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Histopathological Changes in the Kidney of fresh water Fish, *Channa gachua* (Ham.) on acute Nickel exposure

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ABSTRACT

Heavy metals are potential pollutants responsible for histopathological alterations in the fish. The present study deals with the toxic effect of heavy metal Nickel (Ni as $NiSO_4$ on the kidney of fresh water fish, *Channa gachua*. Kidney was examined in the 96 hrs LC50 acute test. Histological examinations of kidney revealed marked pathological alterations like atrophy of renal tubules, degeneration of hematopoietic tissue with necrosis and degeneration of connective tissue, blockage and degeneration of Glomerulus.

Key words: Nickel, Kidney, histopathology, *Channa gachua*

INTRODUCTION:

Environmental Pollution of has become a potential threat for life on earth. The major reasons for the pollution include population explosion and rapid industrialization. Domestic, Industrial and Anthropogenic activities have become the source of contamination of aquatic habitats. Discharge of domestic sewage, industrial effluents, pesticides, fertilizers, etc are the major sources of water pollution.

Many workers have reported the effect of pollutants on aquatic organisms. **Babu et al, 2009** reported histopathological changes in the gills and liver tissues of freshwater fish, *Cirrhinus mrigala* exposed to dichlorvos. Toxicity of Cadmium on the behavioral responses of Zebra Fish was reported by **Sekar et al, 2016**. Alterations in the immunological parameters of Tench (*Tinca tinca* L. 1758) were seen after acute and chronic exposure to lethal and sublethal treatments with mercury, cadmium and lead (**Shah and Altindag, 2005**). Early development of fish is affected by the environmental pollutants as reported by **Weis and Weis, 1989**. Lethal effect of different heavy metal pollution on fish was reported by **Sehar et al, 2014**.

Out of the various aquatic pollutants, heavy metals have a potential threat to aquatic organisms mainly fishes as they are non - biodegradable and tend to accumulate in the food chain. Heavy metals in fish come mainly from their diet, which are then passed from one trophic level to the other in the food chain (**Bawuro, 2018).** Many workers have reported the bioaccumulation of heavy metals in fishes. **Voegborlo et al, 2012** reported bioaccumulation of mercury in 6 species of fish from Kpong hydroelectric reservoir in Ghana. **Gorar et al, 2012,** reported heavy metal concentration in certain tissues of some commercial fish. Bioaccumulation of Heavy Metals in Pelagic and Benthic Fishes of Ogbese River, Ondo State, South-Western Nigeria were reported by **Josephine et al, 2021**. **Ali and Khan, 2019** reported trophic transfer, bioaccumulation and biomagnification of non-essential heavy metals in food chain and food web. **Authman, 2008** reported the level of heavy metal pollution and their lethal effects on *Oreochromis niloticus*. **Authman et al, 2015** reported the hazards of heavy metal pollution on aquatic organisms especially fish as a bioindicator. Assessment of heavy metals pollution and their effects on *Oreochromis niloticus* in aquatic drainage canals was reported by **Khallaf et al, 1998**. **Javed & Usmani, 2019** reported an Overview of the Adverse Effects of Heavy Metal Contamination on Fish Health**. Abida et al, 2009** analyzed heavy metals in water and fish samples of Madivala Lakes of Bangalore, Karnataka. **Deore and Wagh, 2021** reported alterations in liver of fish *Channa gachua* on exposure to heavy metals. **Mohammed, 2009** reported histopathological studies on *Tilapia zillii* and *Solea vulgaris* from Lake Qarun, Egypt.

Among the various heavy metals, Nickel is highly toxic and a nonessential metal. It is used in a range of industrial practices, like the production of stainless steel, Ni-Cd batteries, plating processes, refining ores, etc. Nickle is considered as an important xenobiotic and a nonbiodegradable chemical pollutant of the aquatic environment. Fishes serve as biomarkers of aquatic pollution (**Kelvin et al, 2017).**

Histopathological evaluation is an essential tool in toxicant impact assessment to indicate the effect of pollutants on fish health **(Bernet et al, 1999)**. It also allows for early warning signs of disease and injury in cells, tissues or organs of aquatic organisms. **(Javed and Usmani, 2013).** Thus, the study of histopathological changes due to the effect of pollutants in fishes is a suitable method to check the aquatic pollution. **(Reddy and Rawat, 2013).** The present study deals with the histopathological alterations in the kidneys of fish, which can be used as biomarker in various pollution monitoring programs.

