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Effect of Water Contaminants on the Growth of *Labeo rohita* F. Hamilton, 1822

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ABSTRACT:

Heavy metals (HM) are naturally occurring trace elements found in the aquatic environment. However, their concentrations have been elevated as a result of industrial waste, geological composition, agricultural practices, and mining operations. The many causes of pollution have an impact on the physicochemical properties of water, sediments, and biological constituents, hence exerting a detrimental influence on the abundance and quality of fish populations. Environmental pollution is a pervasive issue on a global scale, with heavy metals posing a significant difficulty as one of the most crucial pollutants. The advancement of industrial activities has resulted in a heightened discharge of toxins into the surrounding ecosystem. The presence of environmental pollution has been found to have detrimental effects on fish, leading to instances of poisoning, the onset of diseases, and in severe cases, mortality. The degree of absorption and accumulation of certain contaminants exhibits variation across many biological systems. In this research article we examine the effect of water pollutants especially arsenic on the tissues of gills of *Labeo rohita* F. Hamilton, 1822. The histopathological studies have a significant impact on the identification of fish disorders resulting from heavy metal exposure.

Key words: Heavy Metals, Contaminants, Histopathology, *Labeo rohita*, etc.

INTRODUCTION

The escalating population in third world countries has resulted in a scarcity of protein sources. Consequently, fish farming has emerged as a viable alternative for providing affordable protein. Nevertheless, in many regions of these nations, recycled water derived from agricultural drainage, industrial drainage, or even sewage is employed. The use of recycled water sources presents a significant health concern, posing risks to the fish population, the overall ecosystem, and perhaps to humans who consume the fish. Hence, water stands as the foremost natural resource on our planet, playing a vital role in both human survival and the advancement of contemporary technology. Therefore, the accelerated process of industrialization is identified as a primary factor contributing to the contamination of aquatic environments. The utilisation of discharged wastewater for fish cultivation has been observed in several geographical areas across the globe [1-3]. Fish are a highly prevalent group of species in aquatic environments and are known to be vulnerable to metal contamination. Consequently, they serve as indicators of the biological consequences of metal pollution in water bodies [4]. The nutritional and economic benefits of fish are derived from its high-quality and cost-effective protein and mineral content, as well as its abundance of unsaturated fatty acids and Omega-3. These components contribute to the lowering of blood cholesterol levels and the prevention of heart-related disorders such as arteriosclerosis [5]. Environmental pollution is a pervasive global issue, with heavy metals being recognized as one of the most significant contaminants. The advancement of industrial sectors has resulted in a rise in the discharge of pollutants into various ecosystems [6]. Environmental contamination has the potential to induce poisoning, illnesses, and mortality in fish. Furthermore, the absorption and deposition of pollutants in various biological tissues exhibit variability. The biomedical issue of interest is to the absorption of heavy metal elements from diverse biological tissues in the presence of pollutants [7]. Pollution refers to the introduction of exogenous chemicals into the biosphere. Certain xenobiotics, which are substances foreign to the human body, can occasionally infiltrate the human system via the food chain. Within the organism, pollutants have the potential to undergo biotransformation, metabolism, and subsequent excretion, thereby mitigating the risk of toxicity. The extent to which these processes occur without adverse effects is contingent upon the chemical properties of these substances as well as their dosage. Nevertheless, certain pollutants exhibit resistance to both chemical and biological transformation processes, leading to their accumulation in various tissues such as the liver, kidney, and nerves, hence resulting in hazardous effects [8]. Water pollution is characterised as the deliberate or unintentional introduction of substances or energy into the aquatic environment by human activities, leading to harmful consequences such as risks to human health, interference with fish behaviour, deterioration of water quality, and diminished climatic benefits [9]. The phrase "heavy metal" encompasses metallic chemical elements characterised by their high density and toxicity or lethal nature even at low concentrations. Mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl), and lead (Pb) are among the heavy metals that might be used as examples. These entities are impervious to degradation or destruction. Heavy metals, specifically known as IIM (Inorganic Industrial Metals), are naturally occurring trace elements found in aquatic environments. However, their concentrations have been amplified as a result of industrial waste, geological composition, agricultural practices, and mining operations [10, 11, 12]. The primary risks to human health stemming from heavy metals (HM) are linked to the potential for lead, cadmium, mercury, and arsenic exposure. Arsenic continues to be a prevalent component in wood preservatives, whereas tetraethyl lead is a widely used ingredient in petrol, albeit with a significant decline in usage observed in developed nations [13]. Bioaccumulation refers to the progressive elevation of a chemical's concentration within a living organism, such as fish, in relation to its concentration in the surrounding environment. The accumulation of compounds in living organisms occurs when their uptake and storage rates surpass their rates of metabolism or excretion [14, 15]. The levels of metals in live fish often exhibit the following order: iron (Fe) > zinc (Zn) > lead (Pb) > copper (Cu) > cadmium (Cd) > mercury (Hg). The concentrations of zinc (Zn) may exhibit significant elevation, reaching values over 3001.1 grammes per gramme of dry weight (g/g dw). The concentrations of lead and copper typically do not surpass 10 1.1g/g dw, indicating a lower maximum level. The buildup of metals in fish is influenced by pollution and can vary across different fish species inhabiting the same waterway [16]. In this study we were studied the histopathological change in the gills of *Labeo rohita* due to arsenic contamination at different concentrations. The fishes was grown in the fishponds of Meja hatchery of Prayagraj, U. P., India.

