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Water Pollution:-Toxic Effect of cadmium chloride on water resources and fish species.

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Abstract: Aquatic ecosystem is one of the most exposed environments to pollutants. In fact all chemicals whether initially released on land in the atmosphere or directly in rivers will eventually find themselves in the rivers and oceans at the end. Therefore aquatic systems contain a wide range of pollutants from sewage effluents factory wastage agrochemicals pesticides heavy metal etc. Cadmium is considered heavy metal pollutants. Cadmium is a non essential heavy metal. Cadmium act as an endocrine disrupter interfering with biological functions in fish and cause and severe histopathological, biological and physiological changes in various fish species. The present reviews summaries the impact of Cd on gonad (Ovary) with special reference to histological changes and alteration in gonadal hormones.

Keywords: Cadmium, water pollution, Fish, Endocrine disrupter, Ovary, Histological changes, Gonadal hormones.

1. Introduction

Environmental pollution caused by the development of industries technology and informal settlements does however threaten many fresh water ecosystems. Not only does environmental pollution cause a decrease in water quality but subsequently affects all living organism in that system. Heavy metals are important contaminants of aquatic environments worldwide. Heavy metals are not destroyed through biological degradation. The heavy metal contamination of aquatic system has attracted the attention of researchers all over the world (Datta and Dalal, 2008). Many studies have reported regarding to heavy metal toxicity in fish (Ellis, 1973). Cadmium (Cd) is considered heavy metal pollutants and it is very damaging to the environment Cadmium is a persistent neurotoxin contaminant that was one of the most commonly used heavy metal in the 1970 (Moore et al.,1984). Environmental pollution from hazardous metal and mineral arise from natural as well as anthropogenic sources. Natural sources are seepage from rocks in to water volcanic activity, forest fire etc. Industry, mining, advanced agriculture; household waste and motor traffic are all among the activities considered to be major sources of metal pollution (Luoma and Rainbow, 2008).

Aquatic organism absorbs the pollutants directly from water and indirectly from food chain. Some of toxic effect of heavy metals on fishes and aquatic invertebrates are reduction of the development and growth. Every pollution in the aquatic environment which impact physiology, development, growth of survival of fish affects human that at the top of food chain consume fish. Fish are relatively sensitive to changes in their surrounding environment including in increase in pollution. Fish health may thus reflect and give a good indication at the health status of a specific aquatic ecosystem. Fish are considered as one of the primary risk organism for endocrine disrupting chemicals (Kime, 1999). Endocrine disrupters are defined as chemical substance with either agonist or antagonist endocrine effects in aquatic animals (Geovgescu et al., 2006). Recently it was demonstrated that heavy metal such as Cadmium (Cd), Mercury (Hg), Lead (Pb) and Zinc (Zn) may exhibit endocrine disrupting activity in experimental animals. Not only they are directly exposed to a wide variety of endocrine disrupter but also sex determination in fish is known to be very labile and can disturbed or even reversed by exogenous hormone exposure at critical development stages (Francis et al.,1992). Heavy metals are known to disrupt the reproductive endocrine system and to affect gamete development and viability either by their cytotoxicity or by altering the hormonal environment during gamete development.

2. Cadmium toxicity in water

Cadmium is a non essential heavy metal. It is regarded as one of the most toxic element in the environment (Shivani et al., 2011). The sources of cadmium in aquatic environment is industrial activity The industrial sources of Cd are zinc smelting, waste batteries , e-waste, paint, sludge, incineration and fuel combustion (Stohs, 1995). Cd may enter the food chain and concentrate within organisms. The acute toxicity of cadmium to aquatic organism is variable, even between closely related to the free ionic concentration of metal. Toxicity of cadmium has been shown to be species specific in fish (Taylor, 1977). Cd act as an endocrine disrupter, interfering with biological functions such as reproduction, growth, development, osmoregulation and the ability to cope up with stress in fish. It cause significant metabolic alteration and injuries of biological system at different levels (Pratap and Bonga, 1990; Brown et al., 1984). Cadmium is known to cause severe histopathological, biochemical and physiological changes in various fish species. Toxic effect of industrial effluents on survivability, histology and physiology of fresh water fishes were worked out by Hingorant et al. (1979); Vanhoof et al. (1984); Chatterjee and Bhattacharya (1985). It has been found that cadmium is generally accumulated in major organ of fish like ovary and testis (Godowicz, 1988; Sehgal and Pandey, 1984).

Toxicity of Cd to fresh water fish has been studied (Spry et al., 1991). The main physiological disruptions associated with Cd toxicity are related to modification of enzymatic activities in several organs (Gill et al., 1991). Cd either activates or inhibits a large number of enzymes in fish (Jackime et al., 1970: Saxena and Kothari 1993). In fish the toxic effect of heavy metal may influence physiological function, individual growth, reproduction and mortality (Hayat et al., 2007).

