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Micronucleus Assay and Hematological Parameters Study due to Presence of Heavy Metals in Four Different Species of Freshwater Fishes of River Mahanadi Cuttack Odisha

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Mahanadi river water is highly polluted. Alkalinity, hardness, pH of water has changed in the last few years. Heavy metals like Pb , Fe, Cu, Mn, K quantity increases which causes hematological and genetic damage to the aquatic ecosystem. Fish are the best biomarkers to find out the threats towards aquatic ecosystem. Water pollution causes hematological damage as well as genetic

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damage and formation of micronucleus. Water sample analysis occurs by evaporation method for extraction of heavy metals. Fish species like *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, *Cirrihinus reba* collected from the several stations of Cuttack 20.44^0N 85.88^0E to 20.46^0N -85.89^0E area and for Hematological study blood was collected by puncturing the caudal vein. Micronucleus assays done by use of Giemsa staining method as a result it shows formation of micronucleus and DNA damage which indicate the presence of high level of pollutants in water of River Mahanadi Cuttack Odisha.

Keywords: Heavy metals (Pb; Fe; Mn; Cu; K); evaporation method; aquatic ecosystem; hematological study; micronucleus; DNA damage; giemsa stain.

1. INTRODUCTION

Water is the one of the fundamental elements for life but according to the National Environment Engineering Research Institute (NEERI), Nagpur it has been noted that 70% of rivers water has been polluted to great extent. Water pollutants include contamination due to the domestic wastes, insecticides, herbicides, food processing wastes, water pollution from livestock operations, organic compounds, heavy metals, domestic wastes, chemicals waste and others. Mahanadi river is the largest river of the Odisha is highly polluted by indicating the change in pH ,alkalinity and hardness as well as highly presence of heavy metals due to drainage system of Jagatpur industrial area other industries and drainage of cuttack City sewage .High amount of heavy metals like Pb, Fe ,Cu, Mn, K are found in the water which causes several life threatening damages to the aquatic ecosystem and fishes are the best bio indicator which indicate the changes in aquatic environment. By the study of micronucleus essay the changes due to pollution on genetic basis can be studied. The micronucleus assays used to calculate the genotoxic effect of pollutants on aquatic ecosystem of river Mahanadi Cuttack Odisha [1-8]. The response of Fish towards the toxicant is similar as higher vertebrates so it's a great benefit to use it as biomarkers. Fish are excellent subjects for the study of mutagenic and carcinogenic potentials of contaminants present in water sample seems they can metabolize concentrate and store waterborne pollutants (Al-sabti, 1991). Aquatic animals have often been used as assay to evaluate surface water (Brugs)hematological study indicate the label of pollutions in the water however due to increase of heavy metals in river water the life and genetic damage occurs. Fish serves as useful genetic model for the evaluation of pollution in aquatic ecosystem (Mitchell and Kennedy, 1992 park, 1993). Micronucleus form due to the pollutants, stress, chemicals, organic waste and heavy metals during the anaphase stage of mitotic cell division by formation of chromosome fragments of whole chromosomes lost during cell division. It occurs due to any abnormalities during cell division which causes the damage. Sometimes during cell division multiple genetic abnormalities shows due to pollution. Heavy metals contain varies harmful substance which effects the hematological parameters. To find out the amount of heavy metals present in Mahanadi river water at Cuttack Odisha and its effect on fish hematological condition and to find out genetic modification, micronucleus formation as well as other nuclear abnormalities due to presence of excess heavy metals in Mahanadi River water at Cuttack [9-12].

2. MATERIALS AND METHODS

Study area: Surface sediment to study the amount of heavy metals in the river Mahanadi at Cuttack by use of evaporation method, and solvent extraction method used for heavy metals study in Mahanadi river water.

Fish species: Fishes like *Labeo rohita*, *Catla catla*, *Cirrihinus mirigala*, *Cirrihinus reba* were collected from Mahanadi river in Cuttack. The physicochemical properties of experimental water temperature varies with pH average 5.5 to 7.03 and dissolve oxygen 6.5-7.2.10 -30 cm length fish are used with *Cirrhinus reba* and *Cirrhinus mrigala* average weight 50 gm and *Catla catla* and *Labeo rohita* average weight 700 gm. 20 ml of blood samples were taken in Thomas pipette and cyanmethemoglobin method used for hemoglobin court .Face blood serum collected and studied by giemsa staining method for micronucleus assay [13-15].

