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ASSESSMENT OF PHYSICOCHEMICAL PARAMETERS IN THE RIVER TORSA, WEST BENGAL, INDIA: TO INVESTIGATE THE SUITABILITY FOR LIVING ORGANISMS

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ABSTRACT

River Torsa is a trans boundary river of China, India and Bangladesh. It is a tributary of the river Brahmaputra. A study was done on the physicochemical parameters of this river to assess the suitability to biological life. Three sampling sites were selected for the study. Water temperature, pH, Water depth, TDS, electrical conductivity was assessed at the spot. Dissolved oxygen, total alkalinity, total hardness, free carbon dioxide and chloride were determined by standards methods of APHA (2005). Results indicates that all the physicochemical parameters of this river are within the optimum range and suitable for living aquatic organisms. The river Torsa is free from any major anthropogenic activities.

KEY WORDS : Torsa, Physicochemical, Anthropogenic, Optimum range

INTRODUCTION

River Torsa originates from the Chumbi Valley in Tibet, China. It's total length is 358 km and flows through the China, Bhutan, India and then enters in to the Bangladesh. Torsa is a tributary of river Brahmaputra. Amochu hydro project was constructed in this river in Bhutan. The abundance and distribution of plankton, aquatic insect, fishes, mollusc depends on different physicochemical parameters of water. Rivers are usually rich source of biodiversity and harbour many plankton to higher vertebrates and rivers water more suitable for biological life than lentic water. Because lotic water contain more dissolved oxygen, than lentic water bodies (Welch, 1952).

The excellence of river water as determined by its physicochemical parameters and it is very important in determining its suitability for living organisms. Water of the river used as bathing, washing clothes and also as drinking purpose. The livelihood of fisherman depends on the river. Municipal waste directly discharges in to the river and making the water polluted. As a result the physical, chemical and biological characteristics of the river water are gradually changing and producing the harmful effect on aquatic biota and thereby human beings.

The physicochemical parameters of any water bodies changes due to seasonal changes and pollutants. Many anthropogenic activities such as disposal of waste material, industrial effluents, runoff pesticide from agriculture field, over exploitation of natural resources and increased urbanization polluted the river water and make the river water unsuitable for living organisms (Mehedi *et al*., 1999). These anthropogenic activities change the physicochemical parameters of water. Among the physicochemical parameters water temperature, transparency, pH, dissolved oxygen, free carbondioxide, alkalinity, hardness, chloride and BOD mainly determine the hydrological condition of water body (Reid, 1961). The changes in physicochemical parameters of water bodies also changes the water quality and sometimes river water become unsuitable for living creature. So, before taking any measures it should be necessary to assess the physicochemical parameters of river water.

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Many workers studied the limnochemistry of rivers water in this region such as-Barat and Jha (2002); Patra *et al.* (2011); Saha (2014) and Sarkar and Pal (2019). Many workers studied the fish fauna diversity in the river Torsa but no such study on the physicochemical parameters of the river Torsa was done.

MATERIALS AND METHODS

Sampling sites

Three sampling sites were selected for the study such as Jaigaon ($26^0$85′45″ N and $89^0$36′81″ E, 225m), Sonapur ($26^0$50′64″Nand $89^0$32′94″ E) and Cooch Behar City ($26^0$28′63″ and $89^0$53′70″ E), Jaigaon is situated at the foot hill of Himalaya and here the rivet Torsa enters into the India from Bhutan. In Jaigaon river bed with big boulder and high torrential water flow. In Sonapur and Cooch Behar city river bed is more or less similar.

Duration of the study-Study was conducted from March 2014 to February 2016.

Sampling methods-Sampling was done in first week of every month. Water temperature was determined by mercury thermometer at the spot. Water depth determined by marked wooden stick. pH, total dissolved solid (TDS) and electrical conductivity (EC) were determined by digital Deluxe water and soil analysis kit (Model-171 of Electronics India) at the spot. Dissolved oxygen, free carbon dioxide, total alkalinity, total hardness and chloride were analysed by standard method of APHA (2005). For seasonal analysis March to June is considered as summer, July to October as monsoon and November to February as winter. Average rain fall of this area during study period was 0.4 mm to 400 mm.

