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**Study of Physico-Chemical Characteristics of Beehar river  
water, Rewa, Madhya Pradesh, India**

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**Abstract**

Water samples were collected from 4 stations of Beehar river and were analyzed for various physico-chemical parameters to understand the water quality of Beehar river and to create the awareness of in the local people. The various physico-chemical components that analyzed, are water temperature, transparency, pH, DO, BOD, COD, electrical conductivity, alkalinity, total solids, calcium and magnesium hardness, total hardness, nitrate, chloride, phosphate and sulphate. Most of the parameters of river water were within the permissible limit except ca hardness and COD.

**Keywords:** Beehar river, Physicochemical parameters, Water quality

**Introduction**

Water is important and essential for the survival of life. River is a vital component of biosphere with a higher ecological and social significance. Rivers are important sources to provide the daily needs of water for living beings and exploited in nature due to the changing life style of the people. They being polluted by disposal of sewage, domestic, municipal and industrial wastes. The water quality parameters provide a basic for assessing the suitability of water for various purposes. The nature of water pollution is characterized by several physico-chemical and biological characteristics. Water quality is directly related to the health, therefore, it is very important to test water quality before being used for various purposes such as drinking, domestic, bathing, agricultural and industrial purposes. The physicochemical data of any water body indicates the suitability of water for the aquatic life or not. Several workers have studied the physicochemical characteristics of river water as Ambedkar and Muniyan (2018) on Kollidam river of Tamil Nadu, Shrestha and Basnet (2018) on Ratuwa river of Damak, Jhapa, Nepal, Tawati et al., (2018) on Sumber Maron river of Indonesia and Soom et al., (2018) on river Katsina-ala at Buruku, Nigeria.

In the present study, the physicochemical analysis of Beehar river water has been carried out during November 2015 to October 2017. The monitoring of these parameters can support the conservation and management of Beehar river.

**Material and Methods**

The Beehar river is a medium sized river and lies in two districts of M.P. viz. Satna and Rewa. It is about 97 km long and situated between longitude 81.02' and 82.18' east and latitude 24.18' and 25.12' north. The water samples from four stations of Beehar river collected on monthly interval between 8 am to 10 am and were analyzed for detection of concentration of inorganic substances followed by standard methods (APHA, 1998). The physico-chemical characteristics of Beehar river water were studied during two years of study period (November 2015 to October 2017). Samples were collected in one litre clean and white polythene containers. The samples were stored in a refrigerator. The temperature, transparency, pH and conductivity were measured by using Celsius thermometer, Secchi disc, digital pH meter and conductivity meter respectively. Total solids was measured by volumetric analysis. Alkalinity, calcium and magnesium hardness, total hardness, DO, BOD, COD and Chloride were analyzed by titration method. Phosphate and nitrate were analyzed by spectrometer.

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## Results and Discussion

The minimum, maximum and mean $\pm$  SD values of selected physico-chemical parameters of Beehar river water are represented in Table 1.

### 1. Water temperature:

The mean value of river water temperature varied between 19.95°C to 31.35°C with mean $\pm$ SD values of 25.61 $\pm$ 3.34°C during first year and between 20.53°C to 30.95°C with a mean $\pm$ SD value of 25.90 $\pm$ 3.10°C during second year of study period. The minimum temperature was observed in winter season (January) and maximum in summer season (May). Boyd (1998) reported the optimum range of water temperature between 25-32°C for tropical climate of a fish pond. WHO (2008) reported the maximum permissible limit of water temperature <40°C.

### 2. Transparency:

The clarity of water is an important determination of its condition and productivity. The mean values of transparency fluctuated between 30.70 cm to 71.30 cm with a mean  $\pm$ SD values of 55.87 $\pm$ 14.19 cm and between 30.08 cm to 72.85 cm with a mean $\pm$ SD values of 57.66 $\pm$ 14.74 cm during first and second years of study period. The high transparency was recorded in dry season could be due to water stability, low suspended particles and high light penetration in to water. Boyd (1998) reported the optimum level of transparency between 30-40 cm for fresh water aquaculture.

### 3. pH:

The mean values of pH ranged between 7.20 (January) to 8.00 (May) with a mean value of 7.59 $\pm$ 0.22 during first year and between 7.25 to 8.08 with mean $\pm$ SD value 7.59 $\pm$ 0.24 during second year of study period. Soom et al. (2018) recorded the range of pH between 5.10  $\pm$ 0.06 to 7.53 $\pm$ 0.09 which is within the range of optimum fish production by WHO (2011).

