

ASSESSING THE INFLUENCE OF SEWAGE WATER OBTAINED FROM STP OF PATNA ON BEHAVIOUR AND BODY WEIGHT OF CATLA CATLA

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ABSTRACT

The repercussions of sewage water obtained from the *Sewage treatment plants (STPs) Saidpur Saidpur* in Patna on the behavior and body weight of *Catla catla*, a significant freshwater fish species. As urbanization intensifies, the discharge of treated sewage water into natural water bodies raises concerns about its impact on aquatic ecosystems. Through a comprehensive analysis of behavioral patterns and physiological responses, this present investigation shows that impact of sewage water on the changes in behaviour and bodyweight of a freshwater fish, *Catla catla*. For this study the treatment of toxic effects of sewage water on the desired fish species that is *Catla catla* was found suitable for the exposure based on the available literature survey. The results of the study evidenced that sewage is toxic and thus, it has led to the altered fish physiology. However the exact mechanism through which this is achieved needs to be studied further.

Keywords: - Fish, River, Sewage water, Weight, Patna.

I. INTRODUCTION

The fast growth of the world population and urbanization has resulted in a significant rise in the production of sewage water. This has necessitated a thorough investigation of its effects on aquatic ecosystems. Patna, the capital city of Bihar, is particularly noteworthy as a central area of concern among the many locations dealing with this difficulty. The Sewage treatment plants (STPs) Saidpur in Patna have a crucial role in the management and treatment of wastewater. However, the effects of releasing treated sewage water into natural water bodies are still being studied by scientists. This research examines the complex dynamics of how sewage water from the sewage treatment plants (STPs) Saidpur Saidpur in Patna affects the behavior and body weight of *Catla catla*, a common freshwater fish species found across the Indian subcontinent. Gaining a comprehensive understanding of the consequences of releasing sewage water into bodies of water on aquatic creatures is of utmost importance for the preservation of ecosystems and the sustainable management of water resources. Patna, renowned for its historical importance and fast urbanization, confronts the task of harmonizing its wastewater management with the preservation of the environment. The city's Sewage Treatment Plants play a vital role in alleviating the detrimental impacts of urbanization on water bodies. Nevertheless, the discharged sewage water that has undergone treatment may still retain trace amounts of contaminants and compounds that might have adverse effects on aquatic organisms. *Catla catla*, often referred to as the Indian main carp, is used as an indicator

species in research because of its economic significance and its susceptibility to environmental changes. The objective of this study is to investigate the behavioral and physiological reactions of *Catla catla* when exposed to sewage water originating from the sewage treatment plants (STPs) Saidpur in Patna. Examining modifications in the innate behavior of fish is crucial for identifying environmental stresses. A thorough examination is required to understand the complex relationship between the content of sewage water and the behavior of *Catla catla*. Swimming patterns, eating habits, and social interactions among the fish population will be carefully examined to identify any abnormalities from the usual behavior. In addition, the research will investigate the possible influence of sewage water on the reproductive behavior of *Catla catla*. This is important since disturbances in breeding patterns might have far-reaching consequences on the overall population dynamics of the species.

Furthermore, the study expands its investigation to the physiological component by assessing the body weight of *Catla catla* fish that have been exposed to sewage water from *sewage treatment plants (STPs) Saidpur*. Fluctuations in body weight may function as a dependable measure of the general health and welfare of fish. The research seeks to determine whether exposure to treated sewage water impacts the growth and development of *Catla catla*, which might have implications for its economic viability and ecological function in the aquatic environment. Gaining a comprehensive understanding of the physiological reactions of this species is crucial, not only for the preservation of the environment but also for evaluating the possible hazards linked to human eating of contaminated fish. The study has great importance as it has the ability to provide valuable insights for the development of environmental policies and practices related to wastewater management in metropolitan settings. The research provides vital insights into the wider discussion on sustainable water resource management and ecological preservation by examining the precise effects of sewage water from the sewage treatment plants (STPs) Saidpur in Patna on the behavior and body weight of *Catla catla*. Furthermore, the results might be used as a foundation for improving current sewage treatment methods in order to achieve a more comprehensive elimination of pollutants, thereby reducing the impact of metropolitan areas on aquatic ecosystems. Given the ongoing process of urbanization and its impact on water resources, it is crucial to comprehend the effects of sewage water discharge on aquatic creatures. The current investigation on the impact of sewage water from the sewage treatment plants (STPs) Saidpur in Patna on the behavior and body weight of *Catla catla* is a significant advancement in tackling this issue. The study seeks to provide a comprehensive understanding of the ecological consequences of sewage water discharge in urban contexts by combining behavioral observations and physiological examinations. In conclusion, the results of this research may provide valuable insights for developing sustainable water management methods and contribute to the overall objective of preserving the natural balance of freshwater ecosystems in fast-growing metropolitan areas.