MATERIALS AND METHODS:

Animal collection and maintenance:

Adult and live *Channa gachua* were collected from the local market and brought to the laboratory. Only healthy fishes, (Length-12-15 cms; Weight 50-56 gms) were taken for the experiment. Fishes were acclimatized in the glass aquaria for 15 days and were fed with fish food. Water in the aquarium was replaced after every 24 hours.

Test chemical:

Stock solution of Nickel Sulphate ($NiSO_4$) was prepared by dissolving appropriate amount of $NiSO_4$ as Ni salt in distilled water.

Bioassay:

Fishes were divided in two groups- Control and Experimental. In experimental group, the fishes were exposed to Nickel for a period of 96 hours. Simultaneously the control group were also maintained. The fishes that survived at the end of exposure period, were sacrificed, dissected carefully to isolate kidney and were fixed in the Bouins' fluid. The tissues were then proceeded for the Haematoxylin & Eosin (H & E) staining. The sections were examined under the light microscope (400X) and photographed.

RESULTS:

In fish, the normal histology of the kidney consists of coiled uriniferous tubules, composed of the Malpighian body and the renal tubules. The proximal segment is the thickened part of the nephron. Wall of proximal tubules is formed of columnar epithelial cells. The distal tubule has the same structure as that of proximal tubule. (Fig 1). In contrast to this, the kidney of treated fish with lethal concentration of Nickel for an acute period of 96 hrs at 150 ppm (LC_{50}) exhibited marked pathological changes as atrophy of renal tubules, shrinkage of glomerulus, degeneration of hematopoietic tissue and connective tissue. (Fig 2)

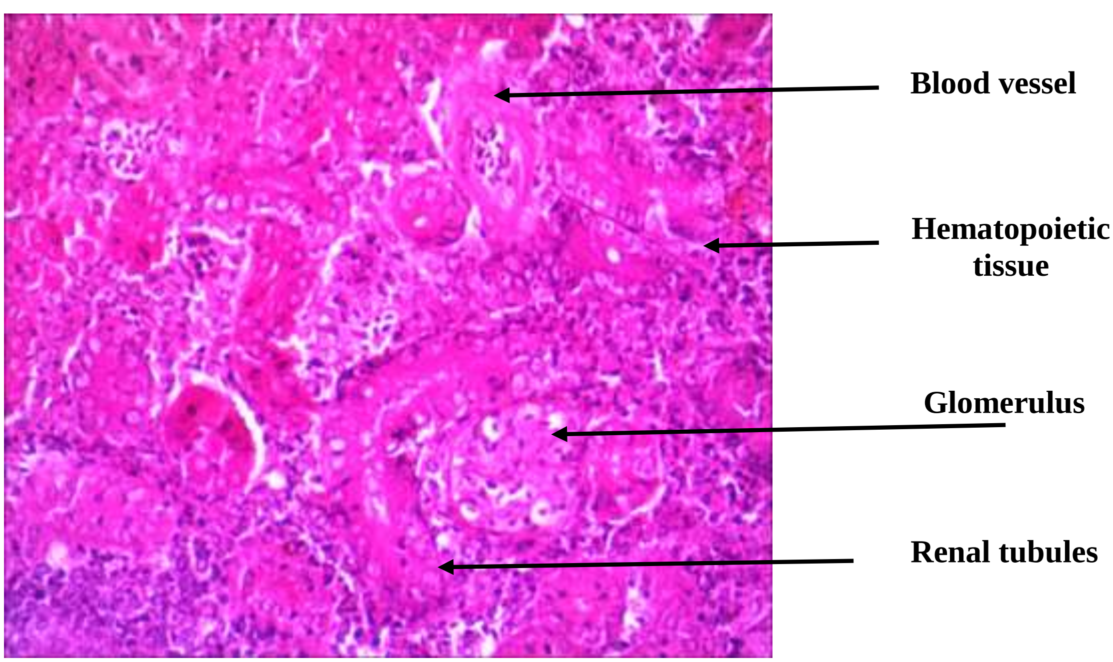

Fig 1: T. S. of Kidney of *Channa gachua* (Normal) (H/E) (400X)

