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POSSIBLE DETOXIFICATION ROLE OF ZINC AND SELENIUM SUPPLEMENTATION AGAINST CADMIUM INDUCED BIOACCUMULATION AND OXIDATIVE STRESS IN TELEOSTEAN FISH *OREOCHROMIS MOSSAMBICUS*

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ABSTRACT

Cadmium (Cd) is one of the most common non-essential toxic element, relatively accessible heavy metal in our environment. The present study examines the detoxification role of zinc (Zn) and selenium (Se) against Cd induced bioaccumulation and oxidative stress in fresh water teleost *Oreochromis mossambicus*. Fish were exposed to sub lethal concentration of Cd ($1/10^{th}$ of LC_{50}/48h) for 7, 15 and 30 days (d) period. 15d Cd exposed fish were considered as control and divided into three groups. The first group of fish were subjected to Zn (1ppm) supplementation, second group received Se (0.5ppm) and third group of fish were supplemented with the combination of both Zn and Se at the above said doses and observed again for 7, 15 and 30d time periods. After specific time intervals, liver, kidney, gill, brain and muscle tissues were isolated and used for the estimation of bioaccumulation levels as well as assay of oxidative stress enzymes like superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione-S-transferase (GST). Simultaneously lipid peroxidation (LPO) levels were also measured. Bioaccumulation levels were significantly increased with the increased period of Cd exposure. After supplementation with Zn and Se, bioaccumulation levels were progressively decreased. A significant elevation in LPO levels with decreased activity levels of CAT, SOD, GST and GPx were observed during Cd intoxication. With Zn and/or Se supplementation, a significant reversal in the above oxidative stress enzymes was observed. The present study reveals that combined supplementation of Zn and Se tends to detoxify the Cd induced alterations in the test tissues than the other modes of supplementation.

KEY WORDS: Cadmium, Bioaccumulation, Oxidative stress, Zinc and selenium, Fish.

1. INTRODUCTION

The contamination of fresh waters with a wide range of pollutants has become a matter of concern over the few decades.[1-3] Natural aquatic resources are extensively contaminated with heavy metals like lead (Pb), cadmium (Cd), nickel (Ni) and copper (Cu) released from domestic, industrial and other man made activities. Among the heavy metals, Cd is one of the most toxic, non-essential heavy metal; known for its corrosive nature and is widely used in paints and dyes, cement and phosphate fertilizers.[4] Cd occurs naturally in the environment in significant amounts but its release in the recent past is steadily increasing due to human activities causing pollution at considerably toxic amounts was reported by earlier workers in various aquatic ecosystems.[5-14] Bio enhancement of Cd transfer along a food chain was studied by Seebaugh *et al.*,[15] and fish were reported to be used as biological indicators to assess water pollution.[16] In aquatic systems, as fish occupy the upper trophic level, there are greater chances of transferring Cd to higher organisms particularly to man.

Cd has an extremely long half-life (20-30 Years) in the human body[17] and is highly cumulative, especially in the liver and kidney.[18-21] It is a ubiquitous toxic metal and induces oxidative damage by disturbing the prooxidant – antioxidant balance in the tissues.[22] Cd inhibits oxidative stress enzymes which protect tissues by either binding to sulfhydryl (-SH) groups essential for the enzymes, replace the bivalent metals like zinc (Zn), copper (Cu), selenium (Se), iron (Fe) and manganese (Mn) required for the enzymes.[23] Cd like many other heavy metals is antagonistic to essential trace elements like Zn, Fe, Se, Cu etc.,[24] and competes with these trace elements for binding sites as transport and storage proteins, metalloenzymes and receptors.

Zn is a ubiquitous essential trace element with numerous functions in biological systems. It occurs in all living cells as a constituent of metallo enzymes involved in