II. REVIEW OF LITRATURE

Kumari, Nisha et al., (2023) The Ganga River in India is in the top 10 most polluted rivers globally. However, there is a lack of data about the presence of plastics in wild-caught fish from this river, as opposed to commercially farmed fish species. The current investigation included capturing wild fish specimens of nine different species from two specific places in Patna (Bihar) along the River Ganga. An analysis was conducted on the organs (including the gastrointestinal system, liver, gills, and muscles) of fishes to determine the presence of plastics. Plastics were detected using a stereomicroscope, and the polymer kinds were determined by FTIR analysis. Among the nine wild fish species, only three (*Labeo rohita*, *Wallago attu*, and *Mystus tengara*) exhibited the presence of plastics inside their bodies. However, only the organs of a single commercially farmed fish species (*L. rohita*) were examined, since this was the only fish species accessible in the local fish market of Gaya (Bihar, India). The fish specimens of this cultivated species were obtained from certain outlets that get their supply from the Fish Farm operated by the Department of Fisheries, Government of Bihar. The mean number of plastic particles per fish in wild-caught and commercially captured fishes was determined to be 2.5 ± 1.6 and 5.2 ± 2.5 , respectively. In addition, the study found that wild-caught fish had the greatest concentration of microplastics (78.5%), followed by mesoplastics (16.5%) and microplastics (5.1%). The prevalence of microplastics in commercial fishes was much greater, reaching 99.6%. Fragments accounted for 83.5% of the microplastic types discovered in wild-caught fishes, while fibers constituted 95.1% of the microplastic types in commercial fisheries. There was a large quantity of colored plastic particles, namely white and blue ones. The column feeder fishes exhibited a higher degree of plastic contamination compared to the bottom feeder species. The most common types of microplastic polymers found in the Gangetic and farmed fish were polyethylene and polyethylene-co-propylene, respectively. This research presents the first-ever findings of plastic contamination in wild fish species from the River Ganga in India, in comparison to fish species that are farmed.

Kundu, Sourav et al., (2023) The Hilsa fish, scientifically named *Tenualosa ilisha*, is an anadromous species that is highly esteemed and referred to as the "Queen of Fishes". It is the most economically significant fishery in the estuary of the Ganga-Hooghly delta. While the detrimental impact of BPA exposure on aquatic creatures has been established, there is currently no study investigating the effects of BPA specifically on the economically important Hilsa shad species found in the Ganga river. In order to address this lack of knowledge, we conducted an analysis of the levels of BPA in Hilsa fish obtained from the Ganga estuary. Bisphenol A (BPA) was detected in the liver, muscle, kidney, and gonads of Hilsa fish of all ages. The liver BPA levels exhibited the greatest values in adult men (272.16 ± 0.38 ng/g-dw), whereas the lowest values were seen in juveniles (5.46 ± 0.06 ng/g-dw). The Hilsa shad muscle contained the greatest quantities of BPA in reproductively mature females, measuring at 196.23 ± 0.41 ng/g-dw. The research also found an association between fish growth and exposure to BPA, with larger concentrations of BPA detected in adult Hilsa species. This research is the first examination of the consequences of BPA contamination on aquatic ecosystems and fisheries. The findings indicate that Hilsa shad is tainted with BPA, which

presents health risks to humans. The findings, which indicate the presence of BPA contamination, are valuable for safeguarding the Hilsa fish population in the Ganga river.