Materials and Methods:

All fishes were grown in Meja hatchery of Prayagraj for the study. The fish samples were taken over a period of 30 days for laboratory studies. Further histological studies were performed in the zoology laboratory of SVN University. The histological examination of gills of various samples of fishes were done in order to find out the changes. pH and TDS of the ponds were also recorded. Furthermore, the detection of heavy metal-induced effects can be achieved through the utilisation of histological techniques. These procedures involve subjecting tissue samples to a sequential sequence of increasing concentrations of ethyl alcohol (ranging from 70% to 100%) in order to achieve dehydration. The process of clarification is typically conducted using xylol or chloroform. The samples that underwent treatment were immersed in paraffin wax at a temperature of 45°C. The paraffin blocks are made and subsequently sectioned using a microtome to achieve a thickness of 0.6 µm. The tissue sections undergo staining using the hematoxylin and eosin (H&E) technique. In the context of extended analysis, the stained slides are coated with Canada balsam and subjected to observation under a light microscope of high resolution. This investigation involves the utilisation of a reference control tissue and the documentation of findings through the use of a digital camera [17, 18].

RESULTS AND DISCUSSION:

pH value and TDS- According some researchers pH of water bodies should be in the range of 6.5 to 9.5. pH values of all the studied water bodies were recorded accordingly (table 1 & graph 1).

