Physico-Chemical Parameters of River Aami and Hematological Aspects of Fresh Water Inhabiting Fishes Are Affected By a Variety of Industrial Effluent

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Abstract- ***The main river that runs along a significant portion of the eastern region of Uttar Pradesh is the Ami River. The river supports not only the aquatic flora and fauna but also the inhabitants of the surrounding area, particularly Khalilabad, Sant Kabir Nagar, district Uttar Pradesh. A significant increase in industrial development, Indian GDP growth, and economic expansion is provided by the GIDA group of industries. However, in recent years it has been clear that this river has a significant amount of irreversible pollution. The current study's objective was to assess and monitor the water's quality in the context of its altered physical and chemical characteristics as well as changes in the hematological profile of fish Channa Punctatus inhabiting the river water***

Indexed Terms- ***Alterations, hematological, physico-chemical, and xenobiotic toxins.***

I. INTRODUCTION

As the main consumers of contaminants, water bodies and various plants and animals play a crucial role in the health and balance of ecosystems. Fertilizers, insecticides, and various types of detergents are just a few of the chemicals that humans use for residential and agricultural purposes. These chemicals also end up in nearby rivers, lakes, ponds, and other bodies of water. [1]The majority of them have been discovered to be highly poisonous, not just to the population of fish but also to the species that in some way or another make up the fishes' food chain [2]. Pesticides are typically and more frequently consumed by fish directly through the gills while they are breathing or directly absorbed through the skin. Once ingested through any method,(these substances, also known as xenobiotics,) tend to cause a variety of physiological and biochemical dysfunctions, such as changes in fishes' hematology [3]. Due to their ability to absorb contaminants and display varying physiological, cellular, and even molecular responses to them, fish species serve as an effective bio indicator of water pollution[5]. Fish blood is being examined more and more in toxicological research and environmental monitoring as a potential sign of physiological and pathological changes in fishery management and disease investigations [7]. Channa punctatus was chosen for the current situation because of its ecology, cosmopolitan distribution in a freshwater environment of Uttar Pradesh, availability throughout the seasons, and commercial importance. These factors make this species an excellent test specimen for biological indicator of water quality. Since blood can be used to assess the impact of contaminants in the aquatic environment, It is explicitly categorised as a potential index of fish response to water quality. Blood is the most fundamental and plentiful body fluid [6]. Fish blood is separated from the water by a thin epithelial barrier, and any negative changes in the water body are very obviously conveyed in the blood [8]. In order to identify physiological adaptability and determine the health of fish, blood parameters in fish have been investigated [9]. Sayed et al. According to[10], haematology may be a useful tool for assessing the stress levels that water pollution has on fish. When fish are subjected to a complex mixture of pesticides and pollutants that are present in water bodies, haematological parameters are increasingly used as indicators of the physiological stress response to both endogenous and external changes [11].According to Tiwari et al., a numerical haematological index such as RBC, WBC, Hb, or HCT is employed. 1295 evaluate the functional state

of the bloodstream and have been employed as an indicator of toxicity pollution in aquatic environments. [12]. Due to the fact that environmental contamination in ground and surface water resources is growing as a result of human activity, there is a significant worry over the negative consequences of environmental pollution on both the environment and human health.

A study was conducted to evaluate the changes in the physical and chemical characteristics of river water that had been exposed to various industrial effluents from mills and large-scale industries, as well as the effects on the haematological profile and other parameters of the river's resident Channa Punctatus.

II. METHOD AND MATERIALS

- *Area under study*

The current study is based on a survey of the Aami River, which is a vital source of life for the residents of Gorakhpur City in Uttar Pradesh eastern most region. It is a major tributary of the river Rapti, which originates in Nepal and travels 102 kilometers from its source near Sant Kabir Nagar in Khalilabad, it receives industrial effluents at a number of locations along a significant portion of its course, beginning in Rudhauli at the Gorakhpur Industrial Development Area (GIDA), sahjanva, and ending at Sohgaura in the district of Gorakhpur. Numerous factories owned by GIDA are rated both nationally and internationally .A few of them are parle, azam rubber, and India glycol restricted on a nationwide scale (Products) Powerlooms, plywood, and Uttar Pradesh's sole jute mill, in addition to footwear whose industrial waste is willfully poured into the river water at a number of spots making it unusable for both human needs and the demands of the aquatic flora and animals. For the study, 5 locations along rivers that are considered sources of water were selected from Sahjanva to the Ami's ultimate confluence, there was industrial runoff in the river water. There was additional work done along the Ami River in Dhaurahra drain. The research areas were as follows:

