International Journal of Global Science Research **ISSN: 2348-8344 (Online)**
Vol. 12, Issue. 2, October 2025, pp. 2678-2687 **DOI: https://doi.org/10.26540/ijgsr.v12.i2.2025.310**
***Available Online* at www.ijgsr.com**

Research Paper

Determination of LC_{50} value of mercury chloride in common carp (*Cyprinus carpio)*

Kirti Singh, Kaneez Zahra and Vijay Kumar Yadav*****
Department of Zoology, Bipin Bihari Post Graduate College, Jhansi, Uttar Pradesh, India
*****Corresponding author Email: vijaybetwa@gmail.com

Received: 19/07/2025
Revised: 25/07/2025
Accepted: 03/08/2025

Abstract: Common carp (*Cyprinus carpio*) is off great importance in toxicological work together with economic aspects. The aim of present work was to determine LC_{50} value of mercury chloride on *Cyprinus carpio* at different time intervals. The fish were treated with different concentration of mercury chloride with increasing concentration for 96 hours. The mortality was recorded after a period of 24h, 48h, 72h and 96h. A dose response curve between % mortality and concentrations of toxicant was plotted. To calculate LC_{50} by probit analysis the concentrations were converted into log concentration. LC_{50} values for different time interval were obtained from the curves by drawing aperpendicular line at 5 probit corresponding to the 50% mortality and taking the inverse log of the concentrations associated with it. We calculated LC_{50}value of 1.15Mg/L, 1.10Mg/L, 1.07 Mg/L and 1.03 Mg/L for the periods 24h, 48h, 72h and 96 h respectively.

Keywords: Common carp, *Cyprinus carpio*, Lc50, Mercury chloride, Probit analysis, Toxicity.

Introduction:

Fishes are source of livelihood for millions of marginalized peoples. Fishes are also ideal model for toxicological research and largely used as bioindicator for aquatic ecosystems. Fishes are most important aquatic food and frequently consumed by humans. Fishes have expressed large economic importance and highly sensitive to heavy metals and toxicants discharged in the aquatic ecosystems. Fish consumes heavy metal by contaminated water or indirectly through eating live things that have bio accumulated the metals (Javed, 2005; Singh and Zahra 2017). Pollution of water bodies with heavy metals is now well documented and its effect of aquatic organisms such as fishes is an active area of research now a day (Sadauki *et. al.*, 2024). Even though some heavy metals are important for aquatic animals in balance amount for their physiological function, however, if present at higher concentration they concentrated in different organs depends on the type of heavy metal and their reaction with target organs, damage tissues, disturbs biochemical and hematological parameters, slow growth and proliferation (Majeed 2023; Alkarkhi, *et. al.*, 2009). Mercury chloride has been considered as most dangerous aquatic pollutant, because

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of its toxicity, bioaccumulation, and bio-magnification properties at higher trophic levels and also due to its non-biodegradable nature. In fishes, mercury chloride targets mainly the body's vital organ like kidney, liver and gastrointestinal tract, organic mercury and its vapor also affects the central nervous system Vahter *et. al.*, 2000; Ghosh and Sil, 2008). Biochemical, histopathological, physiological and behavioral changes in response to $HgCl_2$ exposure is well described in fishes (Jasim *et. al.*, 2016; Saswan *et. al.*, 2012; Kousar *et. al*., 2018; Abdullah et. al., 2018; Latif and Javed, 2018). In long term heavy metals can accumulate in human body that is able to start hematological and histopathological alterations (Clarkson, 1990).

Different indices are adopted to estimate the influence of a given pollutant on the mortality of a given species, e.g., the TL (Tolerance Limit), the LD (Lethal dose), the LC (Lethal concentration) and the ST (Survival time). Several of these criteria are routinely used to establish maximum acceptable values of pollutants (Rajan, 2002). The most important is the LC_{50} (median lethal concentration), which is the theoretical value, causing 50% mortality in the test population. The LC_{50} value is determined after 24hours, 48hours and in some cases after 96 hours Parray *et. al.*, 2017; Vutukuru, 2005). The basic protocol for the determination of LC_{50} is well established and consists of treating groups of animals with a mathematically related series of doses in order to determine the dose that kills 50% of the group and the dose response function (Rengarajulu, 2002). The aim of the present study is to determine LC_{50} value of mercury chloride in *Cyprinus carpio* for 24 hrs, 48 hrs, 72 hrs,96 hrs. This fish is very common animal model for toxicological research and have great economic value. Result will definitely aid future research and development work in Bundelkhand region.