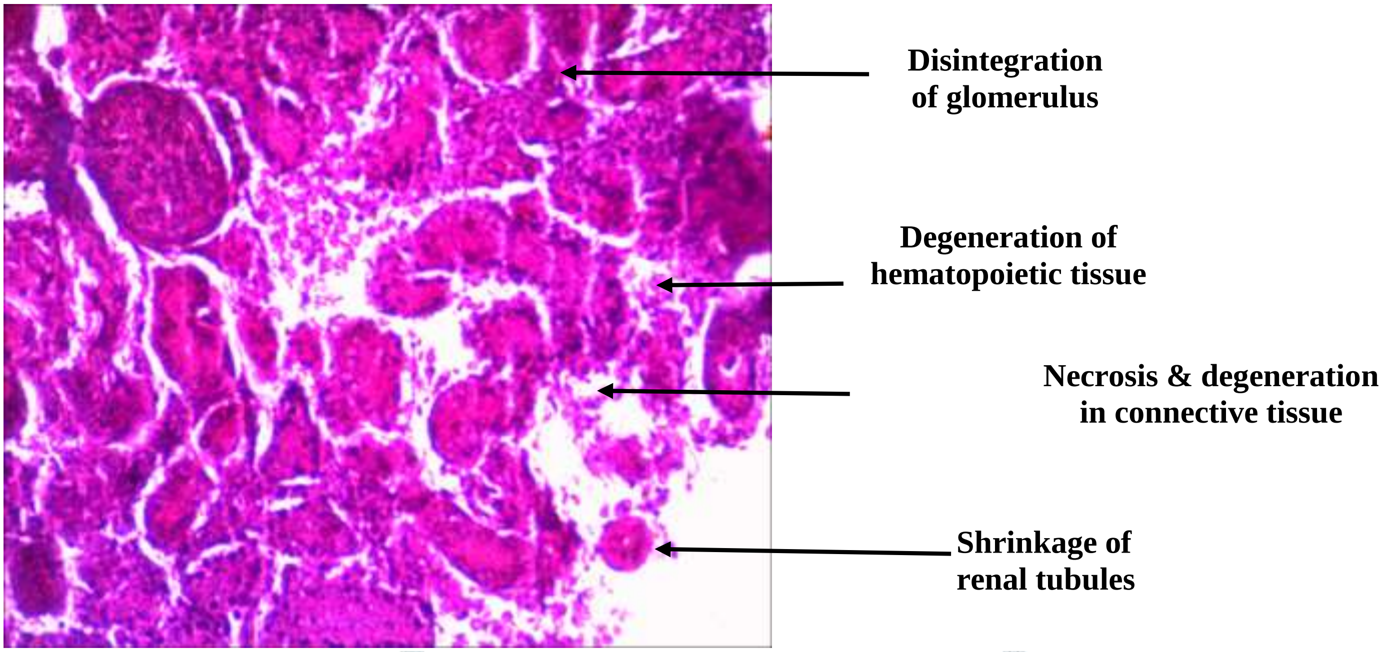

Fig 2: T.S. of Kidney of *Channa gachua* after exposure to heavy metal Nickel (Ni) as $NiSO_4$ at 150 ppm for a period of 96 hrs. (H/E) (400X)

DISCUSSION:

Aquatic pollution is one of the major challenges faced by the human society. Environmental contamination by heavy metals is a threat due to their tendency to bioaccumulate in the tissues of organisms. Heavy metals have become a matter of concern as they have become a major constituent of the industrial effluent. Results from the present investigation indicate that higher levels of heavy metal Nickel can have a negative effect on the fishes and may contribute to a decline in the fish population.

Kidney is a vital organ of excretion and osmoregulation and helps in maintaining a stable internal environment. It is also responsible for selective reabsorption, maintaining pH and volume of blood and body fluids. In the control fish, sections of kidney revealed normal architecture which consists of Bowman's capsule and closely arranged in renal tubules (Fig. 1). However, in the present study, histopathological changes were observed in the kidney of fish, *Channa gachua* on exposure to heavy metal Nickel as (NiSO4) for a period of 96 hrs at 150 ppm. The changes observed were atropy of renal tubules, shrinkage of glomerulus, degeneration of hematopoietic tissue and connective tissue. These investigations are in accordance with the study reported by **Vinodhini and Narayanan, (2009)** on histological alterations in the kidney of *Cyprinus carpio L*. (Common Carp) exposed to heavy metals.

These histopathological changes in the kidney are due to metal ion-kidney tissue interaction which lead to degenerative changes resulting in altered metabolic activity **(Gupta and Srivastava, 2006).** The cellular disintegration in kidney is due to accumulation of heavy metal nickel which in turn affect the process of excretion, osmoregulation as well as detoxification mechanism in fish (**Rana et al., 2015**). In fishes, these interactions disturb homeostasis leading to an unstable internal environment (**Kaur et al 2018**).