Water samples were collected from the sites chosen in plastic containers in undisturbed stage. The sites selected for study are below:

Site-1: River flowing through Dhaurahra Drain (Effluent before treatment plant) where the different types of mill effluents are dumped together in the river such as paper wastes, alcoholic chemical, jute and textile mill effluents

Site -2: Part of river present near Sarya village (Effluent after treatment plant) India glycol limited IGL, Gorakhpur industrial development authority, GIDA, Sahjanwa Gorakhpur.

Site -3: The sugar mill situated in Rudhauli Satnariya Basti(Entry point of effluent treatment plant) discharge the treated and untreated mill effluent in river Ami, which is loaded with different kinds of hazardus chemical That produce adverse effect on fish life of river Ami.

Site- 4 : 200 m away from upstream of entry point of effluent treatment plant.(Rudhauli sugar mill Satnariya Basti)

Site -5 : 200 m away from downstream of entry point of effluent treatment plant .(Rudauli sugar mill Satnariya Basti)

At regular intervals during the summer, rainy, and winter seasons, sampling was carried out at research locations from a depth of between 30 and 45 cm. The river water's loose sediments and rocks were carefully avoided to prevent any disruption. In order to prevent the ingress of extra air bubbles, this was taken into consideration. After the sample bottle was filled to the brim, the lid was put on right there in the river. The gathered samples were immediately taken to the lab, where the physical-chemical characteristics of sample were calculated by using the techniques described in the 2005 APHA manual of water and waste water management.[1]. Temperature, pH Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) were used to analyse the samples that were collected.

Before collecting samples, additional factors including pH and temperature were recorded down on the spot.

- *Hematological analysis*
- *Fish collection*

Adult fish of the same species that were around the same size, weight, and length were taken .It was remembered that the animals that were caught were indigenous to that area. Fish were caught with the assistance of a fisherwoman who was present, and they were then transported into the department laboratory as quickly as possible .Fish that were ill or damaged were removed as quickly as possible, and with the aid of a cast net, 10 healthy Channa punctatus fish were caught, and they were delivered as quickly as possible to the DDU Gorakhpur University's natural product laboratory for evaluation of the various hematological parameter.

The channidae family of common carp includes this fish as one of its larger members. This fish can be recognised by its distinctive trait of having cycloid scales and ctenoid scales on either side of the body as well as by its blakish yellow colour and serrated dorsal, according to Tiwari et al. World Journal of Pharmaceutical Research www.wjpr.net Vol. 10, Issue 6, 2021 Journal Certified to ISO 9001:2015 1297 anal fin. The blood samples were done to see whether the haematological profile had changed. Because they make up the majority of the river's residents and exhibit better levels of adaptation and resilience to the current situation and condition of the river water namely, significant poisoning and contamination caused by industrial effluents of the industries and factories . An experiment was designed to demonstrate the potential effects of toxicants and industrial effluents on fish haematology. The parameters used in the experiment included total haemoglobin content (Hb),Red blood corpuscles (RBC),White blood corpuscles (WBC), packed cell volume (PCV), mean corpuscular haemoglobin content (MCHC), and mean corpuscular volume (MCV). Blood samples were collected from fish, and the results were clearly depicted by a series of tests performed on the blood samples through the help of auto analyser. The same was done for each and every sample taken from the fish specimens chosen for the experiment after meticulously noting and analysing all the observations.