Materials and Methods:

Present work was conducted at department of Zoology, Bipin Bihari degree college, Jhansi affiliated to Bundelkhand University, Jhansi, U.P., India. Alive, healthy/ disease free common carp (*Cyprinus carpio*) of either sex from a single population having mean length and weight of 17.0±2.0 cm and 100.0±10.0 gm respectively were purchased from the nearby fish farm during November to march, 2023. Only healthy fish were employed for the experiment after being properly inspected for damage and disease conditions. Prior to reaching the fish laboratory, the specimens were carried in plastic containers filled with chilled, oxygenated water to reduce their activity and stress. The fish were kept in clear glass tanks so that any abnormal signs could be seen. The fishes were checked against any dermal injury or infection by keeping in 0.2% potassium permanganate solution for 2-4 min. The fishes were acclimatized in laboratory conditions for 5-10 days under natural photoperiod. During acclimatization the fishes were fed with commercial diet. The aquarium used was washed with soap, rinsed with clean water then disinfected with chlorine for 24 hours and sun dried. Each aquarium was filled with 05 carps. Mean temperature of alkaline water (pH7.5±0.2) with total hardness of about 220 ppm was 25±2.5°C. Dissolved O_2 and CO_2 ranged between 5-6 ppm and 3-4 ppm respectively. Total dissolved solid (TDS) was around10 ppm in all the experimental tanks. Alkalinity was 450 ppm for MO (Methyl Orange) and nil for PHP (Phenolphthalein). All the tanks tested negative for Lead nitrate. The optimal values for temperature, pH, and dissolved oxygen were established through regular measurements taken during the acclimation and experimentation phases. Fishes were not given feed 24h before experiment. Mercury chloride (mercury (II) chloride) supplied by manufacturer Alpha Chemika pvt. Mumbai

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was used in the toxicity test.

Two range finding tests for determination of LC_{50} of mercuric chloride ($HgCl_2$) were performed. Wide concentration range was based on previous studies. First test was performed with 3 concentrations i.e. 0.1, 1.0 and 2.0 mg/L respectively and a control group in duplicate taking 5 fish in each aquarium to determine mortality between 0% to 100%. Second test was also performed in duplicate having concentration of 0.1, 0.2, 0.3, 0.4,0.5, 1.0, 1.5, 2.0, mg/L respectively and a control group with same number of fish. Based on the range finding test results, definitive test was per formed with concentrations 0.5, 0.75, 1.0, 1.10, 1.20, 1.25 and
1.50 mg/L respectively (3 replicates with 5fish per aquaria). The mortality was recorded after a period of 24h, 48h, 72h and 96h and dead fish were removed when observed. The concentrations from the definitive test were employed to determine the LC_{50} values by plotting a dose response curve between % mortality and concentrations of toxicant. To calculate LC_{50} by probit analysis the concentrations obtained from definitive test were converted into log concentration. LC_{50} values for different time interval were obtained from the curves by drawing a perpendicular line at 5 probit corresponding to the50% mortality. The actual LC_{50} was determined by taking the inverse log of the concentrations associated with it.

Results:

First range finding tests observed 100% mortality after 24h at 2.0 mg/L concentration. Second range finding test observed 80% mortality at1.5 mg/L concentration after 24 h and 100% mortality was observed after 48h respectively. On the basis of second range finding test, we have taken concentration viz. 0.5, 0.75, 1.0, 1.10, 1.20, 1.25 and 1.50 mg/L for definitive test and observed mortality at different time intervals as mentioned in table/graph 1.