Kumar, Anand & Singh, Chander. (2019). Groundwater that is polluted with geogenic pollutants is recognized as a significant route via which humans might be exposed to these harmful substances. The current research was undertaken in a specific area of the Indus basin to examine the occurrence and spatial arrangement of arsenic (As) and other trace metals in groundwater. The concentration of As ranges from below detection limit (bdl) to 255.6 µg/L in the collected groundwater samples. Approximately 24.6% of the samples exceed the guideline set by the World Health Organization (WHO), which is 10 µg/L. The newer alluvium of Ravi River has a significant accumulation of arsenic. The presence of elevated levels of bicarbonate (HCO₃⁻) and iron (Fe), together with low levels of nitrate (NO₃⁻), suggests the occurrence of reductive dissolution of minerals containing iron (Fe). Nevertheless, the occurrence of silicate weathering, along with elevated levels of sulphate (SO₄²⁻) and a positive oxidation-reduction potential (ORP), suggests the presence of a combination of both oxidizing and reducing conditions. The composition of groundwater is mostly determined by the weathering of minerals and other significant hydrogeochemical processes. Sodium bicarbonate (Na-HCO₃) is the predominant water facies, accounting for 31.5% of the samples, whereas magnesium bicarbonate (Mg-HCO₃) is the second most common, found in 30% of the samples. The health risk assessment for children and adults in the area included the use of several trace elements such as iron (Fe), copper (Cu), cadmium (Cd), chromium (Cr), and zinc (Zn). Among the 73 samples analyzed, 58% had elevated levels of Fe, 32.8% had excessive Zn, and 4.1% showed high Cd concentrations, all beyond the recommended thresholds set by the WHO standards. The health risk of the population has been evaluated by using the chronic dose index (CDI), hazardous quotients (HQ), and hazardous index (HI) for both children and adults. The CDI values exhibit the following order: Fe > Zn > Cu > As > Cr > Cd. Meanwhile, the HQ levels show significant dangers for both children and adults. Out of the groundwater samples, 43.8% exhibit a high Hazard Index (HI) for adults. However, 49.3% of the samples had a high HI for children, suggesting a greater danger for children than to adults. Prioritizing a comprehensive testing program is crucial to assess the presence of arsenic and other trace metals in the wells of the study area, with the aim of mitigating any health hazards.

Reddy, P.. (2018). This study focuses on examining the harmful impacts of mixed wastewater effluents (from both municipal and industrial sources) obtained from an industrial complex in Nagda Town, Madhya Pradesh, India. The analysis revealed that the quantities of dissolved oxygen (DO), total dissolved solids (TDS), pH, chloride, biochemical oxygen demand (BOD), and chemical oxygen demand (COD) in the wastewater effluents above the established criteria. The fish species *Heteropneustes fossilis* was chosen as an experimental model, and the LC50 values over a duration of 96 hours were calculated using probit analysis. The LC50 value for a duration of 96 hours was determined to represent a concentration of 5.8% of the effluent by volume. The fish, *H. fossilis*, were subjected to several sublethal doses (1/10, 1/20, and 1/30%)

of effluent for a duration of 21 days. Various serum toxicological endpoints were assessed. The blood sample was obtained by cutting the caudal peduncle and analyzed to determine the levels of total plasma protein, glucose, Aspartate aminotransferase (AST/GOT), Alanine transaminase (ALT/GPT), superoxide dismutase (SOD), catalase (CAT), and malondialdehyde (MDA). The findings indicate that the mixed effluent exhibited significant toxicity against the fish species *Heteropneustes fossilis*. The findings indicated that fish exposed to sewage water had elevated levels of plasma lipid peroxidation. Exposure to non-lethal amounts of effluent resulted in a notable and progressive rise in AST (SGOT), ALT (SGPT), SOD, and CAT in all experimental groups. Overall, our analysis forecasts that the combined discharge might trigger oxidative stress, impact overall physiology, and perhaps disrupt reproductive physiology. Hence, the combined biochemical, oxidative stress, and histological observations may serve as significant indicators for evaluating pollution levels and monitoring the quality of water. Chemical pollution often impacts aquatic habitats, originating from the discharge of municipal and industrial wastewater and the runoff from urban and agricultural regions. The detrimental effects of water pollution on both aquatic ecosystems and human health are well recognized. Freshwater basins have been transformed into repositories for wastewater generated by city, industrial, and agricultural activities. Multiple freshwater basins in India seem to be contaminated with trace elements and heavy metals, potentially compromising the ecological balance of ecosystems and the physiological processes of individual species. Several harmful chemical compounds are frequently emitted into the natural environment in varying amounts, leading to sudden death or accumulation in the tissues of aquatic organisms. These compounds not only disrupt metabolism but also induce oxidative stress through histopathological damage to various organs. Despite several examinations conducted on the impact of effluents on fish, a comprehensive understanding of the direct relationship between poor water quality and fish well-being remains limited.

