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Impact Of Cadmium Chloride On Serum Cholesterol Level Of Ophiocephalus Striatus

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Abstract- Cholesterol is specialized lipids in nature it is classified as sterol. It is widely distributed in various animal tissues as well as in blood. It can be synthesized also in liver. It is important in metabolism serving as a precursor of various steroid hormones e.g. sex hormones, adrenal corticoids.Serum or plasma studies are of more clinical value than those of whole blood.The determination of serum cholesterol is considered to be significant marker of health condition of the animal as it associated with blood.

Key wards- Cadmium Chloride, Sub-lethal, blood physiology, serum cholesterol, hormones, Ophiocephalus striatus.

I. Introduction:-

Cadmium is a non-essential element, with no known biological function (Viarengo, 1985; Martinez et al., 1999), naturally found at low concentrations in natural waters (Eaton, 1974; Bennet-Chambers et al., 1999). It can have severe toxic effects on aquatic organisms when present in excessive amounts (Hollis et al., 1999), or even if present in extremely low concentrations (Witeska et al., 1989).Cadmium interacts strongly with zinc due to the chemical similarity of the two metals (DWAF, 1996). Cadmium Pollution sources are diverse, but it is commonly accepted that electroplating plants are mainly responsible (Cuthbert et al., 1976). The metal is widely distributed in natural waters due to industrial discharge (Pratrap and Wendelar Bonga, 1993), but it also occurs naturally in the earth's crust and is released with the natural weathering of rocks (DWAF, 1996).It is a fairly common pollutant of plating second-hand metal recovery operations (Eaton, 1974), aerosol fall-out from motor vehicles, paint manufacture, numerous chemical industries, and even sewage might contain high concentrations of the metal at times (Cuthbert et al., 1976). Then there is also agriculture (fertilizers and pesticides) and fossil fuel combustion, lead mining and zinc smelting (Eaton, 1974; Cuthbert et. al., 1976) that adds to cadmium pollution.

The toxicity of cadmium is connected to the metal speciation and water composition. The toxicity of cadmium increases at higher temperatures (Rottner and Health, 1995; DWAF, 1996). Other possible answers to cadmium's high toxicity could be due to the inhibition of enzymatic systems in both vertebrate and invertebrate organisms, but also combination with components of the cell membrane, affecting the permeability to organic and inorganic substances (Cuthbert et al., 1976). Its toxicity might also be because of competition blocking sulfhydry1 groups, which are essential for the normal functioning of enzymes and structural proteins. Cadmium is used primarily in nickel cadmium batteries in coating & plating operation in plastic, synthetic products & alloys industries. Cadmium is widely distributed as a mineral deposit & is found in shale & igneous (volcanic) rocks, coal, sandstones, limestones lake , marine sediments soils etc. Localised & naturally high cadmium concentration can be found in zinc ores where it forms isomorphic imurities in zic sulphide A few rare cadmium minerals are known such as greenokite (Cds), cadminoseite (Cdss) (John 1998).Mining, storage, & production of cadmium metals & dust cadmium oxides cadmium chemicals also results in emission of cadmium to water, air & soil. It also produced from disposal of cadmium products from industries, solid waste, and products of cadmium, scrape, hazardous waste, waste water & sludge.

Nickel cadmium batteries are a major source of cadmium. It also releases from zinc, steel, fertilizer cement, coal & oil burnt industries which were frequently used (John Davidson 1998).Cadmium is naturally released to the environment from volcanic sources (some of 60% of total natural emission) & along with rain water it reaches up to the water bodies. (Boyland 1998). Small amount of cadmium minerals are also associated with lead minerals. Cadmium occurs in earth crust along with zinc, lead-zinc compounds, lead zinc-copper ores. It is usually found as cadmium sulphide.

The average concentration in earth curst is about 0.2 ppm cadmium compounds such as cadmium oxides, carbonates, sulphide & hydroxide are insoluble in water but cadmium fluorides, bromide, chlorides, iodide, nitrate, & sulphate are particularly water soluble. Cadmium is used for electroplating of metals (Butterworth 1995). The aquatic environment is an extremely diverse & highly variable system, crucial for the continued survival of life on planet earth.

The physical & chemical properties for natural waters differ inherently between areas. This is mainly due to differences in the area’s climate, geomorphology, geology, & type of soil (Davis & Day 1998).However, slow & continuous changes by man over the ages have meant that the vast majority of waters on the earth’s surface may no longer be regarded as being in their natural state with respect to their dissolved & particulate matter (Jobling 1995). With the onset of industrial revolution significant changes in natural water chemistry occurred. Most importantly the mining of metal ores & coal produced contaminated drainage water, resulting in increased heavy metal concentrations in flowing & standing waters (Llyod 1992).

II. Determination of serum cholesterol level:-

Cholesterol is specialized lipids in nature is classified as sterol. It is widely distributed in various animal tissues as well as in blood. It can be synthesized also in liver. It is important in metabolism serving as a precursor of various steroid hormones e.g. sex hormones, adrenal corticoids.Cholesterol is more or less evenly divided between plasma & erythrocytes. Serum or plasma about 70 % is present as cholesterol esters of fatty acids. Serum or plasma studies are of more clinical value than those of whole blood. Hypercholesterolemia commonly accompanies hyporglycemia in diabetes mellitus. This condition probably arises from an accumulation of ketone bodies & “active acetate” which lead to increased synthesis of cholesterol. Serum or plasma studies are of more clinical value than those of whole blood. The determination of serum cholesterol is considered to be significant marker of health condition of the animal as it associated with blood. Low cholesterol level (hypercholesterolemia) is associated with anemia, hemolytic jaundice acute infection & hyperthyroidism.