Table: 1. Definitive test for direct interpolation method

Conc. of toxicant (Mg/L)	No. of fishes	24 hours		48hours		72 hours		96 hours	
		M	M%	M	M%	M	M%	M	M%
0.50	5	0	0	0	0	0	0	0	0
0.75	5	0	0	0	0	0	0	0	0
1.00	5	1	20	0	20	0	20	0	20
1.10	5	1	20	0	20	0	20	1	40
1.20	5	1	20	0	20	1	40	1	60
1.25	5	5	100	-	-	-	-	-	-
1.50	5	4	80	1	100	-	-	-	-
1.75	5	5	100	-	-	-	-	-	-

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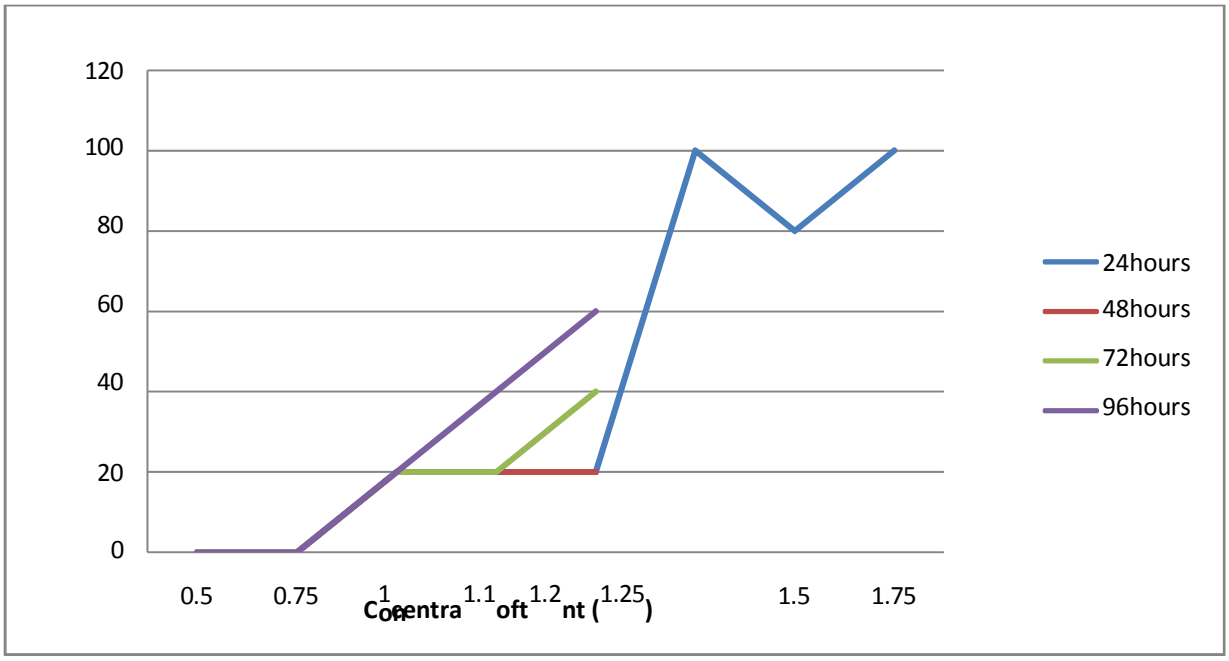

Graph: 1. Percentage mortality after applying different concentration of toxicant at different time intervals

The concentrations taken in definitive test were converted into log concentrations. The correct % and their corresponding probit values are shown in table 2 & 3. After plotting a graph between the log concentration and probit, we observed LC_{50} at1.15Mg/L, 1.10Mg/L, 1.07Mg/L and1.03Mg/L after24h, 48h, 72h and 96hr espectively **(Graph 2-5)**.

