Toxic Impact of Selenium Dioxide on Tissue-Protein-Profiles of Edible, Fresh Water fish, *Channa punctatus* (Bloch)

A.M. Avinashe

P.G. Department of Zoology
S.S.S.K.R. Innani Mavidyalaya, Karanja, Dist. Washim (M.S.), India
ajayavinashe@gmail.com

ABSTRACT

Selenium presents an interesting paradox in the field of aquatic toxicology because it is both a nutrient and a poison. Sub chronic exposure (up to 28 days)of freshwater fish, Channa punctatus(Bloch) to sub lethal concentration (0.5 mg/L) of Selenium dioxide resulted in record depletion in total protein in the organs like liver, gill, kidney, testis and ovary. The decline total protein in all above organs reflects an adverse influence of selenium dioxide exposure on metabolism as well as reproductive activity of the fish.

Keywords: *Channa punctatus,*Selenium dioxide, Liver, Gill, Kidney, Testis, Ovary

Introduction

Fish is an important source of food for mankind all over the world from the times immemorial. The importance of fish as source of high quality, balanced and easily digestible proteins, vitamins and polysaturatedfatty acids is well understood now. Fishes are valuablesources of high grade protein and other organic products. They are most important source of animal protein and have been widely accepted as a good source of protein and other elements for the maintained of healthy body (Andrew, 2001).

Fish are the richest source of an essentially healthy diet. They are however, endangered by water borne pollutants transferred along the food chain (Hoo*et al.*2004; Ayas*et al.* 2007; Kumar and Achyuthan, 2007;Shukla*et al.* 2007; Srivastava and Srivastava, 2008). During the past three decades there has been an increasing interest in the effect of trace elements on human health.Amongst various water pollutants, heavy metal poses a great threat to fishes.Selenium is an essential element and studies on the chemical reactivity of selenium containing compounds against peroxides and oxygen centered radicals led to the concept that selenium could be consider an antioxidant.Selenium interactions with other elements and enzymes, homeostatic mechanism and metabolic route need further studies especially on order to understand selenium toxicity causes. In this peace of investigation on selenium acute toxicity recorded on the tissue of organs like liver, gill, kidney, testis and ovary of freshwater, edible fish, *Channa punctatus*.

Materials and Methods

Live specimens of the freshwater fish, *Channa punctatus* (Bloch) were selected for the present research work. The fish were procured for the experimental purpose from the freshwater “Rishi Lake” of Karanja lad Dist. Washim, M.S., India. They were washed with 1% $KMnO_4$ solution for five minutes for dermal disinfection. The fish were acclimatizing to the laboratory condition for a period of fortnight before conducting the experiment. Particularly in morning hours, fish fed on small pieces of boiled eggs, once in a day.

The 10 fish including males &females, weighing between 46-50gms were selected for the experimental work. They were maintained in separate aquaria, containing free aged tap water.as per standard methods,

the physicochemical parameters of used aged tap water were determined periodically, (APHA,1998).

To study the toxic effects of Selenium dioxide on various organs. The experiments were conducted in two phases. In the first phase of experiment are the Control/ Normal set& second phase of Experimental set, fish exposed to sub lethal concentrations of the experimental toxicant selenium dioxide were studied.96h LC_{50} value was calculated by Probit analysis method (Sprague, 1973), as 2.5mg /L. In second set of an experiment the fish were exposed to sublethal concentration of toxicant selenium dioxide, which was 1/5 of the 96h LC_{50} i.e.0.5mg /L. The experiments were carried out in sub lethal concentration of toxicant selenium dioxide for a period of 7^{th}, 14^{th}, 21^{st}, and 28^{th}days. Parallel sets of control fish were run simultaneously in separate aquaria.

After 7^{th},14^{th},21^{st},and 28^{th} days four male and four female fish of control as well as experimental group were weighed and sacrificed immediately by giving a blow on the head and were dissected. The tissues like liver, Gill, kidney, testis and ovary from both the control and experimental fish were removed with sharp blade & rinsed in salinewater and then blotted with filter paper to remove the blood and cell debris and are to be used for biochemical analysis.Piecesof different tissues weighing 100 gm. prepared extract each were obtained in 90% alcohol for the estimation of protein.

Result and Discussion

In the present investigation, depletion of tissue protein in the fish, *Channa punctatus*exposed to the sub lethal concentration of selenium dioxide has been observed in the organs like liver, gill, kidney and gonads.The observations of the said peace of investigation are mentioned in Table 1.

Table-1 Alterations in total protein contents (mg / 100 gm wet weight) in different tissues of the fish, *Channa punctatus*, following exposure to sub lethal concentration of Selenium dioxide.

