Orffa: Replacing Inorganic Selenium With Excential Selenium 4000, An Organic Selenium Source, In Atlantic Salmon

A current trend in feeding the growing aquaculture sector is to use more plant-based ingredients. These ingredients replace less sustainable and more expensive fish-based ingredients. However, incorporating them poses a challenge.

Improving selenium bioavailability in current plant-based diets

A major challenge with plant-based diets is the decreasing amount of selenium (Se) in fish (Figure 1; Betancor et al., 2016).

Se is an essential trace mineral exerting its role as selenocysteine (SeCys) in selenoproteins and L-selenomethionine (SeMet) in general body protein and is involved in numerous biological processes such as the antioxidant, immune and inflammatory systems (Figure 2). These systems are negatively affected if a selenium deficiency is encountered.

Additionally, decreased Se concentrations in the salmon's body (Figure 1) is problematic since salmon is one of the major sources of Se in the human diet. The primary route of Se supply to the fish is the diet, and since average Se levels in aquafeed have been reduced by the use of plant sources, Se supplementation is vital to meet the minimal dietary requirements (0.6-0.9mg Se/kg) in Atlantic salmon (Prabhu et al., 2019).

Aquafeed producers have the option to use organic (L-selenomethionine; Excential Selenium 4000) and inorganic Se sources in their diets. These chemical forms of Se affect the bioavailability in fish feeds differently (Figure 2, Berntssen et al., 2018). It is commonly accepted that organic Se shows greater availability and is more functional compared to inorganic Se (Prabhu et al., 2016).

To study the effect of replacing inorganic Se with organic L-selenomethionine in salmon, in vitro and in vivo trials were conducted by Prabhu et al. (2020), in which Orffa's L-selenomethionine, Excential Selenium 4000 (Se4000), was compared to inorganic sodium selenite (SS) at various dietary levels.

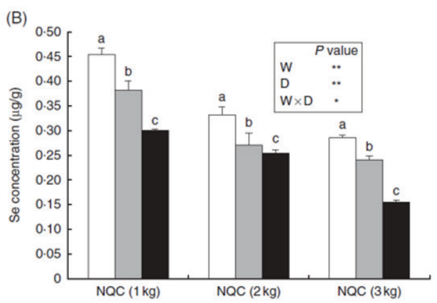

Figure 1: Selenium levels of salmon fillets fed diets with low levels of plant-based materials (white), medium levels of plant-based material (gray) and high levels of plant-based material (black) (Betancor et al., 2016).

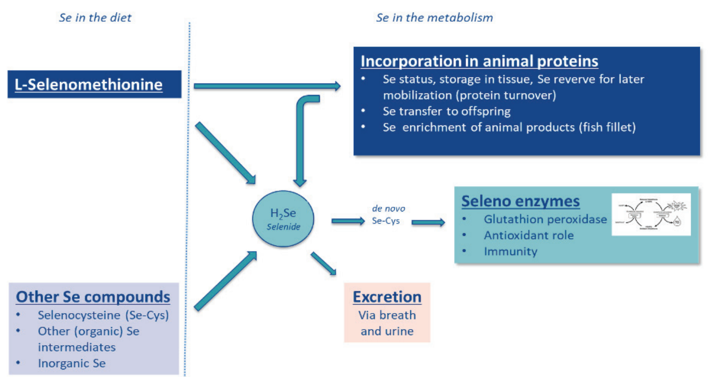

Figure 2: Metabolic pathways of organic Selenium (L-Selenomethionine) and inorganic Selenium like sodium selenite.

Body composition, digestibility, retention and loss of Selenium

When Se contents are increased in the salmon diet, Se concentrations in the body are increased as well.

However, the increase in Se content in fish fillets is much higher when Se4000 is fed compared to SS. The slope ratio Se4000/SS for fish fillets – which is the amount of additional Se concentrated in certain parts of the body when Se4000 is fed – is 9.74 (Prabhu et al., 2020). This indicates that a dietary increase of Se4000 leads to 8.74 times more Se concentration compared to the same dietary increase of SS.

When looking at other specific Se concentrations in the body (Figure 3), it can be observed that the concentration of Se is higher at places in the body where it can be stored or used (the whole body and blood plasma) and lower in places where a lower Se concentration is desired (liver and kidney). Additionally, the amount of Se in the faeces is significantly lower when Se4000 is fed instead of SS (-0.73).

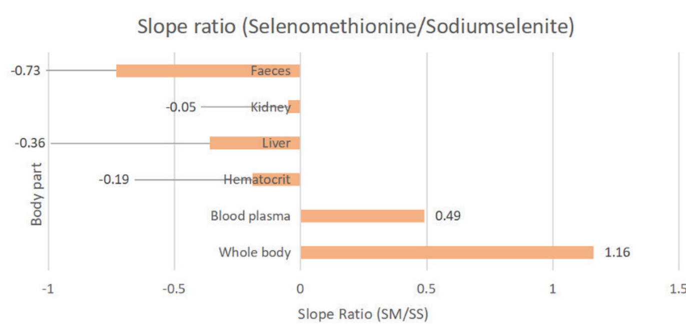

Figure 3: Relative differences of selenium concentrations in different parts of the body when L-Selenomethionine is fed instead of sodium selenite. Adapted from Prahbu et al., 2020.

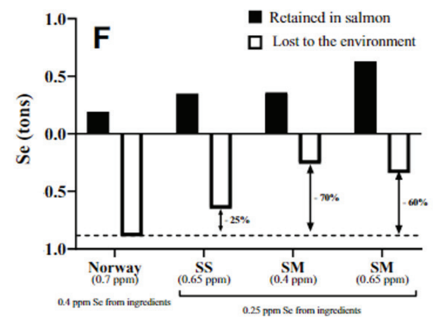

Figure 4: Se retention (black) and Se losses (white) estimated from the current salmon production in Norway and the effects of supplementing SS or SM (Prabhu et al., 2020).

These increased Se concentrations are the result of increased bioavailability, digestion and retention of Se4000 compared to SS. The apparent bioavailability of Se in diets with SS was significantly lower compared to that of Se4000 (27 vs. 72%).

Likewise, the retention in the body was less than half in SS compared to Se4000 (33% vs 61%) (Prahbu et al., 2020). This increased bioavailability and retention leads to a difference in Se demand. Prabhu et al. (2020) observed that Se4000 requires supplementation at a significantly lower level compared to SS (respectively 0.41mg/kg versus 0.66mg/kg). In salmon farming, the combination of increased body deposition and decreased supplementation demands, when using Se4000, can lead to a decrease in Se lost to the environment of up to 70% in the current salmon production in Norway (Figure 4).

Excential Selenium 4000: Increasing sustainable selenium supplementation

Decreasing selenium concentration in salmon diets is a key challenge in aquaculture farming.

Demand for improved sustainability and increased fishmeal prices have led to the need for alternative diets, which require the supplementation of vital ingredients.

Organic selenium sources are proven to have a higher bioavailability and have less polluting effects compared to inorganic selenium sources.

Organic selenium sources like L-selenomethionine (Excential Selenium 4000) are proven to have a higher bioavailability and have less polluting effects compared to inorganic selenium sources like sodium selenite, making it an optimal feed solution.

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