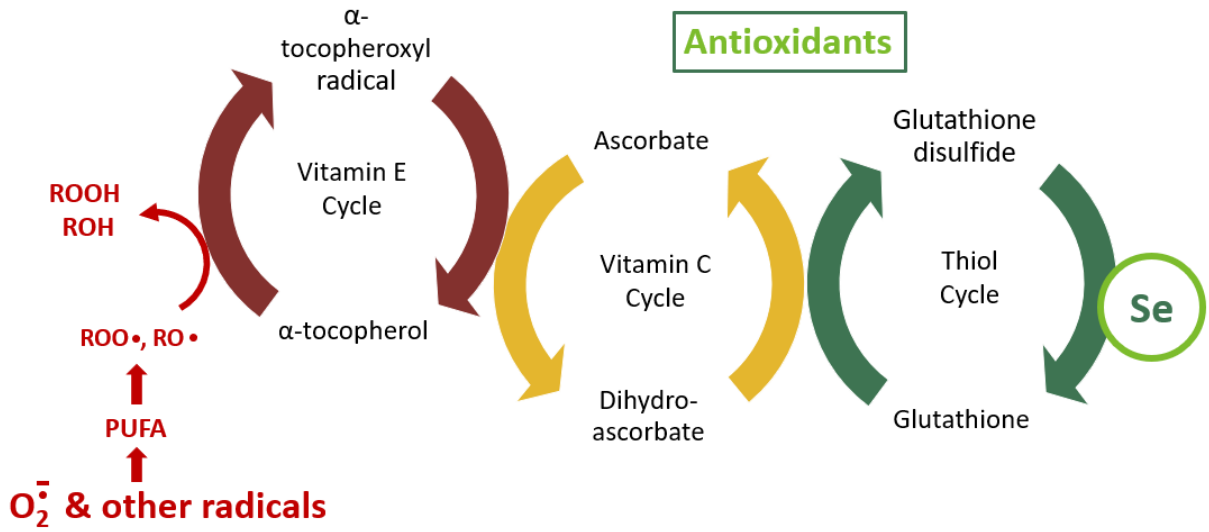

Figure 1: Restoring of antioxidants

Not always are the antioxidant capacities of the animals sufficient. An increase in ROS production may be triggered by several stressful events, such as transportation, thermal stress, or pressure on the immune system. The feed quality, especially when considering mycotoxin contamination or oxidized fats in the diet, also plays a crucial role. These events or circumstances burden the metabolism of affected animals. They may also be reason for a reduced feed intake through the animal: what is intended to relieve the metabolism, actually further aggravates the problem.

A reduced feed intake quickly leads to an energy deficit. The necessary mobilization of energy reserves contributes more ROS. Meanwhile, some of the building blocks required for proper SOD and GSH function, zinc and selenium, are not consumed in adequate amounts. The oxidative capacity is overburdened.

Oxidative stress does not manifest itself in pathognomonic symptoms. Its negative impacts may also be subtle and cumulative, though its economic impact may be immense.

Increased stress levels may lead to an impaired immunity, affecting overall health. An impaired immune system puts a flock at danger for infectious diseases, as antibody production may be inhibited. Other signs such as increasing cases of ascites, sudden death syndrome or performance losses may be the first indicators of increased oxidative stress.

A contribution of oxidative stress to leaky gut syndrome is also widely discussed. A restricted barrier function of the intestine directly impacts feed digestibility, biological performance, and further disease susceptibility.

In recent research about myopathies, especially those which may be seen in fast-growing broilers affecting the breast muscle, oxidative stress is also assumed a culprit.

Supporting the animals

Reduced feed intake in poultry is oftentimes the first sign of impaired wellbeing. During these times, and when the demand for antioxidants is heightened, the provision of feed supplements via the drinking water is a crucial step to foster antioxidant capacities. Biochems **B.I.O.Vit E/Se/Zn liquid** is a unique formulation developed to support the animals in stressful periods when being exposed to oxidative stress. Its composition is fine-tuned to enhance all three levels of antioxidant protection.

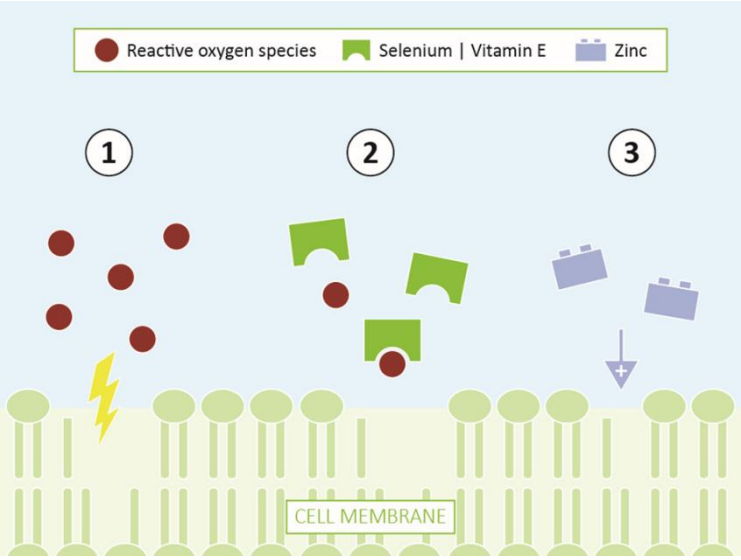

Figure 2: Synergistic effects of the combination of vitamin E, selenium, and zinc.

Zinc and selenium are being supplemented to provide necessary co-factors for the enzymes SOD and GSH-Px, thus strengthening the first line of defense. Vitamin E, being itself an antioxidant, also neutralizes free radicals while also upregulating SOD expression. In the last step, zinc provides valuable support for repair mechanisms and helps to strengthen tight junction bonds (figure 2), completing the scope of protection for your animals and your production.

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