Hydroxy-selenomethionine reduces the effects of stress in fish

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Currently, aquaculture production applies conditions that are sub-optimal to the physiological condition of the species. High-stocking densities, poor water quality or fluctuations in water temperature lead to an excessive production of prooxidant molecules that can surpass the capacity of the antioxidant mechanisms of the animal. Furthermore, genetic selection aims for growth at the maximum rates which diverts resources away from self-maintenance processes such as antioxidant protection and is associated with excessive prooxidants production. Therefore, maintaining balance in the animal's antioxidant system must be a priority for nutritionists.

Selenium plays a very important role in antioxidant defence, with the organic forms being the most effective. Recently published trials have shown that providing organic selenium in the form of hydroxy-selenomethionine (OH-SeMet) to fish increased selenium deposition in tissues and transfer of selenoproteins to progeny. This translates into improved antioxidant capacity and ability to cope with stress. It was also found that supplementation with OH-SeMet reduces lipid peroxidation in muscle, potentially increasing shelf life of fillet. Researchers concluded that supplying selenium as OH-SeMet was advantageous in ensuring optimal performance and quality traits.

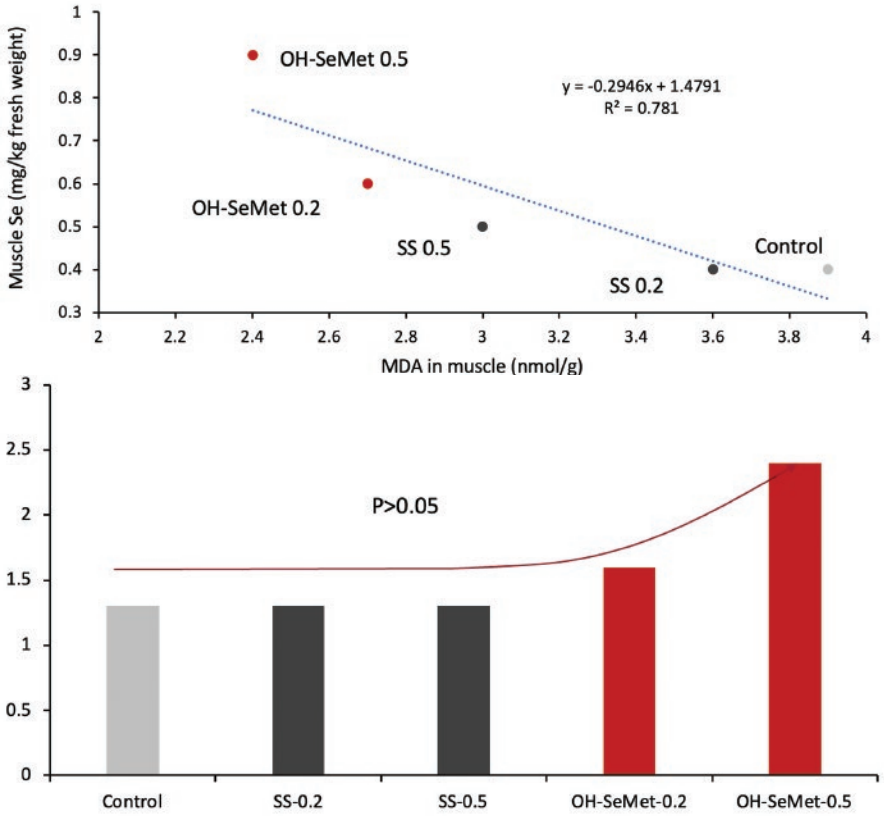

Figure 1. A) Selenium deposition and MDA levels in muscle. Supplemented selenium in ppm. B) Relative gene expression of GPx in liver.

What is oxidative stress?

At the cellular level, stress increases cellular respiration and production of prooxidants, the so-called reactive oxygen species (ROS). This may lead to excessive ROS production and an imbalance between prooxidants and antioxidants that result in damaged cell structures. Oxidative damage constrains the immune response and negatively impacts animal performance and fillet quality.

Selenium - a key player in antioxidant defence

Selenium is present in protein rich tissues as selenomethionine (SeMet) substituting methionine, or as selenocysteine (SeCys) as a key part of selenoproteins. About half of these SeCys containing proteins are antioxidant enzymes that detoxify ROS, with two of them being glutathione peroxidase (GPx) and thioredoxin reductases. Supplementing aquafeed with an optimal level and source of selenium largely contributes to the activity of these antioxidant enzymes and maintenance of the redox balance. Under production conditions that induce oxidative stress, if the antioxidant system is not sufficiently developed, performance and health will be negatively affected.