3. RESULTS

Table 1 shows the highest risk level of metals present in river water. The pH, Hardness, Alkalinity, Do also affect by the presence of

Table 1. (Results of heavy metals) analysis results of Surface sediments of Mahanadi River

Parameters	Minimax	Mean SD
Pb	18.23-±48.65	23.45±8.69
Fe	13.56±34.56	18.76±7.98
Cu	11.23±37.76	16.22±9.19
Mn	0.065-±0.206	0.108±0.105
K	0.87±0.120	0.97±0.86
Sand	97.54±99.10	94.16±1.89
Clay	0.54±0.306	1.74±1.77

Table 2. (Hematological parameters): Hematological parameters observed by the study of different fishes of river Mahanadi

Blood parameters	Species of fish name			
	Cirrhinus mrigala	***Cirrhinus reba***	***Catla catla***	***Labeo rohita***
WBU(X104/mm3)	2.8±0.05	3.4±0.10	3.0±0.76	5.6±0.07
Lymphocyte (%)	6.8±0.15	79±0.03	43.0±0.65	48.0±0.03
Polymorph nuclear (%)	0.01±0.19	12.0±0.42	75.0±0.53	64.0±0.32
Eosinophil (%)	3.0±0.42	0.03±0.07	7.0±0.08	2.10±0.17
Thrombocyte(X104/mm3)	4.0±0.28	2.7±0.16	3.0±0.14	2.0±0.27
RBC(X106/mm3)	0.7±0.16	0.63±0.49	3.8±0.06	1.7±0.56
Hemoglobin (g %)	7.5±0.11	5.9±0.28	4.5±0.08	6.0±0..8
MCH(Pico gram)	120	150	40	20
MHV(U2×10-9	56±0.21	67.11±0.29	20.65±0.13	27.75±0.47
MCHC (%)	17.84	8.98	6.76	6.89
Hematocrit (%)	49.0±0.04	64.0±0.35	79.0±0.53	64.9±0.03
ESR(mm/h)	3.0±0.04	7.0±0..9	3.0±0.07	7.0±0.53

Table 3. Results of micronucleus study

Species	1			2			3			4		
	Blood	**Kidney**	**Gills**	**Blood**	**Kidney**	**Gills**	**Blood**	**Kidney**	**Gills**	**Blood**	**Kidney**	**Gills**
LR	0.6±0.9	0.1±0.3	0.3±0.1	0.12±0.7	0.3±0.03	6.0±0.7	1.8±0 9	12.0±0.9	9.0±0.01	10.0±0.12	32.0±0.12	25.0±0.23
CC	0.4±0.1	0.6±0.2	0.2±0.9	0.8±0.3	0.12±0.6	0.28±0.7	0.4±0.10	0.23±0.14	0.32±0.17	24.0±0.16	23.0±0.64	32.0±0.76
CM	0.9±0.1	0.12±0.8	1.2±0.8	0.19±0.2	1.40±0.9	2.0±0.65	30.0±0.42	27.0±0.54	31.0±0.64	15.0±0.75	0.63±0.65	0.75±24.0
CR	3.1±0.22	*1.9±0.32*	5.0±0.4	4.0±0.29	6.0±0.6	7.0±0.1	9.0±0.6	27.0±0.43	45.0±0.60	18.0±0.9	19.0±0.12	31.0±0.12

LR-Labeo rohita CC- Catla catla CM-Cirrhinus mrigala. CR-Cirrihinus reba

heavy metals, by direct drainage of the industrial and city sewage waste river water shows different levels of heavy metals which causes life threatening damage towards aquatic ecosystems [16-19]. Table 2 The Hematological parameters changes or the damages in hematological condition which is causing by the heavy metals intake by fish from river water and the 3rd Table 3 shows the genetic damage which causes formation of micronucleus in the cells. The results show the life threatening dangerous conditions of the river ecosystem of river Mahanadi Cuttack Odisha.

4. DISCUSSION

The effect of aquatic ecosystems indicates the damages of the environment and it will affect human health based on the damage condition of aquatic ecosystems. The integrated effect of a variety of environmental stress on the health of an organisms and the population community and ecosystem (Obiakor M O, Okonkwo J C, Nnabude P.C and Ezenwajiaku C D, 2012) Genotoxic pollution of aquatic ecosystem describes the introduction of contaminants with the mutagenic teratogenic and carcinogenic potential into principal media and genome of the resident organism (Environ health prespect,1996)

5. CONCLUSION

Control action and awareness programs and proper swage water treatment should be done before release it directly to the Mahanadi River to prevent polluting of Mahanadi River so that we can protect aquatic ecosystem. Increasing level of pollutants produce a stress full environment which causes hematological, nuclear and DNA damage .it somehow makes a question mark regarding the effect of this on human health.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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