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III. RESULTS AND DISCUSSION

The findings of the physical-chemical study of the River Aami during the three seasons of summer, rainy, and winter in the year 2021–22 are tabulated below for five separate sites in table -1, and the results of the hematological evaluation of fish gathered from the sites are listed in table 2 . The findings of the physico-chemical examination of the river Ami are shown in table 1 above. Following that, a haematological evaluation of the fish blood that was obtained from the study sites was conducted and the results are shown in table 2. The research was conducted in the period between March 2021 through February 2022. The three seasons of the 2021–22 calendar year summer (March–June 2021), rainy (July–October 2021), and winter (November 2021-February 2022) were used to evaluate the findings.

From Table 1, It is evident that a change in colour in a body of water is a certain sign of significant

pollution. Because of this, the growth of flora and animals, especially in aquatic environments, is hampered and light penetration is hindered .Fish that thrive on phytoplankton's find it difficult to survive in such a hostile environment because they lack the necessary nutrients for plant growth and photosynthesis. In contrast to Site 3's river water, which is naturally muddy or earthy in colour, Sites 1 and 2, 4, and 5th effluent discharge are very black, indicating severe pollution. It is advised that there shouldn't be any discernible colour in river water in accordance with effluents. While the river water at location 3 is a naturally murky or earthy colour.

All of the study locations chosen for the river Aami are highly polluted. The chosen sites 1 and 2 also had a distinctive fragrance that hinted at the river Ami's poor health, which was evident from the smells that were detected at all the locations. The chosen sites 1 and 2 also had a distinctive odour that suggested the river Aami was in poor health, which is evident from the smells that were detected at all the locations. According to the applicable standards for class A water, there shouldn't be any offensive colours present in the body of water. As a result, it also points to substantial pollution at sites 1 and 2, where the water at site 2 originates from GIDA (Gorakhpur Industrial Development Authority) and smells alcoholic, As a result, it also points to substantial pollution at sites 1 and 3 where the water at site 2 smells strongly of alcohol and pungent odour respectively.

The river's water temperature changed throughout the year and at several locations. For site 2, then site 1, and finally site 3, 4,and 5 the temperature that was observed during the summer was high. However, the lowest was noted during the winter months. There shouldn't be any offensive colours present in class A water, according to the applicable standards. One of the most important physical characteristics of an aquatic environment is water temperature, which is influenced by the type and quantity of nutrients present as well as the habitat nearby. It has an impact on the development and survival of the fauna and flora.

The rise of microbial activity and fish hormonal changes brought on by an increase in water temperature affect fish reproduction and spawning in different ways. The type of industrial effluents discharged as waste by products of continuing chemical processes by large equipment, heavy metals, and toxic compounds are to blame for the rise in water temperature. One of the most important physical characteristics of aquatic ecosystems is water temperature, which is influenced by the types and quality of nutrients . The type of industrial effluents discharged as waste by products of continuing chemical processes by large equipment, heavy metals, and toxic compounds are to blame for the rise in water temperature.

The pH data recorded at all the different locations indicated variances for different sites with changes in season, with site 1 and site 2 having the highest or most alkaline ph and site 3,4 and5 having the lowest pH, which is close to neutral. The pH data recorded at each location revealed differences for each location with changes in season and the highest or alkaline pH has an impact on the flora and fauna's ability to thrive and survive. pH in sites 1 and 2,is hiegist and pH of less than neutral at site 3. The pH has a significant role in determining the water's quality. If the pH of the water is higher than neutral pH 7, then a powerful base has contaminated the water. NaOH pH information also reveals if the contaminants discharged into the water body are acidic or basic, depending on whether they are salts, ions, or any other base.

Additionally, the amount of total dissolve solids varies depending on the season in each of the five locations. Their concentration is higher than the reference value set by the CPCB (Centre of Pollution Control Board) and WHO (World Health Organization), indicating that industrial pollution has severely contaminated the water release by the GIDA's chain of industries (Gorakhpur Industrial Development Area).The amount of total dissolve solids and total suspended solids limits the development of aquatic life and plants. They are solid waste by products that are released by industries. Maximum Site 1 had a certain level of total dissolve solids in the summer, while site 2 had a similar amount of total suspended solids in the winter.