The benefits of OH-SeMet - form is everything

Selisseo® (Adisseo France SAS) contains 100% selenium in the form of hydroxy-selenomethionine (OH-SeMet) – a pure and highly available form of organic selenium. As a compound that has been created by chemical synthesis, its consistency and reliability are assured. The product can withstand the high temperatures and pressures associated with the extrusion processes for aquafeed production. OH-SeMet has been shown to be highly effective at increasing selenium deposition in tissues, building a reserve of selenium that helps the aqua species to better cope with stressful conditions that increase the antioxidant requirements.

OH-SeMet enhances protection from oxidative stress in muscle

A trial carried out at the University of Las Palmas (ECOAQUA-IU, Spain) (Marwa *et al.*, 2019) evaluated the effect of different selenium sources and levels on gilthead sea bream. The peer-reviewed manuscript showed increased selenium deposition with increasing dietary levels. At 0.5 ppm supplementation, deposition was 80% higher for OH-SeMet than for sodium selenite (Fig. 1A), indicating enhanced protection against oxidative stress in fish muscle.

Lipid peroxidation can be measured by the concentration of malondialdehyde (MDA). Any reduction of lipid peroxidation in muscle potentially improves the shelf life and quality of fish fillets. In this study, a negative correlation between muscle selenium content and lipid peroxidation

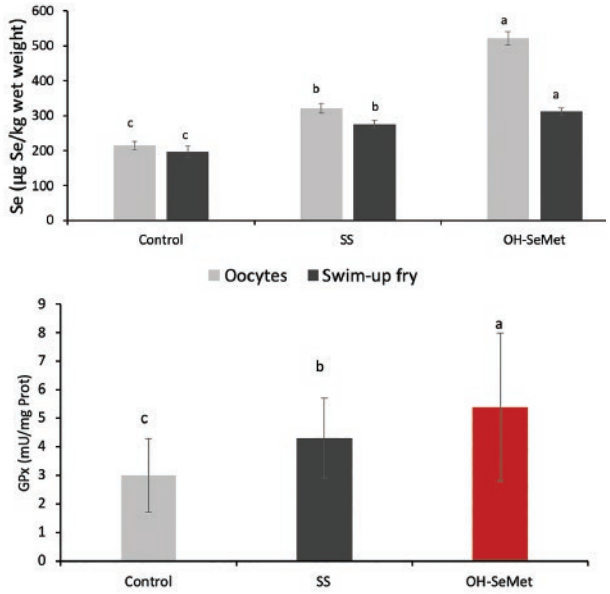

Figure 2. A) Total selenium in oocytes and swim up fry. B) Enzyme activity of total GPx in swim-up fry.

(R^2=0.781) was found, with OH-SeMet leading to a significant reduction of MDA in muscle (Fig. 1A) and in liver.

The expression of antioxidant enzymes such as glutathione peroxidase was also evaluated. Increasing OH-SeMet supplementation resulted in higher up-regulation as compared with sodium selenite (Fig. 1B). This further corroborates the enhanced antioxidant protection in juveniles against stress.

OH-SeMet improves the reproductive performance and antioxidant status of the progeny

The effect of dietary selenium on reproductive performance, selenium transfer and antioxidant status, was studied in rainbow trout at INRA (France) (Wischhusen *et al*., 2019). Over a six-month period prior to spawning, broodstocks were fed one of three diets containing a basal level of selenium (0.3 ppm), or a supplemented level of 0.3 ppm either as OH-SeMet or sodium selenite.

Results showed significantly higher number of spawnings in broodstock supplemented with OH-SeMet along with a high survival of progeny from fertilization to swim-up fry. Enhanced deposition of selenium in muscle and liver was found in females supplemented with OH-SeMet, thus reinforcing the antioxidant defence mechanisms to better cope with the stress associated to spawning.

Enhanced selenium deposition was also observed in the progeny, oocytes and swim-up fry (Fig. 2A), and this translated into enhanced expression of GPx genes and GPx enzyme activity (Fig. 2B). It was concluded that the parental transfer of selenium was more efficient in the form of OH-SeMet, and indicated an enhanced antioxidant capacity of the progeny to respond to stressful events during early life stages.

Ensured performance under challenging conditions

These new peer-reviewed studies add scientific weight to the benefits of selenium supplemented in the form of OH-SeMet. A clear improvement in muscle selenium deposition and consequently in GPx antioxidant activity has been demonstrated. Improved antioxidant capacity translates into reduced lipid peroxidation and potentially into extended shelf life of fish fillets, improved reproductive performance, and overall into better ability to deal with stressful conditions such as those derived current production conditions.

References:
Wischhusen *et al.,* 2019. *Aquaculture 507, 126-138*
Marwa *et al.,* 2019. *Aquaculture 507, 251-259*

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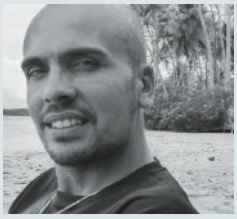

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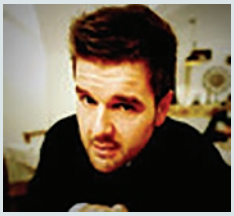

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