TISSUES		EXPOSURE (DAYS)			
		7	14	21	28
Liver	Control	**560.40**±0.62	**568.60**±0.98	**582.36**±0.78	**576.18**±0.80
	Experimental	**555.20**±0.44 (-0.92)	**511.10**±0.66 (-10.11)	**490.88****±0.44 (-15.70)	**410.44**±0.56 (-28.76)
Gill	Control	**144.28**±0.68	**143.80**±0.48	**136.68**±0.98	**142.66**±0.82
	Experimental	**133.76**±0.62 (-7.26)	**146.44****±0.77 (+3.22)	**126.24**±0.48 (-7.63)	**120.22**±0.38 (-15.72)
Kidney	Control	**222.40**±0.50	**221.64**±0.42	**224.12**±0.86	**226.08**±0.98
	Experimental	**202.12**±0.86 (-9.11)	**194.22**±0.74 (-12.37)	**170.62**±0.68 (-23.87)	**140.18*****±0.62 (-37.99)
Testis	Control	**58.16**±0.83	**57.80**±0.78	**58.36**±0.93	**58.44**±0.48
	Experimental	**54.30**±0.55 (-6.63)	**50.68**±0.96 (-12.31)	**44.12**±0.59 (-24.40)	**30.08**±0.38 (-48.53)
Ovary	Control	**311.82**±0.43	**310.65**±0.45	**311.40**±0.42	**310.84**±0.48
	Experimental	**271.32**±0.38 (-12.98)	**211.22****±0.33 (-32.00)	**181.32**±0.50±0.48 (-41.77)	**166.16*****±0.67 (-46.53)

•The values are mean± SD of five observations.
• Figure in parenthesis denotes percent change over control.
• *p < 0.05,**p< 0.01,***p<0.001, NS=Not Significant.

Reduced productivity of sperms and ova was observed in the goldfish,*Carassiusauratus* injected with cadmium (Sangalang and O'Halloran,1974).Earlier studied have also shown that lipid and protein concentration of vital organs like gill, liver, muscle and kidney depleted in fish, exposed to chromium(Arillo*et al.*1982;Ambrose *et al.*1994). Arora and Kulshrestha (1984) observed necrosis of interstitial cells and failure of spermatogenesis in fish, *Channa punctatus* exposed to carboryl and endosulfan. Even at sub lethal concentrations, chronic effects such as decreased reproduction, reduced growth and histopathological alterations in various tissues may occur (Spear, 1981). James *et al.*(1995) observed decreased in protein content in liver, muscle and gill of *Heteropneustes fossilis* exposed to copper, mercury and mixture of both.Jha and Jha (1995) observed protein depletion in liver and gonads of *Anabas testudineus* under the stress of nickel chloride. Exposure of *Cyprinuscarpio*and *Cirrhinamirgala* to zinc for 60 days also result in a decline of total protein in the ovary (Dhawan and Kaur, 1997).

Nanda *et al.* (2000), also reported gradual and significant reduction in the protein contents in the tissue like muscle, intestine, kidney, liver and gill in the fish, *Heteropneustes fossilis* after chronic exposure to nickel. Sindhe*et al*. (2002), observed a decline in liver and ovarian proteins of *Notopterusnotopterus* after exposure to various concentrations of cadmium chloride and mercuric chloride, individually and in combination, for 2 months.Exposure of *Channa punctatus* to Ni for 30 days (Desai *et al*.2002) and Zn for 15 days (Srivastava*etal.*2002)also result in a similar decline in the liver.

According toVutukuru(2003), the result of the present study indicated that the glycogen, total lipid and total protein concentration of liver, muscle and gill were depleted in *Labeo rohita* exposed to 96h LC_{50}concentration of chromium.

The mean values of total proteins were significantly decreased in the exposed fish compared to control. This implicates that the bioaccumulation of heavy metals triggers the oxidative stress in the liver cells by the generation of reactive oxygen species. The defensive surface proteins antagonise the toxic radicals resulting in elimination of protein from the liver cells. The lower level of total protein in plasma, muscle and liver reflects the capacity of protein synthesis and denotes the osmolarity of the blood and liver impariments. Hence, it is a valuable indicator in the diagnosis of toxicity in fish (Rajamanickam and Muthuswamy, 2008).The decline in total proteins and total lipids is similar in both liver and ovary (Srivastava and Verma 2009).

The major findings of the study of sub lethal concentrationsof selenium dioxide in the liver, gill, kidney and gonads of the freshwater, edible fish, *Channa punctatus*shows record changes in tissue protein profile.Thus the result of present investigation with toxic impact of selenium dioxide on tissue –protein profile is almost similar to those of the above investigators.