The aquatic life depends heavily on dissolved oxygen to survive. To support aquatic life, it should in any case be greater than 3.5 mg/l. As a result, both in the summer and the winter, it was least in site 2. Compared to sites 1, 4,5 th site 3's water sample has higher the DO's concentration. However, while looking at all the sites, we can state that DO is higher in the rainy season than it is in the summer and the winter.

The amount of oxygen needed to break down organic matter is known as BOD. The CPCB has set a 30mg/l limit on the permissible level of BOD. In addition, the water quality is outstanding. Detoriation makes it unsuited for human conservation and threatens organisms' ability to survive. The information in table 1. It is obvious that site 2's BOD levels are higher than site 1's, and that they are also higher in the summer and winter. Site 3,4,and 5th has a lower BOD, hence it is less contaminated.

The amount of oxygen needed to oxidize soluble and particulate organic matter in water is measured as COD (chemical oxygen demand). The CPCB and who standard range for COD is 250 mg/l, yet in the analysis of river Aami water, the results obtained were substantially higher in all five locations. Furthermore, compared to the rainy season and site 1, the values were found to be higher in the summer and winter. In contrast to site 3, site 2,4 and 5th had much higher COD levels in its water. On the basis of all the physical and chemical tests carried out on the water sample from the Ami River, It can be concluded that sites 1 and 2, GIDA (Gorakhpur Industrial Development Authority), Sahjanva and Rayna paper mill appear to be significantly more contaminated than sites 3 the important point of the river Aami .Which also consist of site 4 and 5 .

Fish are under stress because of high industrial effluent, which is evident from the statistics shown in table 2 and the haematological tests done on the blood of fish directly obtained from all of these sites of the River Aami .Some significant results from the haematological analysis of the fishes showed that the river Ami's designated sites 1 and 2 are extremely sensitive to contaminated effluents from businesses. Table 2, which shows the haematological parameters alteration in fish life of river Ami .

In comparison to the control group of fishes, there was a significant decrease in the haemoglobin (Hb), red blood cells (RBC), and packed cell volume (PCV) content in the fishes from sites 1 and 2, 3 and 4 . Heavy metals from industrial effluents, which have a negative impact, could be to blame near the edge of the river, bleached craft effluents with polychlorines come from numerous industries. Additionally, it can be ascribed to their harmful effects on the enzyme pathways and chemical reaction chain in charge of producing haemoglobin and creating new cells under the body of fish .

Fish from sites 1, 2 ,4 and 5 had higher mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) values than fish from sites 3; however, these values were determined to be almost identical to the reference range in the control group of fish. Average Corpuscular Volume (MCV) and Average Corpuscular Hemoglobin levels (MCH) were found to be higher for fish from sites 1 and 2, 4 and 5 but at sites 3 they were determined to be about in the same range as the reference values for the control group of fish blood cells of exposed fish.

Comparing the experimental group of fish to the control group, it was also discovered that (MCHC) was elevated. Fish from site 2, 4, and 5 had the highest value out of all the fish, whereas fish from site 1 and 3 had the lowest value. These findings indicate that there may be macrocytic anaemia in fishes. These outcomes were also seen in channa punctatus subjected to heavy metals, which had low levels of RBCs, Haemoglobin, and PCV, leading to polychromic anaemia brought on by the stress caused by effluents. [13,14]. help to clarify additionally.

It was found that the experimental group of fish had a significantly higher white blood cell count than the control group with varied changes in differential leukocyte percentage. This is conclusive proof that the fish have evolved immune-related adaptations in susceptible fish. When compared to the reference value of the control group of fishes, platelets were found to be lower in the experimental group of fishes. Major carp subjected to heavy metals, particularly cadmium chloride, an essential ingredient in the synthesis of glycol, similarly showed a rise in MCV and MCH with a concurrent decrease in the number

of RBCs, haemoglobin content, and packed cell volume. [15]Additionally, it is believed that it serves as a protective mechanism for aquatic fauna against the toxicity of effluents by enhancing erythropoietin, or the creation of blood cells [16].

