Effect of dietary supplementation with zinc enriched yeast (*Saccharomyces cerevisiae*) on immunity of rainbow trout (*Oncorhynchus mykiss*)

Gharekhani, A.[1]; Azari Takami, Gh.[2]; Tukmechi, A.[3*]; Afsharnasab, M.[4] and Agh, N.[5]

[1]Graduated from Faculty of Veterinary Medicine, Science and Research Branch, Islamic Azad University, Tehran, Iran; [2]Department of Aquatic Health and Disease, Faculty of Veterinary Medicine, Science and Research Branch, Islamic Azad University, Tehran, Iran; [3]Department of Pathobiology and Quality Control, Artemia and Aquatic Animals Research Institute, Urmia University, Urmia, Iran; [4]Department of Aquatic Health and Disease, Iranian Fisheries Research Institute, Tehran, Iran; [5]Department of Ecology and Nutrition, Artemia and Aquatic Animals Research Institute, Urmia University, Urmia, Iran

[*]***Correspondence:*** *A. Tukmechi, Department of Pathobiology and Quality Control, Artemia and Aquatic Animals Research Institute, Urmia University, Urmia, Iran. E-mail: a.tukmachi@urmia.ac.ir*

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Summary

Zinc (Zn) is an essential trace element in all living organisms, and the first eukaryotic Zn uptake transporter was discovered in the yeast, *Saccharomyces cerevisiae*. Zinc-enriched yeast is a currently available Zn supplement. The purpose of the investigation was to compare and evaluate the effect of Zn enriched yeast in rainbow trout. The fish (mean body weight 10 ± 0.5 g) were fed a commercial diet supplemented with 0 (control), 1×10^6, 1×10^7 and 1×10^8 CFU/g of Zn-enriched yeast for 60-days. Results showed that significant increase in serum lysozyme activity, complement activity and total immunoglobulin were seen in all treatment groups during feeding trial when compared to the control group. On the basis of our findings, Zn-enriched improved rainbow trout growth, some immune parameters and disease resistance.

Key words: Disease resistance, Immunity, Rainbow trout, Zinc enriched yeast

Introduction

Zinc (Zn) is an essential trace element for all living organisms, its role in biology was first recognized by Raulin in 1869 (Prasad, 2009). It acts as a co-factor for a large number of proteins and enzymes (Schneider, 2013). Also, Zn affects many aspects of the immune system and it is essential for normal development and function of immunity such as phagocytosis, intracellular killing and cytokines production (Prasad, 2009). Zinc also functions as an antioxidant and anti inflammatory agent. Zinc requirements of fish are difficult to determine because fish may in part utilize trace elements that are present in solution. However, Zn is not taken from water in sufficient amounts to meet the needs of fish and must therefore be supplied by the diet to prevent deficiencies. In rainbow trout an adequate Zn content of the diet was estimated to be 15-30 mg per kg. This trace element is readily absorbed from the gastro-intestinal tract, gills, fins and skin of fish. Dietary Zn availability and absorption is reduced in the presence of phytates, and high dietary intakes of calcium, phopshorus and copper (Bury *et al*., 2006). Zinc could be supplemented in diets as inorganic mineral salts, typically as Zn oxide or Zn (Strnadov *et al*., 2011). Usually, the organic forms of trace minerals have higher bioavailability than inorganic forms. In addition, organic forms of them are less toxic and more environmentally friendly than inorganic forms (Yang *et al*., 2012).

Probiotics are live microbial feed supplements with beneficial effects on host by producing inhibitory compounds, competition or chemicals and adhesion sites, immune modulation and stimulation, and improving the microbial balance (Tukmechi *et al*., 2011). *Saccharomyces cerevisiae* contains various immuno-stimulating compounds such as β-glucan, nucleic acids, mannan oligosaccharides and chitin, and has been proved to enhance the immune responses and growth in fish (Abdel-Tawwab *et al*., 2008; Gopalakannan and Arul, 2010). Many studies of the processes involved in the uptake of trace elements by the *S. cerevisiae* have increased considerably in recent years. This yeast has become a model microorganism for studying metal transporters and their accumulation in the cells. *Saccharomyces cerevisiae* is known for its ability to accumulate metal ions from aqueous solutions by different physico-chemical interactions, e.g. by adsorption and absorption, or by a metabolism-dependent mechanism (Stehlik-Tomas *et al*., 2004). Production of yeast biomass rich in organically bound Zn is important to the animal industry because such forms of Zn are readily absorbed by the animal. In a study with growing heifers, it was found that those fed Zn methionine gained weight 8.1% faster and 7.3% more efficiently (Shet *et al*., 2011).

There is no information on the effects of dietary Zn enriched yeast in aquaculture industry. Also, no information is available on the effects of Zn enriched *S. cerevisiae* in rainbow trout. Therefore, the objectives of this study were to determine the dietary Zn enriched