Al-Daraji, Hazim. (2014). The impact of food supplementation with various oils on the egg quality of Japanese quail (*Coturnix coturnix japonica*). The purpose of this experiment was to examine the impact of various oils in the meals of laying quail on the features of their egg quality. A total of 120 Japanese quails (*Coturnix coturnix japonica*), aged 7 weeks, and were divided into four groups. Each group consisted of three repetitions, with 10 quails in each duplicate, resulting in a total of 30 quails per treatment group. The subjects were provided with meals containing 3% oil from various sources, including sunflower (T1), linseed (T2), maize (T3), or fish oil (T4), for a duration of 13 weeks, which included one week of adaptation. Supplementing the diet of laying quail with fish oil (T4) and maize oil (T2) led to a significant increase in various egg characteristics, including egg weight, yolk weight, albumen weight, yolk diameter, yolk height, albumen diameter, albumen height, shell thickness, and Haugh unit. This increase was observed consistently throughout all periods of the experiment and in the overall average of these parameters. Nevertheless, the inclusion of various oil sources in the quail diets during this experiment did not have a significant impact on the overall average shell weight, relative weight of albumen, and relative weight of shell. However, the average relative weight of yolk, yolk index, and albumen index were higher in the birds that consumed diets

containing fish (T4) and maize (T2) oil compared to the other treatments (T1 and T3). The experiment's findings unequivocally showed that adding fish and maize oil to the diet of laying quail significantly enhanced several aspects of egg quality. Hence, the inclusion of fish and maize oil in the diets of Japanese quail might be beneficial for controlling egg quality.

III. RESEARCH METHODOLOGY

The assemblage of *Catla catla* juvenile fish (3 ± 0.21 g; 3 ± 0.25 cm). Spacious aerated containers were used for the transportation of fish to the laboratory. Prior to the experiment, the fish were kept in spacious cement tanks measuring $22 \times 12 \times 5$ feet for a duration of 30 days.

In addition, a group of 40 carp fingerlings were acclimatized to laboratory settings for a period of 20 days at a temperature of 22 ± 2 °C. The fingerlings were placed in 100 L glass aquaria of $120 \times 45 \times 80$ cm.

The aquaria were filled with dechlorinated tap water of the same quality as the water used in the experiment. The water's characteristics were obtained by using the procedures specified in (APHA, 2005) and are shown in Table 1.

Table 1: Physico-chemical characteristics of water quality used in the present studies.

Variable	:	Datum
Temperature	:	22 ± 2 oC
pH	:	7.09 ± 0.10 at 24 oC
Dissolved oxygen	:	8.90 ± 0.45 mg/L
Carbon dioxide	:	2.30 ± 0.25 mg/L
Total hardness	:	27.3 ± 3.3 mg as CaCO ₃ /L
Total alkalinity	:	21.4 ± 5.1 mg as CaCO ₃ /L
Conductivity	:	< 10 μS/cm
Chlorinity/Chloride	:	46.3 mg/l

Experimental Toxicant

Sewage water, often known as household or municipal waste water, is a kind of waste water generated by a collective group of individuals.

The characteristics of water include its volume or flow rate, physical state, chemical composition, hazardous elements, and bacteriological status. The composition of this water mostly comprises grey water, which originates from sinks, tubs, showers, dishwashers, and clothes washers.

Additionally, it contains black water, which is the water used for toilet flushing, along with the human waste it carries. The water also contains soaps, detergents, and, in countries where bidets are not often used, toilet paper. The word sewage is currently considered outdated and is increasingly being replaced with the phrase "wastewater". Therefore, we choose a harmful drug based on the findings of our literature review.

Acute Toxicity Test

The laboratory experiment used the semi-static approach outlined in the OECD guidelines of 1992 to measure the acute toxicity (96h LC50) of Sewage water on the freshwater fish species known as Common carp, *Catla catla*. The experiment included exposing carp fingerlings to different concentrations of Sewage water.

Each replication had 10 fingerlings in a test medium of 20L. Two replicates were used for each concentration, in addition to the control sets.

The test medium was refreshed every 24 hours with the corresponding concentrations of the toxicant, without the use of aeration.

Experimental Design and Test Concentrations

The experiment included selecting different concentrations of sewage water (15ml/L, 30ml/L, 60ml/L, and 120ml/L) and exposing them to a duration of 96 hours to evaluate their acute effects. Each duplicate had 10 fish in a 20 L test medium. Two replicate groups, labeled as group-1 (control) and group-2 (treatment), were maintained for each concentration, including the control.

IV. DATA ANALYSIS AND INTERPRETATION

Exposure: 1, 2, 3 & 4 Day Exposure-Control Groups

Table 2: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Control group of fish, *Catla catla*.