Severe anaemia in fish has been found to be caused by high RBC loss from frequent hemolytic and decreased total haemoglobin content by bleached craft effluents from paper and textile mills, among other key discoveries. Nonetheless, the method of although the exact origin of hemolysis is unknown, certain proposed theories imply that these complex chemical effluents result in a decrease in cellular atp and a decrease in oxygen consumption. Jaundice with a noticeably elevated level of bilirubin in blood plasma has eventually developed as a result of hemolysis overall reduction in haemoglobin content.[16,17,18]. Fish have shown a significant increase in leucocytes (leucocytosis) or white blood cells (WBCs), which has been linked to an excess of stress conditions that caused the direct stimulation of immune defence due to the presence of contaminants in the form of Fish Channa punctatus exposed to chlorpyrifos-ethyl had industrial effluents in their aquatic habitat.[19].This change might be the result of the immune system being activated in the presence of a contaminant, which is thought to be an adaptive response of the organism. resulting in fish haematological changes that enhance the immune defence response in response to the immunological anomelies brought on by industrial effluents. [20].leading to a more potent immune defence reaction in response to the immunological anomelies brought on by industrial effluents through haematological changes in fish [20].

CONCLUSION

The aforementioned proof and experimental research make it abundantly evident that industrial effluents have a detrimental effect on fish health. Fishes are a great experimental resource. Models for evaluating aquatic ecosystems that are directly subjected to environmental pollution in the form of pesticides, insecticides, and industrial mill effluents, whether on a big or local scale, and the ensuing haematological changes. According to the study mentioned above, different types of mill effluents cause increases in MCHC and MCH and decreases in RBC, WBC, Hb, MCV, and PCV. The haematological characteristics are valid and significant in demonstrating the danger that the mill effluents pose. . It is crucial to remember that the condition described in our work will only get worse due of the ongoing discharges of these effluents into the River Aami, which can negatively impact flora ,as well as the local residents and flora. To build a strategy to cope with the huge issue caused by these industries and enhance environmental protection in this area, regular monitoring, public awareness campaigns, and tough law enforcement are required.

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Properties	Season	Chosen Sites					References value set by WHO (world health organization)
		Site-1	Site-2	Site-3	Site -4	Site-5	
Temperature	summer	29.8±0.33	30.2±0.40	30.4±0.43	29.5±0.30	29.5±0.28	Should not exceed 5^0c than receiving water
	winter	19.8±0.37	19.6±0.25	19.7±0.25	19.4±0.21	19.48±0.28	
	Rainy	29±0.35	29±0.26	30.0±0.25	28.1±0.78	28.4±0.63	

							temperature
pH	Summe r	8.56±0.09	8.42± 0.12	8.46±0.10	8.4±0.10	8.3±0.08	6.5-8.5
	winter	8.5±0.11	8.34±0.09	8.5±0.12	8.46±0.11	8.34±0.08	
	Rainy	8.16±0.23	8.2±0.20	8.6±0.19	7.96±0.12	7.94±0.16	
TSS (total suspended solids) (mg/l)	summer	853.6±112	579.1±4.63	800.4±116.4	815±111.3	816±0.08	100 m/l
	winter	703.4±81. 5	677.4±89.9 8	700.4±83.38	705.8±81.4	705.6±81.02	
	Rainy	1243.4±17	1256.4±171	1228±177.8	1245.6±173. 5	1244.8±173. 2	
TDS(total dissolved solids) (mg/l)	summer	588.1±0.2 1	2324.4±136	597.4± 6.06	584.8±0.97	583.4±1.20	500 -1500 mg/l
	winter	592.3 ±0.1	591.6±0.65	590.6±0.53	592.1±0.42	671.3±80.34	
	Rainy	598.4±0.4 8	595.4 ±0.77	593.1 ± 1.6	593.4±1.46	593.4±2.01	
DO (dissolved oxygen) (mg/l)	summer	2.08 ±0.23	2.04 ±0.20	1.68 ± 0.19	2.16±0.22	2.18±0.27	4 mg/l
	winter	2.3 ± 0.70	2.28 ±0.03	2.32 ± 0.06	2.5±0.07	2.5±0.1	
	Rainy	2.52 ± 0.09	2.4 ±0.08	2.42 ±0.14	2.48±0.11	2.42±0.01	
BOD (biochemica l oxygen demand) (mg/l)	summer	811.4±25. 9	811 .6±26.4	802.8±22.5	799.4±22.44	801±22.1	30 mg/l
	winter	1180.4±58	1177.4±54. 9	1166.2±55.1	1109±59.58	1108.2±59.4	
	Rainy	685.2±57. 2	685.4±55.3	747±60.7	703.8±50.63	702.8±50.61	
COD (chemical oxygen demand) (mg/l)	summer	1049.6±61	1003.9±42. 6	1012.3±51.6 2	1037.2±65.0 7	1037±64.55	250 mg/l
	winter	1009.6±62	951.16±85. 6	1039.6±40.7	1019±81.35	1017±81.8	
	Rainy	1093.6±21	1084.6±24. 7	1092.4±20.2	10948±20.17	1094±20.59	