Table: 2. Log concentrations and probit values when exposed to $HgCl_2$ after 24 and 48h

Conc. (Mg/L)	Log Conc.	No. of fishes	24 hours			48 hours		
			% dead	Correct %	Probit	% dead	Correct %	Probit
0.50	- 0.301	5	0	5	3.36	0	5	3.36
0.75	- 0.124	5	0	5	3.36	0	5	3.36
1.00	0	5	20	20	4.10	20	20	4.10
1.10	0.041	5	20	20	4.10	20	20	4.10
1.20	0.079	5	20	20	4.10	20	20	4.10
1.25	0.096	5	100	95	6.64	100	95	6.64
1.50	0.176	5	80	80	5.84	100	95	6.64
1.75	0.243	5	100	95	6.64	100	95	6.64

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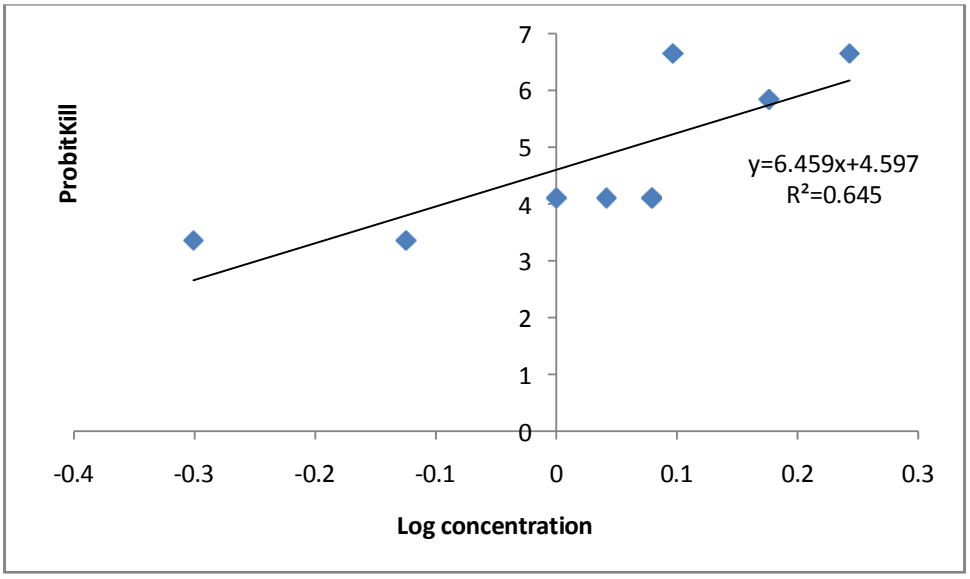
Table: 3. Log concentrations and probit values when exposed to $HgCl_2$ after 72 and 96h

Conc. (Mg/L)	Log Conc.	No.of fishes	72 hours			96 hours		
			% dead	Correct %	Probit	% dead	Correct %	Probit
0.50	- 0.301	5	0	5	3.36	0	5	3.36
0.75	- 0.124	5	0	5	3.36	0	5	3.36
1.00	0	5	20	20	4.10	20	20	4.10
1.10	0.041	5	20	20	4.10	40	40	4.76
1.20	0.079	5	40	40	4.76	60	60	5.25
1.25	0.096	5	100	95	6.64	100	95	6.64
1.50	0.176	5	100	95	6.64	100	95	6.64
1.75	0.243	5	100	95	6.64	100	95	6.64



