Selenium compounds for fish health: An update

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Abstract

Oxidative stress has become an important subject for terrestrial and aquatic toxicology. The trace element selenium has been demonstrated in chemo-prevention and drug-resistance through reduction of oxidative stress. Selenium compounds could prevent damage to the unsaturated fatty acid of subcellular membranes by lipid peroxidation induced by free radicals in fish.

Keywords: Antioxidant, Fish, Oxidative stress, Selenium.

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Introduction

Fish is one of the most important aquatic organisms which can produce important sources of protein for human nutrition. The nutrition of human, it has been considered that fish would be a significance source of protein because of the fact that fish and fish oils contain omega-3 fatty acids; in particular, eicosapentaenoic acid and docosahexaenoic acid (Gulhan *et al*., 2012, Selamoglu Talas and Duran, 2012).

Fish and fishery products have been identified as nutritional sources because of their high protein content. However, their biochemical changes which causes substantial problems in distribution. The limitation of natural resources such as fresh water and land has led to intensification of production systems. This overcrowding and the other stress conditions are likely to produce poor physiological environment and increase susceptibility to infectious diseases. Moreover, nutrition has an influence on health and immune responses of fish; therefore, research into dietary immunostimulant supplements such as organic, inorganic and synthetic matters has increased and many agents (such as various natural antioxidants) are currently used in the aquaculture industry (Gulhan *et al*., 2012, Gulhan and Selamoglu, 2016).

Membrane phospholipids of aerobic organisms are continually subjected to oxidant challenges from endogenous and exogenous sources, while peroxidized membranes and lipid peroxidation products represent constant threats to aerobic cells. Chemical toxic pollutants are important sources of reactive oxygen species (ROS) in biological systems. The primary antioxidant protection against free radical and ROS is provided by the enzymes glutathione peroxidase (GSH-Px), superoxide dismutase (SOD) and catalase (CAT), respectively (Orun *et al*., 2008).

In recent years, there has been a considerable rising in scientific researches about antioxidant agents and their potential protective effects. The antioxidant protection against cellular damages is provided by the enzymes such as GSH-Px, SOD and CAT. Consequently, these antioxidant enzymes contribute to the maintenance of a relatively low level of the reactive and harmful species hydroxyl radical. The nonenzymatic antioxidant systems are mainly substances of low molecular weight, such as vitamins C and E, urate, retinyl esters, β-carotene, glutathione (GSH), etc. Selenium was recognized as an essential trace element in aquatic animals and has important roles in antioxidant stress defenses, DNA and protein synthesis at normal concentration (Hesketh, 2008). Selenium is essential for humans and animals, and used by both in the form of inorganic as well as organic selenium compounds (Ates *et al*., 2008, Hesketh, 2008).

Discussion

Heavy metals in toxic agents can have a significant role in the development and progression of many disease processes

and damage the fish tissues. The heavy metal damage is an important factor in many pathological and toxicological processes. It is known that metal stress can change biochemical data including enzyme activities and amount of lipid peroxidation products. These changes are also depend on the type of metal used, the fish species, water quality and exposure time. It has been reported that cadmium ruined mitochondrial enzyme activities by causing defect in cells and tissues (Orun *et al*., 2008).

Increasing environmental pollution caused by heavy metals, due to industrial and agricultural activities, is becoming a significant problem in the modern world. Some heavy metals are essential trace elements required for maintaining cellular role and are an integral part of a number of heavy metals-containing enzymes. Selenium is a structural component of several enzymes with physiological antioxidant properties, including GSH-Px and thioredoxine (Orun *et al*., 2008). Selenium is an essential trace element and acts as an antioxidant by incorporation with selenocysteine in selenoproteins. In most of the studies, the external selenium was given to experimental animals as Se^{4+}. Selenium could prevent damage to the unsaturated fatty acid of sub-cellular membranes by lipid peroxidation induced by free radicals (Ates *et al*., 2008, Orun *et al*., 2008).

Inorganic and/or organic selenium compounds are necessary for the development of the acquired immune system. Biological importance of selenium is due to its being cofactor for GSH-Px, which plays a key role in the primary antioxidant defence system of the cell. GSH-Px prevents free radical formation by metabolizing peroxides formed in the cell (Orun *et al*., 2005).

In recent years, there has been a great deal of studies carried out on selenium metabolism. In most of these studies the external selenium was given to experimental animals in sodium selenite form. Because of the health problems induced by many environmental pollutants, many efforts have been undertaken in evaluating the relative antioxidant potential of selenium. In result of a study have been reported that sodium selenite has an important contribution to antioxidative defense for the spleen and heart of rainbow trout. The ability of sodium selenite to prevent the oxidative stress induced by heavy metals in fish was rationalized (Ates *et al.*, 2008, Orun *et al*., 2005, 2008, 2012).

In conclusion, some investigations provide a direct evidence for the preservation role of selenium on the antioxidative defense system against toxic agents. With administration of selenium, the toxic effects on inhibition of antioxidant enzyme activity have prevented significantly. This might be related to the fact that toxic agents are detoxicated by selenium, which thus enabled fish exposed to toxic pollutants to survive. In reality, selenium is an interesting agent for research on antioxidative effect.

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