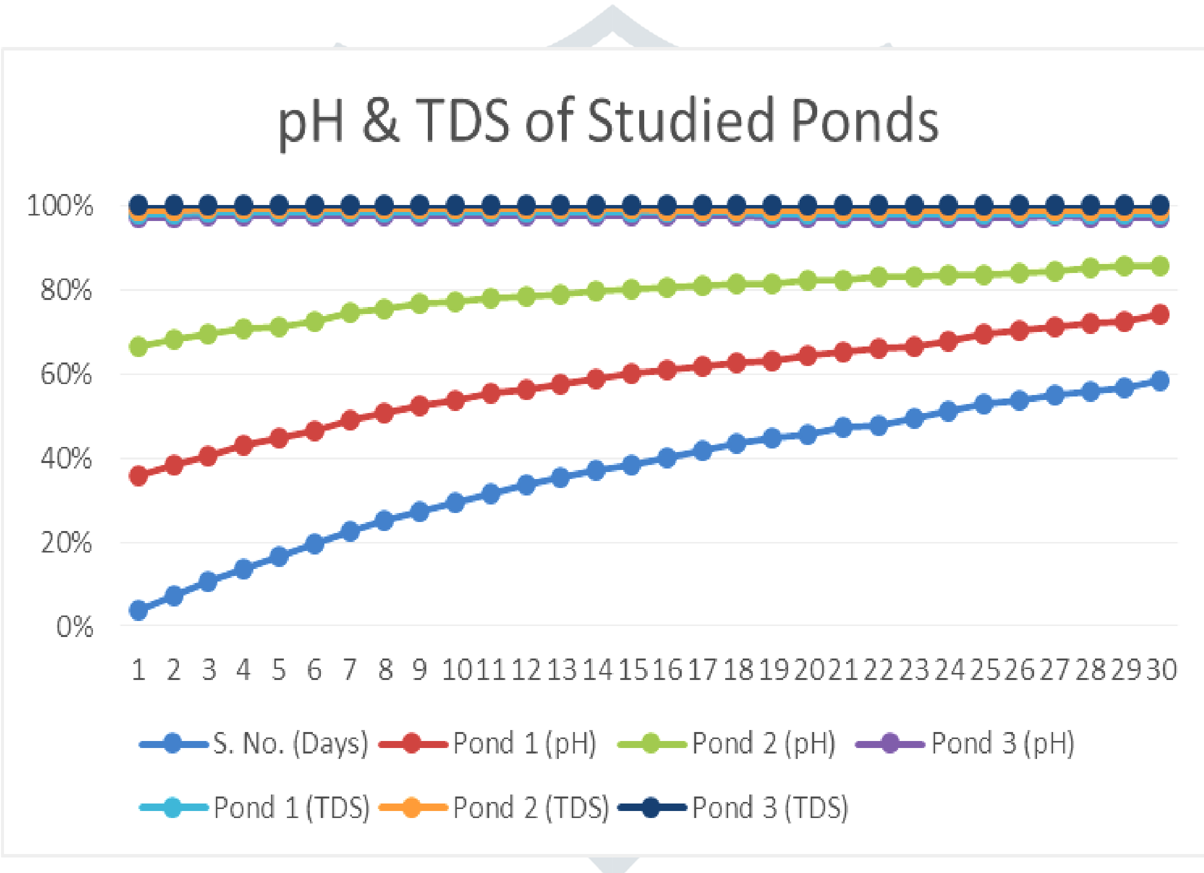
The range of total dissolved solid was 22 to 930 mg/ml. We found a rise in TDS which may be due to continuous addition of feeding and essential materials for the survival of fishes (table 1 & graph 1).

Table 1. pH and TDS of studied water bodies.

S. No. (Days)	Pond 1 (pH)	Pond 2 (pH)	Pond 3 (pH)	Pond 1 (TDS)	Pond 2 (TDS)	Pond 3 (TDS)
1	8.30	8.0	8.0	0.229	0.240	0.240
2	8.28	8.10	7.80	0.230	0.240	0.240

3	8.20	8.01	7.80	0.231	0.240	0.230
4	8.40	8.02	7.77	0.230	0.240	0.240
5	8.30	7.95	7.80	0.231	0.240	0.250
6	8.20	7.95	7.65	0.223	0.260	0.260
7	8.10	7.95	7.05	0.221	0.250	0.260
8	8.30	7.90	7.05	0.235	0.250	0.280
9	8.25	7.94	6.95	0.245	0.250	0.270
10	8.29	7.93	7.01	0.240	0.250	0.290
11	8.30	7.85	6.95	0.245	0.240	0.280
12	8.00	7.80	6.90	0.250	0.260	0.290
13	8.20	7.95	6.92	0.250	0.260	0.300
14	8.31	7.85	6.90	0.290	0.270	0.300
15	8.33	7.85	6.84	0.286	0.270	0.340
16	8.22	7.80	6.80	0.284	0.290	0.390
17	8.12	7.84	6.80	0.284	0.290	0.390
18	8.02	7.81	6.76	0.285	0.320	0.390
19	7.95	7.80	6.72	0.300	0.350	0.500
20	8.20	7.80	6.60	0.305	0.350	0.550
21	8.02	7.70	6.61	0.300	0.350	0.560
22	8.42	7.75	6.58	0.300	0.360	0.565
23	8.00	7.75	6.55	0.305	0.362	0.560
24	7.90	7.23	6.55	0.310	0.365	0.560
25	7.90	6.70	6.45	0.310	0.365	0.570

26	7.95	6.62	6.39	0.320	0.370	0.568
27	7.98	6.60	6.30	0.321	0.375	0.570
28	8.00	6.60	6.10	0.310	0.380	0.601
29	8.01	6.61	6.05	0.325	0.390	0.610
30	7.90	6.00	5.98	0.352	0.400	0.600



Graph 1. Graph showing pH & TDS of 30 days of Studied water bodies.

