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## Effect of water pollutants on the Snake headed fish, *Channa punctatus* collected from the Sawan Nallaha, Balrampur, U.P.

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### Abstract

Sawan Nallah is a small lotic water body of Balrampur, U.P., India, which received semi treated effluents of sugar factory and distillery as well as municipal / domestic waste. The aim of the present investigation was to evaluate the toxic impact of these industrial and domestic wastes on water quality of Sawan nallaha and its toxic effect on fish population inhabiting it. The industrial effluent discharged in it caused significant changes in water quality that altered the haematological parameters (RBCs, WBCs, Hb% and PCV) and serum biochemical parameters (protein, free amino acids, glucose and triglycerides). The physico-chemical parameters of water were much higher than the tolerance limit recommended by Central Pollution Control Board of India.

**Keywords:** Pollution, haematological parameters, biochemical parameters, *Channa punctatus*

### Introduction

Rapid industrialization, urbanization and other developmental activities had led to water pollution by directly discharging industrial effluent and municipal waste into the water bodies (Prakash and Singh, 2020) [14]. Discharge of untreated or semi-treated industrial effluent and municipal waste in water body changes the physical, chemical and biological characteristic of water. Day by day water pollutants are attributed to producing of different products, are release many toxic chemicals to capable of interacting aquatic ecosystem. Industrial effluent affects the aquatic ecosystem by depleting the dissolved oxygen content that disturb the respiratory metabolism of aquatic biota. Many toxic substances are lipophilic and are easily penetrates the cell membrane and accumulate in the different tissues or organs. These toxic substances or chemicals disturbed the normal functioning of cell and this in turn, may result in alternation in the functional biochemical and physiological mechanisms of aquatic organism including fishes. Fishes are important members of aquatic ecosystem but now days they get more polluted because different industrial waste, agricultural waste and sewage are directly discharged into water bodies and affect the aquatic flora and fauna as well as human health. Thus, there is urgent need to estimate the water quality or pollution status of a water body before discharging the industrial effluent.

Due to rapid industrialization many rivers in India are facing the problems of chemical pollution because these Indian rivers act as temporary reservoirs for drainage of water and industrial effluent and often are highly contaminated with anthropogenic materials. It is truly stated that the Sawan Nallaha, a lotic freshwater body is more polluted because it receives huge amount of semi-treated industrial effluent from sugar factory and distillery, domestic sewage waste water, automobile washing waste etc from different sites, therefore, the aim of present study was evaluated the effects of pollutants on the fishes of Sawan nallaha. The result of the present study provide baseline information for aware the people and government to take action for treatment of the polluted water of Sawan Nallaha.

### Materials and Methods

**Study Area:** The present study area, Balrampur city is situated in the eastern Uttar Pradesh adjacent to Indo-Nepal border at 27°16' to 27°32' N latitude and 82°03' to 82°22' E longitude and an altitude of about 113 meters above the mean sea level. Sauwan Nallah is a polluted small perennial lotic fresh waterbody of Balrampur district U.P. (India). Now a day Sawan Nallaha is more polluted because it receives huge amount of effluents from sugar factory and

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its distillery units as well as domestic sewage. After travelling a distance of 7 km., it ultimately joins the river Rapti flowing down in the north.



Fig 1: Sawan Nallaha of Balrampur

**Collection and analysis of polluted water sample:** The water sample were collected from three different sites of Sawan Nallaha in glass stopper bottle. The selected three sites were-

1. Entry point of effluent in the Nallaha.
2. 300 meters away from the entering point in downstream.
3. 300 meters away from the entry point in upstream in all the three seasons i.e. rainy (July-September), winter (November-January) and summer (April-June).

The collected samples were transported immediately to the laboratory for the estimation of physical and chemical properties of sample water. The collected samples were analyzed for temperature, pH. Dissolved oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen demand (COD) by following standard methods given by APHA (2005) [1].