Table 1: physicochemical characteristics of sample water collected from different sites of sampling station of river Ami of year 2021-22 seasonally (summer ,rainy and winter season).

Hematological parameters	Control	Ste-1	Ste-2	Site-3	Site-4	Ste-5
Hemoglobin (Hb) (g/dl)	11.8±0.37	8.45±1.8	9.33±0.03	8.03±0.007	10.9±0.05	11.1±0.07
Red blood cells(RBC) (10^6 cells/mm^3)	5.7±1.35	3.75±0.06	3.5±0.12	2.4±0.07	4.2±0.09	4.12±0.08
Packed cells volume (PCV) (%)	40.2±0.05	35.2±0.01	34.6±0.13	36.4±0.15	40.1±0.08	40.4±0.08
Mean carpuscular	64.4±0.14	67.5±0.13	65.7±2.15	86.5±0.136	64.2±0.14	64.2±0.07

volume(MCV) (femtoliters/10^{-15} L)						
Mean carpuscular hemoglobin(MCH) (pictograms/10^{-12} grams)	21±0.05	21.3±0.10	22.9±0.05	25.4±0.13	21.06±0.09	20.3±0.12
Mean carpuscular hemoglobin concentration(MCHC) (pictograms/10^{-12} grams)	31.7±0.005	30.45±0.15	32.4±0.12	38.5±0.14	31.5±0.13	31±0.23
White blood cells (WBC)(/mm^3)	18.6±0.05	20.04±0.01	19.6±0.3	29.9±0.01	18.0±0.05	18±0.07
Platelets(lakhs/mm^3)	2.04±0.05	1.55±0.13	1.6±0.07	1.15±0.01	2.02±0.08	1.9±0.05

Table -2 shows hematological parameters of fish (Channa punctatus) considered variation in each different location of sampling sites of study.

REFERENCES

[1] Ghosh D, Bhattacharya S, Mazumder S. Perturbations in the catfish immune responses by arsenic: organ and cell specific effects. Comparative Biochemistry and Physiology, part C. 2006; 143: 455-463.

[2] Lavanya S, Ramesh M, Kavitha C, Malarvizhi A. Hematological, biochemical and ionoregulatory responses of Indian major carp Catla catla during chronic sublethal exposure to inorganic arsenic. Chemosphere. 2011; 82(7): 977-985.

[3] Qayoom I, Shah FA, Mukhtar M, Balkhi MH, Bhat FA, Bhat BA. Dimethoate Induced Behavioral Changes in Juveniles of Cyprinus carpio var. communis under Temperate Conditions of Kashmir, India. The Scientific World Journal. 2016. Tiwari et al. World Journal of Pharmaceutical Research www.wjpr.net | Vol 10, Issue 6, 2021. | ISO 9001:2015 Certified Journal | 1304

[4] Tripathi S, Sahu DB, Kumar R, Kumar A. Effect of acute exposure of sodium arsenite (Na3 Aso3) on some hematological parameters of Clarias batrachus (common Indian cat fish) in vivo. Indian Journal of Environmental Health. 2003; 45: 183-188.

[5] Mohanty G, Mohanty J, Nayak AK, Mohanty S, Dutta SK. Application of comet assay in the study of DNA damage and recovery in rohu (Labeo rohita) fingerlings after an exposure to phorate, an organophosphate pesticide. Ecotoxicology. 2011; 20(1): 283-292.