### 4. DO:

DO level is controlled by water temperature and organic dissolved matters. The river water exhibited the DO values between 5.10 mg/l to 7.20 mg/l with a mean $\pm$  SD value of 6.29 $\pm$ 0.73 mg/l and between 5.08mg/l to 7.28 mg/l with a mean $\pm$ SD value of 6.30 $\pm$ 0.71 mg/l during first and second years of study period respectively. Shrestha and Basnet (2018) reported the average value of DO 5.17 mg/l in Ratuwa river of Damak, Jhapa, Nepal. WHO (1998) limits for DO was between 8.10 mg/l and BIS (1991) 6.0 mg/l.

### 5. BOD:

During present study, the BOD values fluctuated between 2.10 mg/l to 7.13 mg/l with mean $\pm$  SD value of 4.47 $\pm$ 1.56 mg/l during first year and between 2.10 mg/l to 7.48 mg/l with a mean $\pm$ SD value of 4.62 $\pm$ 1.73 mg/l during second year of study period. The higher values of BOD were recorded in summer season and lower in winter season. Boyd (1998) reported the optimum level of BOD <10 mg/l for fresh water aquaculture. Tawati et al. (2018) reported the BOD between 6.28 $\pm$ 3.74 mg/l to 8.51 $\pm$ 4.34 mg/l in the Sumber Maron river, Kepanjen, Malang, Indonesia.

### 6. COD:

COD is related to organic and inorganic pollutants which reduce the growth of microorganisms. The permissible limit of COD is 10 mg/l (WHO, 2011). The mean values of COD varied between 17.73 mg/l to 39.85 mg/l with a mean value of 27.74 $\pm$ 6.43 mg/l during first year and between 17.03 mg/l to 38.88 mg/l with a mean $\pm$ SD value of 27.44 $\pm$ 5.87 mg/l during second year of study period. Boyd (1998) reported the COD >50 mg/l for fresh water aquaculture.

### 7. Electrical conductivity:

The present study showed the mean variation of electrical conductivity between 105.00 to 232.00  $\mu$ mhos/cm with a mean $\pm$  SD value of 174.73 $\pm$ 36.21  $\mu$ mhos/cm during first year and between 114.25 to 236.25  $\mu$ mhos/cm with a mean $\pm$ SD value of 175.83 $\pm$ 37.46  $\mu$ mhos/cm during second year of study period. Tawati et al. (2018) recorded the value of EC between 243.0 $\pm$ 8.18 to 270.33 $\pm$ 25.00  $\mu$ mhos/cm in Sumber Maron river, Kepanjen, Malang, Indonesia. The value of EC falls within the criteria set by the WHO (750  $\mu$ mhos/cm).

### 8. Alkalinity:

It is the capacity of water to neutralize acids and provides an idea of natural salts present in water. The standard desirable limits of alkalinity in potable water is 200 mg/l prescribed by WHO. The range of mean values of alkalinity in river water were between 139.75 to 180.25 mg/l with a mean $\pm$ SD value of 159.60 $\pm$ 12.56 mg/l during first year and between 139.75 to 186.00 mg/l with a mean $\pm$ SD value of 162.94 $\pm$ 13.25 mg/l during second year of study period. Shrestha and Basnet (2018) recorded the average value of total alkalinity 97.75 org/l in Ratuwa river. Soom et al. (2018) observed value of alkalinity 63.33 $\pm$ 4.91 mg/l in river Katsina-ala at Buruku, Nigeria. BIS standard limit for alkalinity was 600 mg/l. Boyd (1998) reported the range of alkalinity between 50 to 300 mg/l for fish culture.

**9. Total solids:**

The mean values of total solids fluctuated between 209.00 to 474.00 mg/l with a mean±SD value 303.98±87.07 mg/l during first year and between 198.75 to 498.25 mg/l with a mean±SD value of 315.42±98.28 mg/l during second year of study period. Boyd (1998) reported the optimum water quality requirement for total solids <500 mg/l. Shrestha and Banset (2018) reported the value of TDS and TSS 77.25 mg/l and 56mg/l respectively in post monsoon period. Both are below 500 mg/l according to WHO standards.

**10. Calcium and magnesium hardness:**

The calcium and magnesium are very common minerals in river water and are essential for bone growth, bone structure, muscle contraction and blood clotting. During present study, the Ca hardness varied between 52.00 to 124.50 mg/l with a mean±SD value of 81.90±24.53 during first year and between 49.50 to 126.00 mg/l with a mean±SD value of 79.65±24.38 mg/l during second year of study period.