**Haematological and Biochemical analysis:** The specimens of healthy *Channa punctatus* (11.5±1.2cm and 97.5±1.3 gm) were collected from local fish form and brought to the ichthyology laboratory, Department of Zoology, M.L.K.P.G. College, Balrampur, U.P. and washed with 1% solution of KMnO<sub>4</sub> for five minutes and then transferred to the plastic jar containing 50L dechlorinated tap water for acclimatization. The collected fishes were acclimated to laboratory conditions

for 15 days at room temperature. These acclimatized fishes were used as control group. The live *Channa punctatus* collected from three different selected sites of Sawan Nallaha were directly used as uncontrolled group or experimental group for haematological and biochemical analysis. For the haematological analysis, blood sample of controlled and uncontrolled fishes were collected from caudal vein with sterile heparinized syringes and needles in the labeled Eppendorf tubes containing 0.5 mg ethylene diamine tetra acetic acid (EDTA) an anticoagulant. All haematological parameters such as RBC count, WBC count, Hb%, Platelets, and PCV were estimated by following standard methods. For serum biochemical analysis, blood samples of controlled and uncontrolled fishes were collected from caudal vein in the glass tubes and centrifuged at 3500 rpm for 10 minutes and serum was transferred into eppendorfs. The serum metabolites such as serum bilirubin, glucose, protein, amino acid and triglycerides were analyzed by Bruckner (1961) [5], Mendel *et al.* (1954) [12], Lowery (1951) [11], David (1992) [6] and Barnes and Blackstock (1973) [2] respectively.

### Results and Discussion

The results of physico-chemical parameters of Sawan water samples and analysis of haematological and biochemical parameters of fish reared in unpolluted water and fish caught directly from different sites of polluted Sawan Nallah are given in Table 1 & 2, respectively.

The water temperature is one of the most important physical characteristics of aquatic ecosystem, as it affects the physiological activities of aquatic organisms (Verma and Prakash, 2020) [22]. In the present study temperature of polluted water samples varied with different seasons. The highest temperature was observed in summer season at site-1 and lowest in winter at site-2. The temperature of sites 1&3 was comparatively high because of addition of warm water from the sugar factory and distillery industry.

The pH is an indicator of overall environmental condition of the aquatic system. It measure the acidity and alkalinity of water and is one of the most stable measurement. In the present study the pH of Sawan Nallaha ranged from 6.9-8.2. The highest pH value was observed during summer and lowest during rainy season in all the three selected sites. The pH of the Sawan Nallaha was within the range recommended by Central Pollution Control board of India. The alkaline nature of water is suitable for aquatic life (Verma and Prakash, 2020) [22].

Table 1: Physico-chemical characteristic of Sawan Nallaha

Characteristic	Season	Site-1	Site-2	Site-3	Standard of CPCB of India
Temperature (°C)	Rainy	25.2±0.07	24.4±0.06	24.6±0.04	Not exceed 5°C above the receiving water temperature
	Winter	16.4±0.05	15.4±0.03	16.2±0.06	
	Summer	29.8±0.04	29.4±0.05	29.6±0.07	
pH	Rainy	7.0±0.03	8.0±0.02	7.8±0.04	5.5-8.5
	Winter	7.3±0.02	7.8±0.10	7.6±0.03	
	Summer	6.9±0.04	8.2±0.05	7.2±0.06	
Dissolved Oxygen (mg/L)	Rainy	6.5±0.05	7.4±0.02	7.2±0.05	-
	Winter	6.9±0.04	7.8±0.10	7.2±0.5	
	Summer	6.2±0.03	6.6±0.02	6.4±0.04	
BOD (mg/L)	Rainy	458±1.54	278±1.78	101±0.32	30mg/L
	Winter	504±1.21	245±1.54	94.4±1.41	
	Summer	467±1.64	265±1.14	87.1±1.35	
COD (mg/L)	Rainy	977±2.58	675±3.21	387±2.58	250mg/L
	Winter	1032±2.47	498±3.21	325±2.57	
	Summer	984±1.87	452±3.24	412±2.14	
Chloride (mg/L)	Rainy	179±2.58	157±1.41	148±1.21	1000mg/L
	Winter	214±2.47	197±1.48	174±1.23	
	Summer	2.11±2.12	177±1.38	164±1.43	

Dissolved oxygen plays an important role in growth, survival, behavior and physiology of aquatic organisms. The dissolved oxygen level in a water body depends on water temperature as well as the photosynthesis and community respiration. The highest dissolved oxygen was observed during winter season may be attributed to low temperature. Oxygen depletion in summer months may be due to high temperature and rapid oxidation of organic matter.

BOD is the amount of oxygen taken up by micro-organism for the decomposition of organic waste matter in water (Prakash and Ranjan, 2020) [13]. The BOD level between 3.0 to 6.0 mg/l has been reported as optimal for normal activities for fishes (Bhatnagar and Devi, 2013) [3]. Boyd (1998) [4] reported the

optimum level of BOD 10mg/l for fresh water aquaculture. In the present study the level of BOD level was very high as recommended by Central Pollution Control board of India and also not suitable for fish (Bhatnagar and Devi, 2013) [3].