Graph: 2. Determination of LC_{50} at 24h

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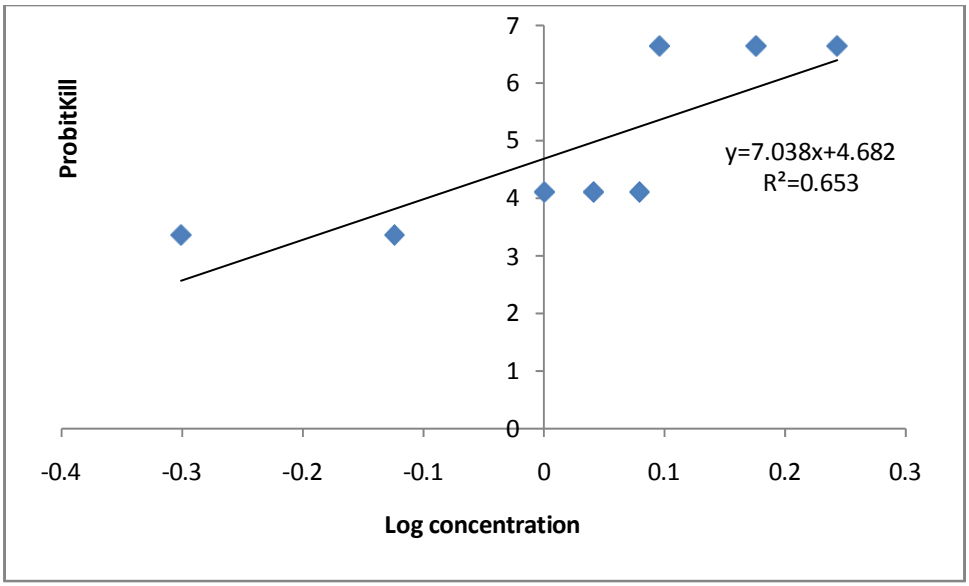
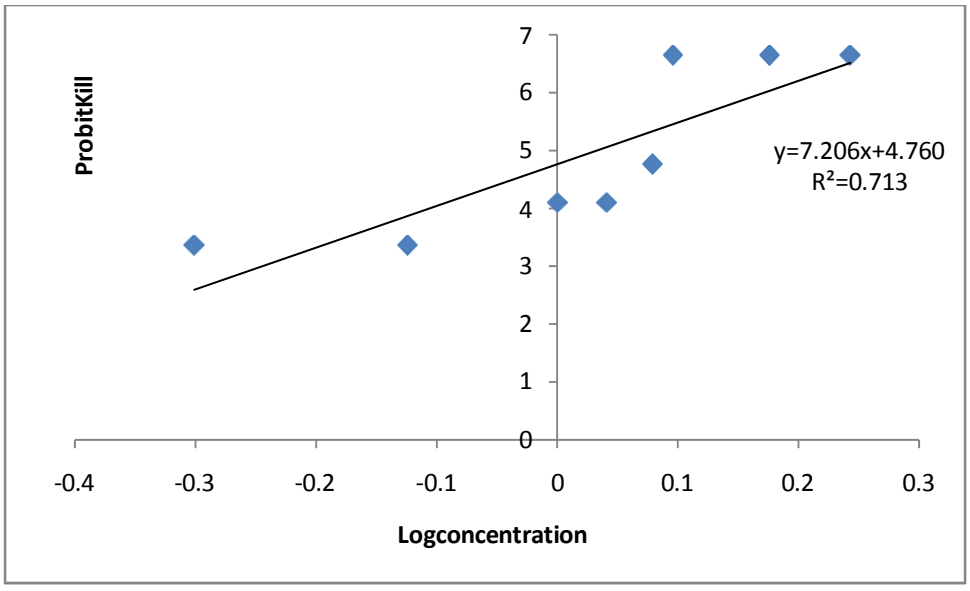