References

APHA (1998). In:Standard Methods for the examination of water and waste water. American Public Health Asso, 874.

Ambrose, T., C.A. Kumar, L. Vincent, S.R. Lambert (1994). Biological responses of *Cyprinuscarpio*communites to the toxicity of tannery effluent. J. Ecobiol., 3:213-216.

Andrew, A.E. (2001). Fish processing Technology , University of Horin press, Nigeria., pp:7-8.

Arillo, A.,C. Margiocco, F. Melodia, P. Mensi (1982). Biochemical effects of long term exposure of Chromium, Cadmium and Nickel on Rainbow trout, *Salmogairdnerii*, Chemosphere, 11: 45-58.

Arora, N. and S.K. Kulshrestha (1984). Composition of toxic effect of two pesticides on the testis of a fresh water teleost, *Channa striatus* (Bloch). Acta.Hydrochiumet. Hydrobiol., 12(4):435-441.

Ayas, Z,G. Ekmerkci, S.V. Yerliand M. Ozmen (2007). Heavy metal accumulation in water, sediments and fishes of Nallihan Bird paradise. Turkey, J. Environ. Biol.28:545-549.

Desai, H.S., B. Nanda and J. Panigrahi (2002). Toxicological effects in some biochemical parameters of fresh water fish, Channa punctatus(Bloch), under the stress of nickel. J. Environ. Biol. 23:275-277.

Dhawan, A. and K. Kaur (1997). Effect of zinc on maturation of and breeding potential of *Cyprinuscarpio* and *Cirrhinamirgala*. Intern. J. Environ.Stu.53:265-274.

Hoo L.S. , A. Samat and M.R. Othman (2004). The level of selected heavy metals (Cd, Cu, Fe, Mn, Pb and Zn) at residential area nearby Labs river system riverbank, Malaysia, Res. J. Chem.Environ.8: 24-29.

James R., K. Sampath, V. Sivakumar, S. Babu and R. Shanmuganandam (1995). Toxic effect of copper and mercury on food intake, growth and proximate chemical composition in*Heteropneustes fosilis*. J. Environ. Biol.16 (1):1-6.

Jha, B.S. and M.M. Jha (1995). Biochemical effects of nickel chloride on the liver and gonads of the fresh water climbing perch, Anabustestudinous (Bloch). Proc. Aca. Sci., India,65(8):39-46.

Kumar, A and H. Achyuthan (2007). Heavy metal accumulation in certain marine animals along the east cost of Chennai, Tamil Nadu,Indian J. Environ. Biol.28: 637-643.

Nanda, P., B.N. Panda and M.K. Behera (2000). Nickel induced alterations in protein level of some tissue of *Heteropneustes fossilis*. J. Environ. Biol.21, (2):117-119.

Rajamanickam, V. and N.Muthuswamy (2008). Effect of heavy metals induced toxicity on metabolic biomarkers in common carp (*Cyprinuscarpio* L.) Maejo Intern. J. Sci.Tech. 2,(01):192-200.

Sangalang, G.B. and M.K. O'Halliran (1974). Adverse effects of cadmium on brood trout testis and on in vitro testicular androgen synthesis. Biol. Reprod., 9:374-403.

Shukla, V., M. Dhankhar, J. Prakash and K.V. Sastry (2007). Bioaccumulation of Zn, Cu and Cd in *Channa punctatus*.J. Environ. Biol.28: 395-397.

Sindhe, V.R., M.V. Veeresh and R.S. Kulkarni (2002). Ovarian changes in response to heavy metal exposed to the fish,*Notopterusnotopterus* (Palas) J. Environ. Biol.23:137-141.

Spear, P.A. (1981). Zinc in the aquatic environment: Chemistry , distribution and toxicology. National Council of Canada Publication No. 17589.

Srivastava, N., N. Kushik and P. gupta (2002). Zinc induced changes in the liver and muscle of the fish, Channa punctatus (Bloch). J. Ecophysiol. Occup.Hlth. 2:197-204.

Srivastava, Rama and NeeraSrivastava (2008). Changes in nutritive value of fish, *Channa punctatus* after chronic exposure to zinc. J. Environ. Biol.29:299-302.

Srivastava Neera and Hemlata Verma (2009). Alteration in biochemical profile of liver and ovary in zinc –exposed fresh water murrel, *Channa punctatus*(Bloch). J. Environ. Biol.30,(3):413-416.

Vutukuru, S.S. (2003). Chromium induced alterations in some Biochemical Profiles of the Indian MajorCarp, *Labeo rohita* (Namilton). Bull. Environ. Contam.Toxicol.70:118-123.