III. Materials & Methods:-

Live & healthy fishes was used for collecting the blood. The initial mean weight & length of fishes were 100 ± gm & 25-30 cm respectively. Blood samples were collected from the puncturing the caudal vein after 96 hrs exposure periods of median lethal (LC50) & sub-lethal (10 % of LC50) during 24 – 96 hrs. The percent serum cholesterol content is calculated. The method was suggested by Alcohol-Acetone method Plummer (1990) .Where as the statistical analysis was done by Standard deviation.

IV. Results:-

In present investigation the serum cholesterol content was determined in Ophiocephalus striatus exposed median lethal (LC50) & sub-lethal (10 % of LC50) during 24 – 96 hrs along with control. Serum cholesterol level is increased significantly in experimental (LC50) at 96 hrs fishes. Serum cholesterol level is also steadily but slightly increased in sub-lethal (10% of LC50) during 24-96 hrs over control sample of fishes. Shown in table.1 and 2.

V. Discussion:-

Thyroxine decreases the fat storage by mobilizing it from adipose tissues like liver & kidney & mobilized fat is converted into free fatly acids & transported by blood. Thus thyroxine hypo secretion increases the cholesterol level in serum possibly this reason is responsible for slightly increases the serum cholesterol level. In present study in experimental fish of liver & kidney shows highest reduction in total lipids level. Possibly the endocrine dysfunction is responsible for slightly increases the serum cholesterol level in experimental fish.

Table:1 Levels of serum cholesterol level in Ophiocephalus (channa) striatus exposed to median lethal (LC50) at 96 hrs. & sub-lethal (10% of LC50) at 24 - 96 hrs. concentration of cadmium chloride ($CdCl_2$).

Parameter mg / dl.	Exposure					
	Condition	Median lethal at 96 hrs. (LC50)	Sub-lethal (10 % of LC50)			
			24 hrs	48 hrs	72 hrs	96 hrs
Serum cholesterol	Control	165.12 ± 4.47	165.10 ± 4.07	165.14 ± 5.47	165.12 ± 4.98	165.15 ± 5.61
	Experimental	169.48 ± 4.69*	165.91 ± 4.28*	166.50 ± 3.29*	167.11 ± 5.80*	167.90 ± 3.70*

Values are mean ± SD of six replicates significant at.*P < 0.05, **P < 0.01, ***P > 0.01 significant when student's't' test was applied between control & experimental groups.

Table: 2 Variation in level of serum cholesterol content in Ophicoephalus (channa) striatus in terms of % increase (↑) over control exposed to median lethal (LC50) at 96 hrs. & sub-lethal (10% of LC50) at 24 - 96 hrs. concentration of cadmium chloride ($CdCl_2$).

Parameter	**Exposure**				
	Median lethal (LC50) at 96 hrs. % (↑)	**Sub-lethal (10 % of LC50)**			
		24 hrs %(↑)	**48 hrs** %(↑)	**72 hrs** %(↑)	**96 hrs** %(↑)
Serum cholesterol	2.64	0.49	0.82	1.20	1.66

Another hypercholesterolemia commonly comprises hyperglycemia in diabetes mellitus. This condition probably arises from an accumulation of ketone bodies which leads to increased synthesis of cholesterol. In histopathologically degradative changes caused the increased cholesterol level. Similar kinds of result are found in experimental liver & kidney of fish in histopathological studies in present work. So it is evident that a histopathological change in experimental liver & kidney is responsible for increased serum cholesterol level.

Atef (2005) stated the increased serum cholesterol level in fresh water fish Oreochormis niloticus sub-lethal exposed to cadmium. He also concluded that increased serum cholesterol level is possibly due to the degradative changes in liver & kidney also it is caused due to the nephrotoxic changes in kidney of fish.

Mona et.al., (2007) stated that hyercholestermia is found in experimental fish Clarias lazera. She also concluded that hyercholestermia might be due to necrotic changes occurring in liver with liberation of cholesterol as a byproduct of cell destruction. She also stated that impaired liver function due to necrosis leads to increased serum terasnsaminase enzymes activity. In present work SGPT& SGOT level are significantly increases in experiment fish. Singh & Reddy (1990) mentioned the increased serum cholesterol level in Indian cat fish Heterobranchus fossilis (Bloch) exposed to copper sulphate.Kumar & Barthwal (1991) stated the increased serum cholesterol level in rat exposed to hexavalent chromium.

Hontela et.al.,(1996) concluded that cadmium is decreases the thyroid secretion (hypothroidism) & affects the metabolic function in Rainbow trout possibly caused the increased serum cholesterol level.Richard et.al.,(1998) concluded the subchronic exposure of cadmium choride infulence the thyroid function (hyposecretion) & affects the metabolic function in Rainbow trout Oncorhynchus mykiss.

Kirubagaran & Joy (1994) stated that the short term exposure of methyl mercury chloride decreases thyroid hormones level in cat fish Clarias batraus. Aziz et.al., (1993) stated that the serum cholesterol level is slightly increased in fresh water fish Tilapia mossambic sub-lethal exposed to cadmium chloride. He also concluded that increased serum cholesterol level is associated with liver & endocrine dysfunction in cadmium exposed fish.

VI. Conclusion:-

The serum cholesterol content in all the toxicant exposed median lethal (LC50) at 96 hrs and sub-lethal (10 % of LC50) fish was significantly increased over the control. The order of increase in toxicant exposed fish over the control is observed in following manner 24hr<48hr<72< 96hr in sub-lethal (10 % of LC50). The highest increase in serum protein content was found in median lethal concentration (LC50) at 96 hrs. In present study increased level of serum cholesterol level in experimental fishes is possibly due to the endocrine dysfunction as well as kidney dysfunction due to cadmium chloride toxicity.

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