The toxicity effects of heavy metals on kidney has been studied by many workers. **Athikesavan et al, 2006** reported histopathological alterations in the kidney of freshwater fish, *Hypophthalmichthys molitrix (Valenciennes)* on exposure to heavy metals. **Saxena and Saxena, 2008** reported histopathological changes in Lymphoid Organs of Fish After Exposure to Water Polluted with Heavy Metals. **Singhal and Jain, 1997** reported Cadmium induced changes in the histology of kidney in common carp, *Cyprinus carpio* (Cyprinidae). **Ray and Banerjee, 1998** reported hematological and histopathological changes in kidney of *Clarias batrachus (Linn)* exposed to Nickel and Vanadium.

In recent years, environmental contamination by heavy metals has become a global public health problem. Also human exposure to metal pollutants has risen dramatically. From the present study it is suggested that precautionary measures should be taken against the discharge or the treatment of this effluent before releasing it in the fresh water bodies and also, a scientific method of detoxification is required.

CONCLUSION:

From the present study, it can be concluded that severe histopathological changes were observed in kidney of fish, *Channa gachua* which could be attributed to the significant accumulation of heavy metals Nickel in these tissue beyond the prescribed limits. Thus, it is suggested that there is a need for control of this type of pollution, which can be achieved by reduction or prevention at source.

REFERENCES

1. **Abida B, Harikrishna S, Irfanulla K (2009)**: Analysis of heavy metals in water, sediments and fish samples of Madivala Lakes of Bangalore, Karnataka. *Int J Chem Technol Res 1:245–249*
2. **Ali, H., & Khan, E. (2019):** Trophic transfer, bioaccumulation, and biomagnification of non-essential hazardous heavy metals and metalloids in food chains/webs—Concepts and implications for wildlife and human health. *Human and Ecological Risk Assessment: An International Journal*, *25*(6), 1353–1376.
3. **Athikesavan, S., S. Vincent, T. Ambrose and B. Velmurugan (2006):** Nickel induced histopathological changes in the different tissues of freshwater fish, *Hypophthalmichthys molitrix (Valenciennes) J. Environ.Biol.*27 (2) 391-395
4. **Authman MMN (2008):** *Oreochromis niloticus* as a biomonitor of heavy metal pollution with emphasis on potential risk and relation to some biological aspects. *Global Vet*., 2(3): 104-109

5. **Authman Mohammad MN, Mona S Zaki1 , Elsayed A Khallaf and Hossam H Abbas Authman et al, 2015:** Use of Fish as Bio-indicator of the effects of Heavy Metals Pollution *J Aquac Res Development* 2015, 6:4
6. **Babu VelmuruganI; Mariadoss SelvanayagamI; Elif Ipek CengizII, Erhan UnluII (2009):** Histopathological changes in the gill and liver tissues of freshwater fish, *Cirrhinus mrigala* exposed to dichlorvos **Environmental Sciences** • Braz. arch. biol. technol. 52 (5) • Oct 2009 • https://doi.org/10.1590/S1516-89132009000500029
7. **Bawuro,A. A., R. B. Voegborlo, and A. A. Adimado, 2018:** Bioaccumulation of Heavy Metals in Some Tissues of Fish in Lake Geriyo, Adamawa State, Nigeria 2018 *Journal of Environmental and Public Health* / volume 2018 |Article ID 1854892 |
8. **Bernet D., H. Schmidt, W. Meier, P. Burkhardt-Hol and T., Wahli,** (1999): Histopathology in fish: proposal for a protocol to assess aquatic pollution, *J. Fish Disease*, 22, 25-34
9. **Deore, S.V and Wagh S.B**. (2021): Heavy metal induced histopatholoigcal alterations in liver of *Channa gachua (Ham), Jrnl. Exp. Biol, 3*(3), 35-38 (2012)
10. **Gorar F. K., R. Keser, N. Akiel, and S. Dizman** (2012): "Radioactivity and heavy metal concentrations of some commercial fish," *Chemosphere*, vol. 187, pp. 56–36.
11. **Gupta P and Srivastava N, (2006):** Effects of sub-lethal concentrations of zinc on histological changes and bioaccumulation of zinc by kidney of fish *Channa punctatus (Bloch). Journal of Environmental Biology*. 27(2):211-215. 40.
12. **Javed Mehjbeen & Usmani Nazura, (2019**): An Overview of the Adverse Effects of Heavy Metal Contamination on Fish Health *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences* volume 89, pages389–403
13. **Javed M and Usmani N (2013):** Haematological indices of *Channa punctatus* as an indicator of heavy metal pollution in wastewater aquaculture pond, Panethi, India. Afr J Biotechnol 12:520–525.
14. **Josephine Omowumi Olayinka-Olagunju, Adekunle A. Dosumu & Adetola Mary Olatunji-Ojo (2021**): Bioaccumulation of Heavy Metals in Pelagic and Benthic Fishes of Ogbese River, Ondo State, South-Western Nigeria *Water, Air, & Soil Pollution* volume 232, Article number: 44
15. **Kevin V. Brix,Christian E. Schlekat,Emily R. Garman (2017):** The mechanisms of nickel toxicity in aquatic environments: An adverse outcome pathway analysis Environ Toxicol and Chem, Volume36, Issue5 2017, Pages 1128-1137
16. **Khallaf EA, Galal M, and Authman M (1998**): Assessment of heavy metals pollution and their effects on *Oreochromis niloticus* in aquatic drainage canals. J Egypt Ger Soc Zool 26: 39-74.
17. **Mohamed F.A.S**. (2009): Histopathological Studies on *Tilapia zillii* and *Solea vulgaris* from Lake Qarun, Egypt, World J. Fish and Marine Sciences, 1(1), 29-3
18. **Rana MA, Jabeen F, Shabbir S, Naureen A, Sultana K, Ahmad I et al**. (2015): Histopathological study of liver and kidney in common carp (*Cyprinus carpio*) exposed to different doses of potassium dichromate. International Journal of Biosciences; 6(12):108-116.