Dose Concentrations/ Days/hrs	Number of fishes	Bodyweight in gms Day-1	Body weight in gms	Body weight in gms	Body weight in gms	Behavioural Toxicological Symptoms Day-1 to Day-4
			Day-2	Day-3	Day-4	

0ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	3.5	3.2	3.5	3.1	N
	02	4.1	4.1	4.2	4.2	N
	03	3.6	3.6	3.5	3.3	N
	04	3.1	3.1	3.1	3.1	N
	05	4.3	4.3	4.3	4.2	N
	06	3.2	3.1	3.3	3.1	N
	07	4.1	4.3	4.2	4.2	N
	08	3.8	3.1	3.3	3.2	N
	09	4.3	4.6	4.2	4.0	N
	10	4.4	4.2	4.3	4.1	N

The table displays the findings of a toxicological investigation conducted on fish that were subjected to a concentration of 120 ml/L of a chemical for a duration of four days, with measurements taken at 24, 48, 72, and 96 hours. The quantity of fish (ranging from 01 to 10) and their corresponding body weights are documented on days 1 to 4. The documented toxicological symptoms include erratic and rapid swimming patterns, heightened excitability, overturning, and adherence to the water's surface, agitation, respiratory distress, impaired balance, and congregating near the ventilation filter. On the first day, fish 01 displayed irregular activity and saw a weight gain from 3.8 to 4.1 grams. Fish 02 exhibited a reduction in weight from 3.7 to 3.2 grams, while fish 03 had a drop from 3.6 to 2.8 grams. The surviving fish exhibited consistent patterns of body weight changes and behavioral abnormalities during Day-4. The general trend indicates detrimental impacts on fish, with some individuals exhibiting decreased body mass and anomalous behavior. The results suggest that the drug may be harmful, which raises worries about its effects on aquatic organisms and highlights the need for more research on its environmental consequences.

Table 3: It indicates that Bodyweight and Behavioural Toxicological Symptoms appear to be normal in day-1, 2, 3 & 4 Treated group of fish, *Catla catla*.

Dose Concentrations/	Number of fishes	Bodyweight in gms	Body weight in gms	Body weight in gms	Body weight in gms	Behavioural Toxicological

Days/hrs		Day-1	Day-2	Day-3	Day-4	Symptoms Day-1 to Day-4
120ml/L/ Day-1, 2, 3 & 4/ 24, 48, 72 & 96 hrs	01	3.8	3.8	4.1	3.1	Irregular, Erratic and darting swimming movements, Hyper excitability, apsizeing, Attaching to the surface, Restlessness, Difficulty in breathing, Loss of equilibrium and Gathering around the ventilation filter
	02	3.7	3.1	3.2	3.2	
	03	3.6	3.1	2.8	2.4	
	04	3.1	3.1	3.1	3.5	
	05	4.1	3.4	2.3	2.1	
	06	3.1	3.1	3.4	3.2	
	07	4.1	3.5	2.5	2.4	
	08	3.6	3.4	3.6	2.5	
	09	4.1	3.1	2.7	2.5	
	10	4.8	3.8	3.1	3.3	

The table presents the findings of a toxicological investigation in which 10 fish were subjected to a concentration of 120 ml/L of a chemical for a duration of four days, with measurements taken at 24, 48, 72, and 96 hours. The weight of each individual fish is measured daily, along with observations of their behavior and symptoms related to toxicity. Fish 01 had erratic swimming patterns, heightened excitability, flipping over, clinging to the water's surface, agitation, respiratory distress, impaired balance, and a preference for congregating near the ventilation filter. The weight variations exhibited heterogeneity among the fish, with some individuals seeing a decline while others demonstrated an increase throughout the course of the four-day period. Overall, the data indicate that the chemical has potential toxicity and is harmful to the fish. Further inquiry is necessary to comprehend the environmental influence and possible hazards of this drug on aquatic life, as indicated by the reported behavioral symptoms and changes in body weight.

V. CONCLUSION

This research highlights the urgent need to thoroughly evaluate the effects of sewage water from Patna's Sewage treatment plants (STPs) Saidpur on *Catla catla*. The observed changes in the fish's behavior, together with modifications in body weight, highlight the possible ecological consequences of untreated pollutants. These results support the use of improved

sewage treatment techniques to protect aquatic environments. This study provides policymakers with useful insights that help establish a sustainable equilibrium between urban expansion and environmental protection in the field of wastewater management.

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