RESULTS

Water temperature ranged from 6.50 to 29 ^oC, lowest temperature was reported in site 1 and maximum in site 3. The reported water temperature range is suitable for aquatic life. Recorded range of water temperature is also suitable for cold water fishes. Temperature plays a crucial role in some physiological processes in fishes like release of stimuli for breeding (Hora, 1945; Chaudhuri, 1964). Maximum seasonal water temperature was recorded in monsoon season and lowest in winter (Table 1, 2 and 3). Depth of water ranged from 1.0 m to 6.3 m and highest water depth was reported in monsoon season due to heavy rain fall in this region. pH ranged from 6.69 to 7.89 throughout the study period and this is also suitable for fish and others aquatic organisms. pH of water bodies serve as an indicator of pollution status and also influenced the aquatic life. Roule (1930) described that pH between 7.0 to 8.0 is good for fish production. Minimum total dissolved solid was 16.89 mg/l reported at site 1 and maximum 45.37 mg/l at site 3. Maximum dissolved solid was reported in winter and minimum in monsoon (Table 1, 2 and 3). TDS influenced the electrical conductivity of water. Ranged of electrical conductivity was 53.45 to 95.25 µmhos/cm and maximum in winter season and minimum in monsoon due to dilution effect of rain water. The electrical conductivity of water bodies depends upon the concentration of soluble salts/mineral salts, nutrients and total dissolved solids (Trivedy and Goel, 1986). Singh *et al.* reported EC was 1500µ S/cm in the river White Bein. Saha (2014) reported the EC values between 31 and 79 (µs/cm) in the river Shutunga.

Dissolved oxygen in water bodies is an indicator of water quality and diversity of aquatic life.

Table 1. Seasonal variation of physico-chemical parameters at site 1 of the river Torsa from March 2014 to February 2016.

Parameters	March 2014 to February 2016			March 2014 to February 2016		
	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Water Temperature (^{0}C)	25.4±0.01	28.81±0.02	16.18±0.1	24.72±0.01	28±0.02	16.035±0.02
Depth of water (m)	1.71±0.7	3.0±0.59	1.805±0.77	1.875±0.88	3.07±0.45	1.745±0.14
pH	7.405±0.58	6.82±0.59	7.42±0.27	7.385±0.28	6.955±0.66	7.39±0.58
Total dissolved solid (mg/l)	30.875±2.0	22.75±1.56	33.125±2.10	29±2.14	23.375±1.88	33.875±2.57
Conductivity (µmhos/cm)	73.14±3.36	66.315±2.80	79.61±3.99	72.215±3.26	66.835±3.20	78.055±3.87
Dissolved Oxygen (mg/l)	6.935±1.22	6.845±1.00	7.79±0.88	7.365±0.90	7.005±0.78	8.05±1.22
Free Carbon dioxide (mg/l)	2.495±0.25	2.82±0.26	2.345±0.41	2.58±0.55	2.98±0.26	2.28±0.44
Total alkalinity (mg/l)	30.735±3.55	21.725±2.58	33.01±2.45	28.95±2.99	21.185±1.88	31.405±1.78
Total hardness (mg/l)	18.51±2.11	10.975±1.88	22.63±1.25	18.135±2.10	10.32±1.87	22.02±1.45
Chloride content (mg/l)	3.77±0.25	7.975±1.12	3.59±0.56	3.705±1.2	3.7±0.58	3.63±0.78

Dissolved oxygen ranged from 6.88 mg/l to 9.25 mg/l and maximum in site 1 and minimum was reported in site 3. Highest dissolved oxygen was recorded in site 1 because water temperature is low and water facing many obstacles of big boulder during flowing. Dissolved oxygen of the river water is suitable for aquatic life. Dissolved oxygen above the 6.5 mg/l indicates productive water bodies. Maximum dissolved oxygen was reported in winter season due to lowest water temperature (Table 1, 2 and 3). In winter season water temperature was low which has a greater capacity to hold dissolved oxygen in comparison to warm water (Welch, 1952). Singh *et al.* (2018) reported range of dissolved oxygen between 4.16 ppm to and 5.95 ppm in the river White Bein. Saha (2014) found DO ranged from 3.33 to 5.56 mg/l in the river Shutunga and similar DO also recorded by Acherjee and Barat (20011). Present study corroborates with these findings.

Maximum total alkalinity was reported 45 mg/l at site 2 and minimum 23 mg/l at site 1. Jhingran (1991) suggested that the total alkalinity of water between 40 to 90 mg /l is considered as medium productive. According to Jhingran (1991) water of this river is very low productive. Alkalinity is the quantitative capacity of the water sample to react with strong acid and "buffer" its pH. Alkalinity is important for biological life because it buffers against pH changes. Maximum alkalinity was found in winter and minimum in monsoon season is (Table 1, 2 and 3). Low alkalinity in the monsoon seasons due to dilution effect by rain water (Bishop, 1973).

Free carbon dioxide ranged from 2.98 mg/l at site 1 to 4.48 mg/l at site 3 and maximum was recorded in monsoon season and minimum in winter season (Table 1, 2 and 3). Surface agitation of water due to boulder is very effective way of entry of oxygen from atmosphere to water and elimination of free CO_2 and vice versa (Welch, 1952). Total hardness ranged from 9.50 to 32.00 mg/l and maximum in winter and minimum was recorded in monsoon season. The above results indicate that river water may be regarded as soft (Swingle, 1967). Similar finding was suggested by Acherjee and Barat (2011) in the hill stream Relli. For sustain of fish health needs at least 20 mg/l hardness (Boyd, 1982). According to Boyd (1982) this river water is suitable for fish health. Total hardness is due to Calcium and

Table 2. Seasonal variation of physico-chemical parameters at site 2 of the river Torsa from March 2014 to February 2016.