19. **Ray, D. and S, K. Banerjee (1998):** Hematological and histopathological changes in *Clarias batrachus (Linn*) exposed to Nickel and Vanadium. Envi. and Ecol. 16 (1): 151-156.

20. **Reddy P.B.1 and Rawat S**. (2013): Assessment of Aquatic Pollution Using Histopathology in Fish as a Protocol ISSN 2319–1414 Vol. 2(8), 79-82, August (2013) Int. Res. J. Environment Sc.

21. **Saravpreet Kaur, Kuldeep Singh Khera and Jasjit Kaur Kondal (2018):** Heavy metal induced histopathological alterations in liver, muscle and kidney of freshwater cyprinid, *Labeo rohita* (Hamilton Journal of Entomology and Zoology Studies 2018; 6(2): 2137-2144

22. **Saxena M. P. and H. M. Saxena (2008):** Histopathological Changes in Lymphoid Organs Of Fish After Exposure To Water Polluted With Heavy Metals. The Internet Journal of Veterinary Medicine 5 (1)

23. **Singhal, R.N and M. Jain (1997):** Cadmium induced changes in the histology of kidney in common carp, *Cyprinus carpio* (Cyprinidae). Bull. Environ. Contam. Toxicol. 58, 456-462.

24. **Sehar Afshan, Shafaqat Ali, Uzma Shaista Ameen, Mujahid Farid, Saima Aslam Bharwana, Fakhir Hannan, Rehan Ahmad (2014):** Effect of different heavy metal pollution on Fish. Res. J. Chem. Env. Sci., Volume 2 [1]: 74-79

25. **Sekar J.C. N, RR, Chandran R. J.C., N., R. Sekar and R. Chandran (2016):** Acute Effect of Chromium Toxicity on the Behavioral Response of Zebra Fish *Danio Rerio*. The International Journal of Plant, Animal and Environmental Sciences 2016.

26. **Shah SL and Altindag A (2005).** Alterations in the immunological parameters of Tench (Tinca tinca L. 1758) after acute and chronic exposure to lethal and sublethal treatments with mercury, cadmium and lead. Turk. J. Vet.

27. **Vinodhini, R. and Narayanan, M. (2009):** Heavy metal induced histopathological alterations in selected organs of the *Cyprinus carpio L* (Common Carp). Int. J. Environ. Res., 3(1):95-100.

28. **Voegborlo R. B., A. Atta, and E. S. Agorku**, **(2012)**: "Total mercury distribution in different tissues of six species of freshwater fish from the Kpong hydroelectric reservoir in Ghana," *Environmental Modeling & Assessment*, vol. 184, no. 5, pp. 3259–3265.

30. **Weis JS and Weis P (1989**). Effects of environmental pollutants on early fish development. Rev. Aquat. Sci. 1: 45–7