Histopathological Alterations Due to Arsenic Pollution in Fish gills:

The gills exhibited lamellar hyperplasia, edoema, separation, and fusions, as well as expansion of the cartilaginous base of the gill arches (Figures 1-3). Gills are examined under high resolution microscope after 30 days of doses of arsenic with two different concentration i.e., 60 ppm and 120 ppm. Both are compared with control one. At 60 ppm muscles of gills are dangerously devastated as compared to control and 120 ppm.

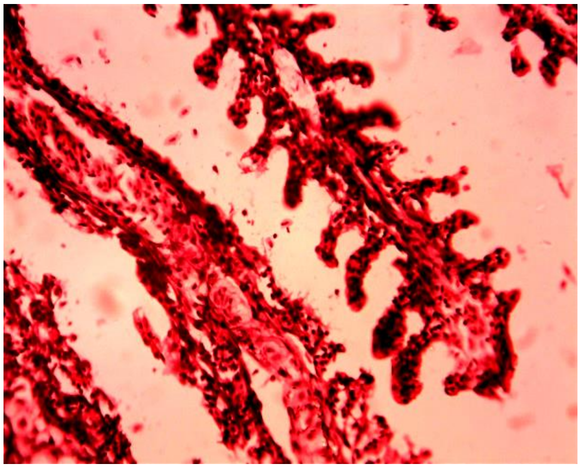


Figure 1. Control (without arsenic).

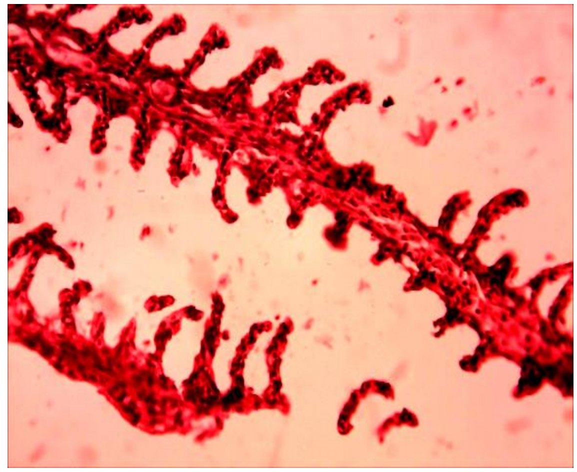


Figure 2. Gills with 60 ppm (arsenic).

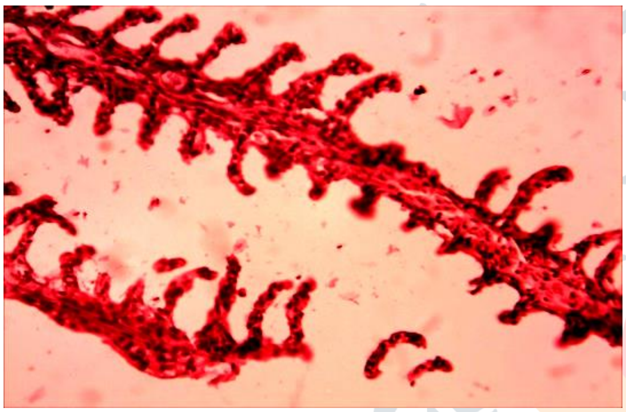


Figure 3. Gills with 120 ppm (arsenic).

CONCLUSION

This research paper elucidates the aetiology and ramifications of heavy metals poisoning on the gills systems of fish. The accumulation of metals in fish tissues is influenced by various factors, including environmental concentrations, environmental circumstances (e.g., pH, TDS). We found a steady increase of pH and TDS with the change in days. At 60 ppm muscles of gills were destroyed severely whereas at 120 ppm distortion were found to be lesser. It is because of more intake of arsenic at lower ppm. The surveillance of environmental parameters, encompassing natural elements, artificial substances, and biological and microbiological attributes, constitutes a crucial undertaking in environmental management. This practise serves to address the restoration of contaminated ecosystems and forecast the potential impacts resulting from anthropogenic alterations to the environment.

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CONFLICT OF INTEREST: No conflict of interest.

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