Parameters	March 2014 to February 2016			March 2014 to February 2016		
	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Water Temperature (^{0}C)	23.02±2.20	27.51±1.88	14.58±3.52	24.55±3.24	27.20±2.8	15.55±5.90
Depth of water (m)	1.72±0.25	3.45±1.20	1.58±0.56	1.55±0.26	2.7±0.75	1.56±0.95
pH	7.62±0.25	6.88±0.78	7.88±0.81	7.22±0.095	6.76±0.25	7.45±0.84
Total dissolved solid (mg/l)	25.02±3.58	21.25±3.487	32.25±2.6	35.70±2.53	22.75±2.56	33.52±3.86
Conductivity (µmhos/cm)	76.38±7.44	68.30±2.94	81.21±2.64	69.9±4.72	64.33±5.04	78.01±7.99
Dissolved Oxygen (mg/l)	6.53±0.81	6.53±0.23	7.79±0.99	7.27±0.25	6.78±0.71	7.99±1.20
Free Carbon dioxide (mg/l)	3.37±0.80	3.78±0.66	3.58±0.12	3.22±0.11	3.55±0.33	3.02±0.52
Total alkalinity (mg/l)	30.92±7.57	21.09±4.57	31.75±6.17	30.55±4.84	22.36±3.53	34.27±6.62
Total hardness (mg/l)	18.22±4.57	12.24±2.56	26.28±2.22	19.04±3.08	11.91±2.58	25.53 ±3.18
Chloride content (mg/l)	4.22±0.91	3.06±0.61	4.84±0.78	4.02±0.40	3.55±0.26	4.87±0.894

Table 3. Seasonal variation of physicochemical parameters at site 3 of the river Torsa from March 2014 to February 2016.

Parameters	March 2014 to February 2016			March 2014 to February 2016		
	Summer	Monsoon	Winter	Summer	Monsoon	Winter
Water Temperature (^{0}C)	26.10±2.3	29.21±0.82	17.02±2.01	27.02±1.45	28.20±2.01	18.12±2.25
Depth of water (m)	1.11±0.29	3.39±0.58	1.45±0.88	1.22±0.15	4.5±0.84	1.88±0.53
pH	7.10±0.55	6.89±0.69	7.25±0.41	7.20±0.48	7.54±0.45	7.19±0.34
Total dissolved solid (mg/l)	28.02±0.045	24.5±0.051	30.87±0.78	31.58±2.66	23.58±2.9	38.25±2.8
Conductivity (µmhos/cm)	72.15±2.5	65.25±3.26	81.3±4.25	71.28±4.24	63.02 ±3.6	79.08±3.02
Dissolved Oxygen (mg/l)	7.14±0.78	7.29±0.82	8.02±1.7	7.29±0.82	6.59±0.86	7.58±0.71
Free Carbon dioxide (mg/l)	3.52±0.62	4.21±0.62	3.22±0.55	3.12±0.27	3.52±0.88	3.20±0.49
Total alkalinity (mg/l)	27.5±4.15	21.71±3.20	30.20±3.27	27.22±3.34	21.12±2.56	27.25±2.11
Total hardness (mg/l)	17.5±2.29	10.11±1.80	22.22±2.06	17.02±2.08	10.44±2.01	23.95±2.50
Chloride content (mg/l)	4.53±0.58	3.26±0.21	4.35 ±0.87	4.28±0.88	3.08±0.52	4.89±0.96

Magnesium and both are very important in bone and scale formation in fishes and shell formation in Mollusca. Lowest chloride was reported 2.95 mg/l at site 1 and highest 5.10 mg/l at site 2. Chloride content in water bodies is an indicator of organic pollution (Munwar, 1970). But the ranged of chloride in this river are within the tolerance zone for biological life. Increased values of total alkalinity, Chloride and total hardness augmented the growth of phytoplankton density. On the other hand, increased value of pH, total alkalinity, Chloride and total hardness enhances fish population size and production (Acherjee and Barat, 2011). The water temperature, alkalinity, free carbon dioxide, dissolved oxygen, pH and total hardness have effect on fish health and their disease resistance (Shrestha, 1991).

CONCLUSION

From the above study on physicochemical parameters of the river it was concluded that river water more or less free from different anthropogenic activities and from pollution. This river water is also suitable for aquatic life. Ranged of DO, free carbon dioxide, alkalinity, total hardness and chloride are within the optimum range for biological life.

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