Graph: 3. Determination of LC_{50} at 48h



Graph: 4. Determination of LC_{50} at 72h

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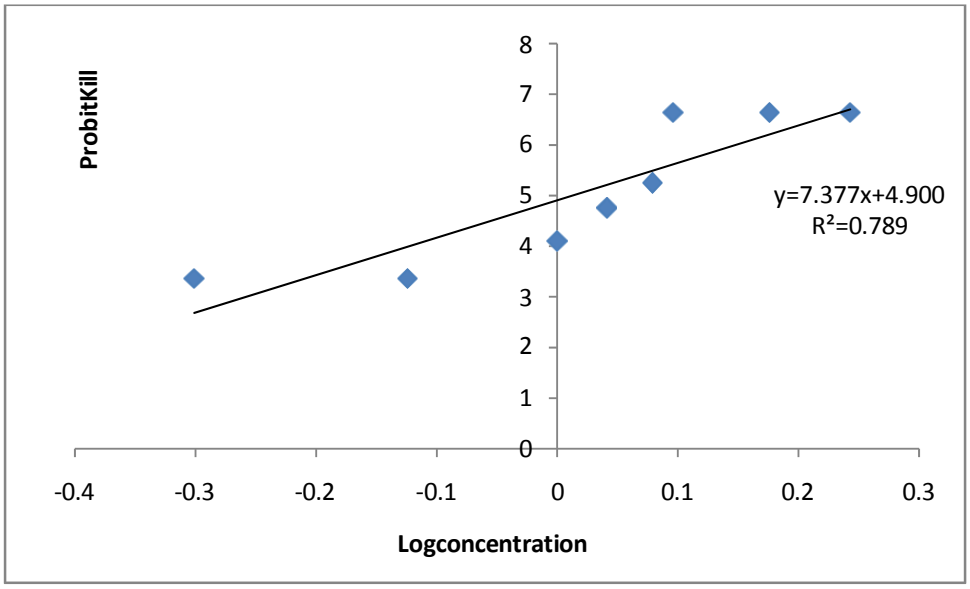

Graph: 5. Determination of LC_{50} at 96h

Discussion:

Various workers carried out determination of LC_{50} value of $HgCl_2$ on different fish models. Itis important to mention that workers denoted concentration of $HgCl_2$ by different units of measurement. The LC_{50} values of $HgCl_2$were 1.339, 0.649,0.411 and 0.310 (Pg/L) at 24, 48, 72 and 96 hours respectively in marine fish *Theraponjarbua* and observed significant increase in MN (micro nucleus) frequency in erythrocytes (Nagrani, *et. al*., 2009). The 96 h LC_{50}value of mercuric chloride was 0.6ppm in *C. batrachus* using the probit analysis method (Maheswaran *et. al*., 2008). The acute toxicity for 96 h LC_{50} was found to be 0.25Mg/Lfor freshwater fish *Labeo rohita* (Naik *et. al*., 2017). Median lethal concentration (LC_{50}) for mercury chloride to fish *Cyprinus carpio* for 96 hours was found to be 1.3ppm (Lone et. al., 2021). The median lethal concentration of $HgCl_2$ for 24hours was 0.3 ppm and for 96 hours it was 0.1 ppm (Rajan, 2002). The LC_{50} values of Hg within 24, 48, 72 and 96 h recorded for *Oreochromis sp.* with 95% confidence limits were1.09 (0.92-1.40mg/L), 0.75 (0.47-1.32mg/L), 0.54 (0.12- 0.96 mg/L) and 0.30 (0.17- 0.44 mg/L). Furthermore, it was added that tolerance to mercury decreases with the increased in time of exposure (Jasim *et. al*., 2016). The LC_{50}-96h of mercury was 0.24 Mg/L for Nile tilapia *Oreochromis niloticus* (Kaoud and Mekawy, 2011). LC_{50}-96h of mercury had higher value (1.15 mg/L) in air-breathing fish *Channa punctatus* (Pandey *et al*., 2008; 2005). Histopathology of liver, kidney, spleen, gills and muscles of fresh water fish exposed to ½ LC_{50} (96 hours) for 7 days and for 1/10 LC_{50} (96 hours) found Hg residues 0.22 ppm/gm at 2nd day, 0.411 ppm/gm in the 5th day ended with 0.96 ppm/gm in the 7th day in acute toxicity. In chronic toxicity it was 1.1320, 1.7140, 2.3620 and 3.5640 ppm/gm respectively from the 2nd to the 8th week of exposure (Saswan *et. al*.,

