

**Original Article**

# **ZINC AND CALCIUM SUPPLEMENTATION TO COMBAT CADMIUM INDUCED BIOACCUMULATION IN FRESH WATER TELEOST *Oreochromis mossambicus* (TILAPIA)**

**OBAIAH JAMAKALA\*, A. USHA RANI**

Division of Animal Biotechnology and Environmental Toxicology, Department of Zoology, Sri Venkateswara University, Tirupati 517502, Andhra Pradesh, India  
Email: obaiah.j@gmail.com

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## **ABSTRACT**

**Objective:** The present work was carried out to know the therapeutic role of zinc (Zn) and calcium (Ca) supplementation to combat cadmium (Cd) induced toxicity in selected tissues of freshwater teleost, *Oreochromis mossambicus* (Tilapia) exposed to Cd.

**Methods:** The freshwater fish, *Oreochromis mossambicus* (Tilapia) was brought from the local ponds and were allowed for acclimatization to the laboratory conditions. After acclimatization, fishes were exposed to 1/10<sup>th</sup> of LC<sub>50</sub>/48 hr of Cd i.e. 5 ppm for 7, 15 and 30 days (d) long sojourn. After 15d Cd exposure, fish were divided into three groups. The 1<sup>st</sup> group was supplemented with Zn at a dose of 1 ppm; Group-II was supplemented with Ca at the dose of 1 ppm and Group-III received a combination of both Zn and Ca at the above said doses for 7, 15 and 30d. After specific time intervals, fish were sacrificed and liver, kidney, brain, gill and muscle tissues were isolated in ice cold conditions. Then the tissues were used for bioaccumulation studies.

**Results:** A significant (P<0.05) elevation was observed in bioaccumulation levels during Cd exposure. The high amount of Cd accumulation was found in 30d Cd-exposed kidney (22.353±0.410 µg/g) followed by other tissues. After supplementation with Zn and Ca, Cd accumulation was progressively decreased in all the test tissues. The maximum percentage of Cd depletion was found in 30d Ca-supplemented muscle tissue.

**Conclusion:** Our findings clearly envisage that the Zn and/or Ca supplementation is very effective in reducing the Cd toxicity in the teleostean fish, *Oreochromis mossambicus*.

**Keywords:** Cadmium, Zinc, Calcium, Bioaccumulation, Tilapia

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## **INTRODUCTION**

Heavy metals are considered the most important constituents of pollution from the aquatic environment. These metals accumulate in the tissues of aquatic animals and may become toxic when accumulation reaches a substantially high level. Accumulation levels vary considerably among metals and species [1-3]. Studies carried out with different fish species have revealed that non-essential metals can produce toxic effects in fish by disturbing physiological activities [4], biochemical processes [5], reproduction and growth [6]. Among the heavy metals, Cd is one of the most toxic, non-essential heavy metal and accumulates in tissues of aquatic organisms like fish [7, 8]. Problems with Cd bioaccumulation were studied by many authors in aquatic animals [9-14].

Cd was readily bioaccumulated and bio-concentrates in aquatic organisms. Tissue Cd concentrations build up at the site of exposure, gills in a waterborne exposure or gastrointestinal tract in a diet bore exposure and are transferred via the circulation to other tissues. Cd accumulates in nearly all tissues and organs of liver, kidney and gill reaching relatively high levels. Available reports indicate that the kidney, liver and gills were the critical targets for Cd in fishes [15-17] in which they have been reported to cause significant metabolic, biochemical and physiological effects. The bioaccumulation of heavy metals in the different fish tissues has been studied by several investigators [18-24].

Despite many years of research, we are still far from an effective treatment of heavy metal poisoning. The main therapeutic option for metal poisoning relies in chelation therapy. Chelating agents are capable of linking together metal ions to form complex structures which can be easily excreted from the body. Cd can compete and interact metabolically with essential nutrients such as selenium (Se), Ca, Zn, copper (Cu) and iron (Fe) in the body [25-27]. Zn is the most abundant trace intracellular element required for a number of

cellular processes, including cell proliferation, reproduction, immune function and defense against free radicals [28]. Indeed, increasing evidence suggests that zinc plays an important role as an antioxidant and protects cellular components from oxidation. Zn is one of the most important nutritional factors influencing the metabolism and toxicity of heavy metals, including Cd.

Ca is an important element needed for the maintenance of membrane integrity and ion regulation. It plays a diverse role in the living organisms. In most of the vertebrates, it is a major component of the skeleton, but it also has vital functions in the body fluids and soft tissues [29]. Ca supplementation protected against accumulation of Cd in kidney, liver and other selected tissues of fish [30]. Cd accumulation was reduced with the increase of waterborne and dietary Ca [31-33]. Higher water Ca levels reduce the amount of Cd binding to gills [27] and reduce bronchial Cd uptake rates resulting in lower accumulation in the kidney, liver and other tissues of fish. Hence the present study was carried out to know whether the supplementation of Zn and Ca either individually or in combination would reduce the Cd bioaccumulation in the selected tissues of Cd-exposed *Oreochromis mossambicus*.

## **MATERIALS AND METHODS**

### **Chemicals**

Cadmium as cadmium chloride (CdCl<sub>2</sub>), zinc as zinc chloride (ZnCl<sub>2</sub>) and calcium as calcium chloride (CaCl<sub>2</sub>) were purchased from Merck (Dormstadt, Germany). The other chemicals which were used in the present study were obtained from the standard chemical companies like Sigma Chemical Co. (St Louis, Mo, USA), SD Fine Chemicals. The chemicals used for this study were of the highest purity.

### **Maintenance of animals (Fish)**

Fish *O. mossambicus* (Tilapia) weighing 10±2 gm were collected from the local fresh water ponds and acclimatized to laboratory