3. Effect of cadmium on histological changes in fish species

Histological studies currently in many biological phenomena such as fish reproduction to invent new and effective methods for increasing efficiency of brood stock, increasing fish production and ultimately increase efficiency and higher fish are predicted (Vinodhini et al.,2009). Histological analysis appears to be very sensitive parameter and is crucial in determining cellular changes that may occur in target organs, such as the gonads (Dutta, 1996). They also affected sexual differentiation of the gonads timing of sexual maturation gonodosomatic index, reproductive tract and gonad morphology (Milnes et al., 2006). The teleostean ovary is usually paired and attached to the dorsal wall of the body cavity by a short thick mesovarium. The two ovaries lie close to each other. The histomorphological details of the ovarian tissue of almost all the fishes are similar (Iwamatsu et al., 1988). The, histological and biochemical effects of heavy metal on ovary received little attention (James et al, 2003; Deshmukh and Kulkarnee, 2005). However the Environment induced alteration in the reproductive histology and physiology of fish will consequently affect its fecundity (Herrera, 1984).

Kumar and Pant (1984) reported a significant Artesia in the ovary with major damage to younger oocytes in *Puntius conchonius* after exposing to Zinc. Kumar and Pant (1984) suggest direct action of heavy metal on the ovary of *Puntius conchonius.* Kling (1981) reported total Artesia of late vitellogenic oocytes in the ovaries of lebaycid treated *Tilapia leucostica*. Mercury is reported to reduce gonadotrophin release which causes impairment in yolk formation by the oocytes of *Channa punctitus* (Ram and Sathyanesan, 1984). Kirubagaran and Joy (1988) attribute the atrocity changes caused by mercury to *Clarias batrachus* as a direct action of mercury on the ovary. Baruah and Das (2002) also noted partial lyses, swelling Artesia and change in ovarian nucleus after Cd exposure for 20 days. Long term exposure of cadmium chloride in *H. fossilis* resulted in marked degenerative changes in the ovary. These changes included prominent interfollicular space, appearance of atretic follicles, degeneration in nucleus degenerative in the ovarian follicles (Sharma et al., 2011).

Histological changes in gonads provide insight to any abnormality in the fish health. The inhibition of spermatogenesis or oogenesis coupled with high incidence of atretic follicle and lack of spawning observed that indicates its usefulness as indicator of physiological disturbances (Wester et al., 2003). The histological changes observed in the exposed female gonad were inhibit maturation of oocytes coupled with increasing number of attresic follicles (Vincent et al., 2009).

A histological response of the fish gonad to environmental stress has shown to be a biomarker indicative tool to assist in to the bio-monitoring process of aquatic ecosystem (Byuiyan et al., 2001). The histopathological changes produced may be due to direct action of heavy metal on ovaries or the reason may be damage of steroid producing tissues of ovary or action be mediated through hypothalamo -hypohysial route (Poorey, 1990). The ovary of fish *Cyprinus carpio* exposed to 0.5 ppm mercuric chloride exhibited large degenerative change with decreased genosomatic index (Masud et al, 2003). On the other hand the oocytes development was reduced in the same fish observed by Masud et al., (2009). Four ppm of Cd significantly decreases ovarian and testicular geno somatic index in the fresh water fish *Labeo bata* whereas 25 ppb of Cadmium decrease geno somatic index in winter Flounder (Das,1988; Pereira ea al., 1993).

4. Effect of cadmium on hormonal changes in fish species through polluted water

Cadmium (Cd) is a ubiquitous element and a significant inorganic pollutant that has previously been found to bioaccumulate in reproductive organs of fish and disrupts important endocrine processes, especially those involved in synthesis, release and metabolism of hormones. Gonadal steroid release was significantly decreased in males and female, Japanese Medaka at 0 to 10 ppb Cd exposure. In female plasma estradial levels were significantly altered at concentration higher than 5 ppb Cadmium (Tilton et al., 2003). Sangland and O'Hallaran, (1972) reported that the testis ability to synthesize steroid hormones invitro had also been affected by Cadmium. The gonads were unable to produced testeron or 11- Ketotestosteron from precursors.

Sanglang and Freeman (1974) recorded the effect of Cd on tissue development and hormone production on the testis of brook trout (*Salvelinus foniralis*).

Cd specifically modify amine metabolism of the central nervous system and pituitary hormone secretion. Thus the physiological function controlled by these hormone modulated by cadmium. Cadmium is associated with deleterious effects on the gonadal function and with changes in the secretary pattern of other pituitary hormone like prolactin ACTH, GH or TSH. In recent years, trace metals such as mercury, Cadmium, lead and copper have also been identified as EDCs able to interfere with the synthesis, transport and degradation of endogenous hormones. There is a wealth of literature available on the effects of trace metals on developmental and reproductive disorders observed in many different hormones and hormone functions (Salmon, 2007). Cadmium [Cd], have estrogenic affects through different molecular and cellular mechanisms (Safe, 2003; Henson et al., 2004) Several studies in mammals and fish suggest that Cd has a high affinity to ER (Safe, 2003; Henson et al., 2004). Estrogen receptor cadmium-binding sites have even been identified (Nesatyy et al, 2005).

5. Conclusion The above mentioned literature document that oxidative stress induced by metals is an important issue in aquatic ecosystem. Frequently aquatic contamination involves various chemicals that interact with one another. For that region studies on metal- metal infraction are required. Organic substance in water influences the availability of metal to fish and reduce metal toxicity. Some metals are rapidly bound to organic substances and thus cannot be detected in water however they can later become accessible in fish food. it should becorne in mind that fish of different species , sex, size and age are involved in field studies. Fish can be used as bioindicators of metal in the environment by studying the induction of oxidative stress; however the specific forms of biomarkers and mechanism of their action still need to be investigated. It can be concluded that the Cadmium and their compounds negatively affect fish life and also water resources.

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