[6] Owolabi OD. Hematological and serum biochemical profile of the upside-down catfish, Synodontis membranacea Geoffroy Saint Hilaire from Jebba Lake, Nigeria. Comparative Clinical Pathology. 2011; 20(2): 163-172.

[7] Zutshi B, Raghu Prasad SG, Nagaraja R. Alteration in hematology of Labeo rohita under stress of pollution from Lakes of Bangalore, Karnataka, India. Environment Monitoring Assessment. 2010; 168: 11-19.

[8] Kori-Siakpere O, Ubogu EO. Sublethal haematological effects of zinc on the freshwater fish, Heteroclarias sp. (Osteichthyes: Clariidae). African Journal of Biotechnology, 2008; 7(12).

[9] Adel M, Safari R, Yeganeh S, Kumar PS, Safaie P. Hematological and Biochemical Profile of Pike Breeders (Esox lucius Linneaus) from the Anzali Wetland, Caspian Sea. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 1758, 1-6.

[10] Sadeghi P, Savari A, Movahedinia A, Safahieh A, Azhdari D. An assessment of hematological and biochemical responses in the tropical fish Epinephelus stoliczkae of Chabahar Bay and Gulf of Oman under chromium exposure: ecological and experimental tests.

Environmental Science and Pollution Research. 2014; 21(9): 6076-6088.

[11] Saleh YS, Marie MAS. Use of Arius thalassinus fish in a pollution biomonitoring study, applying combined oxidative stress, hematology, biochemical and histopathological biomarkers: A baseline field study. Marine Pollution Bulletin. 2016; 106(1): 308-322.

[12] Satheeshkumar P, Ananthan G, Senthilkumar D, Khan AB, Jeevanantham K. Comparative investigation on hematological and biochemical studies on wild marine teleost fishes from Vellar estuary, southeast coast of India. Comparative Clinical Pathology. 2012; 21(3): 275-281.

[13] sastry k.v., sachdeva s.s., Effect of water borne cadmium and copper on the blood of the fish channa punctatus. Environment and ecology, 1994; 12(2): 291-297. Tiwari et al. World Journal of Pharmaceutical Research www.wjpr.net │ Vol 10, Issue 6, 2021. │ ISO 9001:2015 Certified Journal │ 1305

[14] Nounou a.h. soliman m.m., rizkalla e.h., assad m.n., Hematological and biochemical changes in clarias lazera as a result of long term exposure to trial combination of lead, mercury, and arsenic. egyptin journal of agriculture research, 1997; 75(1): 247-270.

[15] Mukherjee j.r., sinha g.m., cadmium toxicity on hematological and biochemical aspects in an Indian freshwater major carp, labeo rohita (Hamilton). Journal of freshwater biology, 1993; 5(3): 245-251.

[16] abd alla g.a., Ibrahim m.s., bahnasawy m.h., abdel-baky t.e., toxic effects of some water pollutants (gallant and mercury) on blood parameters of catfish. journal of Egyptian german society of zoology, 1991; 6(a): 201-209.

[17] Nikinmaa m., oikari a.o.j. Physiological vchanges in trout (salmo gairdneri) during a short term exposure to resin acids and during recovery. Toxicology letters, 1982; 14: 103-110.

[18] Everall n.c., Mitchell c.g., groman d.b., Johnson j.a.a., Tracing of hematoxic agents with the aid of fish: a studywith captive adult atlantic salmon salmo salar in river don, aderdeenshire, Scotland (uk). Diseases of aquatic organisms, 1991; 10: 75-85.

[19] Okechukwu EO, Auta J. (The effects of sub-lethal doses of lambda-cyhalothrin on some biochemical characteristics of the African catfish Clarias gariepinus. Journal of Biological Science, 2007; 7(8): 1473-1477.

[20] Modesto KA, Martinez CB. Effects of roundup transorb on fish: hematology, antioxidant defenses and Acetylcholeneesterase activity. Chemosphere, 2010; 81(6): 781-787