Chemical oxygen demand (COD), represented the amount of oxygen required oxidizing all the organic matter biodegradable and non-biodegradable. The optimum level of COD was < 50 mg/l for fresh water aquaculture as recommended by Boyd (1998) [4]. In the present study COD level in all the three sites and all the seasons were higher than the recommended by Central Pollution Control board of India and also optimum level for aquaculture as recommended by Boyd (1998) [4].

**Table 2:** Impact of water Pollution on Haematological and Serum Biochemical Parameters *Channa punctatus*

Parameters	Season	Fish reared in Fresh water	Fish caught from Sawan Nallah		
			Site-1	Site-2	Site-3
RBC (10 <sup>6</sup> /mm <sup>3</sup> )	Rainy	4.5±0.07	1.4±0.03	1.5±0.04	2.7±0.03
	Winter	5.4±0.15	2.2±0.01	2.7±0.05	3.1±0.04
	Summer	4.6±0.11	1.3±0.03	1.8±0.05	2.1±0.04
WBC (10 <sup>3</sup> /mm <sup>3</sup> )	Rainy	6.1±0.02	13.4±0.04	9.2±0.05	10.2±0.06
	Winter	6.8±0.03	2.25±0.07	3.12±0.05	2.78±0.08
	Summer	5.4±0.07	1.78±0.03	2.54±0.07	1.97±0.04
Hb (%)	Rainy	9.2±0.02	4.8±0.02	7.8±0.06	5.8±0.7
	Winter	12.2±0.02	2.4±0.05	1.97±0.04	1.25±0.03
	Summer	10.1±0.12	1.65±0.4	2.4±0.05	2.2±0.06
PCV (%)	Rainy	54.4±1.4	17.4±0.07	25.4±0.16	20.4±0.14
	Winter	42.4±1.8	16.8±0.06	22.7±0.08	20.4±0.04
	Summer	51.8±0.15	12.4±0.05	19.7±0.06	17.8±0.06
Serum Bilirubin (mg/ml)	Rainy	0.55±0.32	0.68±0.16	0.61±0.43	0.63±0.23
	Winter	0.58±0.33	0.69±0.15	0.65±0.32	0.67±0.33
	Summer	0.57±0.24	0.66±0.35	0.64±0.22	0.65±0.32
Glucose (mg/dl)	Rainy	103.0±1.11	68.50±1.15	79.21±1.21	81.25±1.24
	Winter	112.0±1.14	61.45±1.22	75.81±1.14	85.54±1.16
	Summer	98.50±1.21	52.58±1.51	58.25±1.31	67.25±1.11
Total Protein (mg/dl)	Rainy	3.07±0.64	2.34±0.76	2.48±0.86	2.87±0.55
	Winter	3.25±0.57	1.74±0.72	1.88±0.58	2.12±0.65
	Summer	3.16±0.62	1.86±0.28	1.98±0.35	2.14±0.55
Free Amino Acid (mg/dl)	Rainy	23.12±0.12	26.13±0.42	28.51±0.24	31.61±0.31
	Winter	23.24±0.26	31.33±0.20	34.62±0.21	36.11±0.24
	Summer	23.18±0.31	28.15±0.18	32.15±0.32	34.13±0.15
Triglycerides (mg/dl)	Rainy	87.72±1.12	101.6±0.87	105.7±0.19	128.8±1.01
	Winter	87.98±1.23	115.8±0.54	138.2±0.85	168.5±1.11
	Summer	88.13±0.78	113.8±0.57	124.2±0.81	157.5±1.02

Haematological studies help in understanding the relationship of blood characteristics to the habitat and adaptability of the species in the environment. Many environmental, physical and physiological factors alter the haematological parameters of fish (Hattings and Petzen, 1974) [8]. In the present study, the RBC counts were decreased in the fishes inhabited the Sawan Nallaha. Maximum RBC counts decreased in the fishes inhabited at site-1 followed by site-2 and 3. The decreasing trend of RBC and physico-chemical condition of water clearly indicates that site-1 was maximum polluted site followed by site 2 & 3. The RBC counts may be decreased due to break down of RBC that results in severe anemia in fishes exposed to pollutants. In the present investigation, decrease in Hb% and PCV% in the fishes inhabited in Sawan Nallaha indicate that effluent exposed fishes are anemic. It was found that decrease in RBC, Hb% and PCV% in heavy metals exposed fishes cause macrocytic hypochromic anaemia (Sastry and Sachdeva, 1994; Prakash and Verma, 2014; Verma and Prakash, 2018 & 2019) [18, 15, 20, 21]. The mechanism of hemolysis is not clear, but these compounds are