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2012). Common carp (*Cyprinus carpio*) exposed to water borne $HgCl_2$ at levels of 0.01, 0.05 and 0.1 Mg/L respectively for 30 days showed significantly decreased in lymphocyte transformation index, phagocytic/ lysozyme activities, albumin and globulin content and increased blood glucose, urea particularly at higher dose of $HgCl_2$ (Mustafa and Al-Rudainy, 2021). There was decrease of erythrocytes by 1,678,000 cells/ mm3, leukocyte increase by 16,360 cells/mm3, hemoglobin decrease by 6.7g/dl , hematocrit decrease by 10.24% and an increase in blood sugar by 99 mg/dl in treatment with 0.015 ppm $HgCl_2$ (Setiyowati *et. al.*, 2019). Restlessness, erratic swimming, jerky body movement, rolling body, convulsion, mucous secretion, loss of equilibrium, rapid opercular movement, difficulty in breathing, lethargic are some observed behavioral responses (Majeed, 2023). The concentration of electrolytes such as Na+, K+ and Cl- is also get affected by $HgCl_2$ (Clarkson, 1990). It is clear that mercury chloride affect organisms at every biological parameter even at very low concentrations. So far LC_{50} value is concerned, we observed comparatively higher concentration that may be due to variation in species local population and/or experimental conditions.

Conclusion:

The present study was an attempt to find the toxicity mercury chloride on common carp (*Cyprinus carpio*) and the results conclusively showed that this is highly toxic to fishes even at very low concentration. Mercury chloride is now leading toxicant present in aquatic ecosystem affecting aquatic environment and organisms from cellular to behavioral level. Common carp is amodel organismfor ecotoxicological researchtogetherwith its economic importance. Determination of LC_{50} of mercury chloride for this fish will help researchers in ecotoxicological research and economic wellbeing of peoples living in socioeconomically backward region of Bundelkhand of this country.

References:

Javed, M. (2005) Heavy Metal Contamination of Freshwater FishandBedSediments inthe River Ravi Stretch and Related Tributaries. Pakistan Journal of Biological Sciences, 8 1337-1341.
DOI:10.3923/pjbs.2005.1337.1341URL: https://scialert.net/abstract/?doi=pjbs.2005.1337.1341

Singh, A. and Zahra, K. (2017) LC_{50} Assessment of cypermethrin in *Heteropneustes fossilis*: Probit analysis. Int J Fisheries Aquatic Studies. *5*(5), 126-130.

Sadauki, M. A., Auta, T. and Umaru, J. (2024) An appraisal of aquatic pollution: Areview. Agricultural Science: An International journal, 1(2), 1-19

Majeed, M. (2023) The Protective Role of vitamin C ascorbic acid against lead induced hematological and histological alterations in common carp *Cyprinus Carpio* Linn. Ph. D. thesis. Department of applied zoology and aquaculture, Barkatullah University. http://hdl.handle.net/10603/579977

Alkarkhi, A. F., Ismail, N., Ahmed, A. and Easa, A. M. (2009) Analysis of heavy metal concentrations in sediments of selected estuaries of Malaysia a statistical assessment. Environmental monitoring and assessment. 153 (1-4), 179-185. DOI: 10.1007/s10661-008-0347-x.

Vahter, M., Åkesson, A., Lind, B., Björs, U., Schütz, A. and Berglund, M. (2000) Longitudinal study of methylmercury and

inorganic mercury in blood and urine of pregnant and lactating women, as well as in umbilical cord blood. Environmental Research. 84(2), 186- 194.

Ghosh, A. and Sil, P. C. (2008) A protein from *Cajanus indicus* Spreng protects liver and kidney against mercuric chloride-induced oxidative stress. *Biological and* Pharmaceutical Bulletin. 31(9), 1651-1658.

Jasim, M. A., Sofian-Azirun, M. Yusoff, I. and Rahman, M. M. (2016) Bioaccumulation and histopathological changes induced by toxicity of mercury ($HgCl_2$) to Tilapia fish *Oreochromis niloticus*. *Sains Malaysiana*. 45(1), 119–127

Saswan, A. O., Elobeid, M. and Fouad, E. (2012) Cadmium Bioaccumulation and Toxicity in Tilapia Fish (*Oreochromis niloticus*). Journal of animal and veterinary advances. 11(10), 1601- 1606. http://dx.doi.org/10.3923/javaa.2012.1601.1606

Kousar, S., Javed, M., Ambreen, F., Ashraf, A., Ilyas, R., Batool, M. and Azmat, H. (2018) Assessment of copper induced genotoxicity in peripheral erythrocytes of *Cirrhina mrigala* by using Comet Assay and Micronucleus Test. Pakistan J. Zool. 13, 65-73

Abdullah, S., Mateen, A., Abbas, K., Naz, H., Hassan, W. and Anum, S. (2018) Changes in glutathione S- transferase activityin fish *Channastriata* exposed to different aquatic pollutants (Heavy metals and pesticides mixture). Pakistan J. Zool. 13, 42-47

Latif, F. and Javed, M. (2018) Cadmium induced oxidative stress in different organs of *Labeo rohita* and *Catla catla.* Pakistan J. Zool. 32-35.