associated with reduction in cellular ATP and diminished oxygen consumption. Declines in Hb concentration caused by hemolysis usually result in jaundice and elevated the concentration of bilirubin in plasma. In the present investigation. The serum bilirubin level was also increased in fishes inhabiting in polluted water body was due to hemolysis. WBCs are involved in the regulation of immunological functions and their numbers increase as a protective response in fish to stress (Verma and Prakash, 2019) [21]. In the present study, high WBCs counts in the fishes inhabiting in Sawan Nallaha was the indication of leukemia or by damage of body tissues or by severe physical stress. Thus, in the present study increased in WBCs count might be due to stimulation of immune system caused by tissue damage. Similar findings were also documented significantly higher in fish exposed to heavy metals (Verma and Prakash, 2019) [21].

The serum glucose levels were significantly decreased in the *Channa punctatus* inhabiting in polluted waste water as compared to fishes reared in unpolluted water (Table.1). The

fall in the glucose content (hypoglycemia) in the serum indicates its rapid utilization by the fish as a consequence of metabolic toxic stress. Similar decrease in serum glucose level has also been reported in arsenic exposed *Mystus vittatus* by Prakash and Verma (2020) <sup>[16]</sup>. Proteins are highly sensitive to pollutants and happen to be one of the earliest indicators of its toxicity. In the present study significant decline in the serum proteins contents was observed in polluted waste water exposed fish, *Channa punctatus* as compared fishes reared in unpolluted water (Table.1). Similar decrease in serum glucose level has also been reported by Srivastava and Prakash (2018) <sup>[19]</sup> and Prakash and Verma (2020) <sup>[16]</sup> in arsenic exposed fishes. This hypoproteinemia in the present study can be attributed to the enhanced proteolysis. Proteolysis seems to offer a physiological mechanism in a bid to provide energy to cope up with the stressful situation caused by effluent toxicity. Depletion in protein level in effluent exposed fish thus might be due to its enhanced use to build up new cells or enzymes to reduce the stress.

The free amino acid level was significantly increased in effluent exposed *Channa punctatus* as compared to fishes reared in unpolluted water (Table.1). Similar increase in free amino acid level has also been reported by Hyalij (2013) <sup>[9]</sup> in effluent induced fish, *Lepidocephalus thermalis*. The decrease in serum protein with increases in free amino acid shows that during stress conditions these free amino acids are utilized in the glycogenesis to compensate the excess energy demand (Prakash and Verma, 2020) <sup>[16]</sup>.

Serum triglycerides levels are usually used to evaluate the metabolic status of an organism. In the present study, serum triglyceride was increased significantly in polluted waste water inhabited fish, *Channa punctatus* when compared to fishes reared in unpolluted water (Table.1) and hence lead to hypertriglyceridemic condition. Similar increase in serum triglyceride level has also been reported by Devi (1982) <sup>[7]</sup> in endosulfan exposed *Channa punctatus*. Kaur and Mishra (2019) <sup>[10]</sup> recorded histopathological changes in liver of fish *Channa punctatus* exposed to sub lethal concentration of hybrid pesticide. Prakash (2020) <sup>[17]</sup> pointed out that homeostasis of lipid is one of the principal liver functions and any change in serum triglyceride concentration is used as an indicator of liver dysfunction. Srivastava and Prakash (2018) <sup>[19]</sup> pointed that various lipolytic enzymes which convert triglycerides into fatty acids and glycerol may be released into blood due to the degeneration of liver cells leaving triglycerides unprocessed.

Thus, it seems that reduced rate of lipolysis ultimately results in the elevated serum triglycerides levels.

### Conclusion

It is clear from the above investigation that Sawan Nallah got polluted due to effluents discharged from sugar factory and distillery along with municipal sewage discharged of Balrampur city and this pollution has adversely affected the aquatic flora and fauna. However the seriousness of this problem has been realized recently but no work had been done to study the toxic effects of effluents on the water quality and fish fauna present in this lotic water body. Hence, an attempt was made to assess the toxic impact of effluents on water quality and haematological as well as serum biochemical parameters of fish directly caught from the different sites of Sawan Nallah. So it should be believed that

the data obtained from this investigation will provide baseline information for making effective fishery conservation programme in this tarai region.

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