Clarkson, T. W. (1990) Human health risks from methylmercury in fish. Environmental Toxicology and Chemistry 9(7), 957-961.

Rajan, A. P. (2002) Bioaccumulation of mercury and its effect on nonspecific biomarkers of a freshwater teleost Fish *cyprinus carpio* var communis. Ph.D. thesis. Department of Zoology, Bharathiar University.

Parray, M. A., Dixit, R. and Rather, A. A. (2017) Acute toxicity of Mercuric chloride on the survival and behavioural response of Indian fresh water stinging cat fish *Heteropneustes fossilis* (Bloch,1794) at 48 and 96 hours. Ecology, environment and conservation. 27(2), 910-916.

Vutukuru, S. S. (2005) Acute effects of hexavalent chromium on survival, oxygen consumption, hematological parameters and some biochemical profiles of the Indian major carp, Labeorohita. International Journal of environmental Research and Public health. 2(3), 456-462.

Rengarajulu, V. (2002) Interactive effects of selenium and cadmium on the hematological and biochemical parameters of a freshwater fish *cyprinus carpio* var communis. Ph. D. thesis. *Department of Environmental Sciences, Bharathiar University*.

Nagrani, N., Devi, V. J., Devi, C. A. and Kumaraguru, A. K. (2009) Genotixicity assessment of mercuric chloride in the marine fish *Therapon jarbua*. Environment Asia. 50-54.

Maheswaran, R, Devapaul, A, Muralidharan, S, Velmurugan, B. and Ignacimuthu, S. (2008) Haematological studies of fresh water fish, *Clarias batrachus* (L.) exposed to mercuric chloride. International Journal of Integrative Biology. 2(1), 49-54.

Lone, V. B., Suryawanshi, V. D. and Jagtap, H. S. (2021) Effects of mercury chloride on hematological parameters to fresh water fish *Cyprinus carpio*. Journal of Emerging Technologies and Innovative Research. 8 912) 38-41.

Kaoud, H. A. and Mekawy, M. M. (2011) Bioremediation the toxic effect of mercury-

exposure in Nile tilapia (Oreochromis niloticus) by using Lemna gibba L. *Journal of American Science*. 7(3), 336-343.

Pandey, S, Parvez, S, Ansari, R, Ali, M, Kaur, M, Hayat, F, Ahmad, F. and Raisuddin, S. (2008) Effects of exposure to multiple trace metals on biochemical, histological and ultrastructural features of gills of afreshwater fish, *Channa punctata* Bloch. *Chemico-Biological Interactions*. 174, 183-192.

Pandey, S, Kumar, R, Sharma, S, Nagpure, N, Srivastava, S. and Verma, M. (2005). Acute toxicity bioassays of mercuric chloride and malathion on air-breathing fish *Channa punctatus* (Bloch). Ecotoxicology and Environmental Safety. 61, 114-120.

Mustafa, S. A. and Al-Rudainy, A. J. (2021) Impact of mercury chloride exposure on some of immunological and biochemical assays of common carp *Cyprinus carpio*. Iraqi Journal of Agricultural Sciences. 52(3), 547-551.

Setiyowati, I, Suprapto, H. and Mahasri G. (2019) The Effects of mercury chloride ($HgCl_2$) on the changesin hematologyand blood sugarlevelincarps (*Cyprinus carpio*). *IOP Conf. Series:* Earthand Environmental Science. 236. 012104doi:10.1088/1755-1315/236/1/01210

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