The range of mean values of magnesium fluctuated between 2.70 to 8.80 mg/l with a mean±SD value of 5.12±1.79 mg/l and between 3.38 to 9.75 mg/l with a mean±SD value of 5.75±1.89 mg/l during first and second years of study period. Shrestha and Basnet (2018) recorded the concentrations of calcium 25.14 and 19.24 mg/l and magnesium concentration 1.94 and 12.15 mg/l during pre-monsoon and post monsoon season. The desirable limits of a calcium and magnesium for drinking water were 75 mg/l and 50 mg/l respectively as per WHO standards.

**11. Total hardness:**

The mean values of total hardness observed between 58.25 to 127.20 mg/l with a mean±SD value of 87.01±23.02 mg/l during first year and between 36.03 to 129.38 mg/l with a mean±SD value of 85.39±22.96 mg/l during second year of study period. The minimum values of total hardness were recorded in rainy season and maximum in summer season. The increase of hardness in summer was due to decrease of water level and increase of temperature. Sawant and Chavan (2013) recorded the total hardness between 88.5 mg/l to 136.0 mg/l in Mahagaon reservoir, Maharashtra with higher values in Summer season.

**12. Nitrate:**

The mean values of nitrate fluctuated between 0.24 to 0.63 mg/l with a mean±SD value of 0.42±0.12 mg/l during first year and between 0.30 to 0.67 mg/l with a mean value of 0.47±0.12 mg/l during second year of

study period. WHO standard for nitrate was 45 mg/l. Chakravarty et al. (2016) reported the range of nitrate between 3.36 mg/l to 6.40 mg/l in culture ponds of Andhra Pradesh. Banerjee and Babulal (1990) reported that more than 1.00 ppm of nitrate is considered to be good for optimum production of fish.

**13. Chloride contents:**

It is a dominant anion in water and is essential for life. During present study, the mean values of chloride varied between 13.25 to 35.75 mg/l with a mean±SD value of 24.23±6.53 mg/l during first year and between 13.75 to 34.25 mg/l with a mean±SD value of 23.67±6.61 mg/l during second year of study period. Shrestha and Basnet (2018) reported the range of chloride between 2 mg/l to 7 mg/l in Ratuwa river of Damak, Jhapa, Nepal. The chloride level of drinking water quality should be within 250 mg/l (WHO). Boyd (1998) recorded the optimum limit of chlorides between 31-50 mg/l for fresh water aquaculture. Kashyap (2016) reported the chloride content between 120 to 190 mg/l in various water samples of Rewa. The chloride content of Beehar river water was within desirable limit of WHO and BIS standards and suitable for fishes.

**14. Phosphate contents:**

Phosphate is important in assessing the potential biological productivity of water. The mean values of phosphate varied between 0.06 to 0.29 mg/l with a mean±SD value of 0.14±0.07 mg/l during first year and between 0.06 to 0.31 mg/l with a mean±SD value of 0.15±0.07 mg/l during second year of study period. Ambedkar and Muniyan (2018) observed the phosphate between 0.10 to 0.25 mg/l in Kollidam river, Tamil Nadu.

**15. Sulphate content:**

It is the least toxic anion of which WHO standards for drinking water is 200 mg/l. The mean values of sulphate content in Beehar river water fluctuated between 11.50 to 24.25 mg/l with a mean±SD value of 17.38±4.09 mg/l during first year and between 10.00 to 25.50 mg/l with a mean±SD value of 17.83±5.12 mg/l during second year of study period. Shrestha and Basnet (2018) recorded the value of sulphate between 25 to 129 mg/l in Ratuwa river of Damak, Jhapa, Nepal. Ambedkar and Muniyan (2018) observed the value of sulphate between 10 to 90 mg/l in Kollidam river of Tamil Nadu. The sulphate value of Beehar river falls within the desirable limit of WHO standards (200 mg/l).

Table 1: The magnitude of the mean values of physico-chemical factors of Beehar river, Rewa (M.P.) during Nov. 2015 to Oct. 2017

S. No.	Parameters	Unit	Nov. 2015 to Oct. 2016			Nov. 2016 to Oct. 2017		
			Min.	Max.	Mean±SD	Min.	Max.	Mean±SD
1	Water temperature	0°C	19.95	31.35	25.61±3.34	20.53	30.95	25.9±3.1
2	Transparency	cm	30.70	71.30	55.87±14.19	30.08	72.85	57.66±14.74
3	pH		7.20	8.00	7.59±0.22	7.25	8.08	7.59±0.24
4	DO	mg/l	5.10	7.20	6.29±0.73	5.08	7.20	6.30±0.71
5	BOD	mg/l	2.10	7.13	4.47±1.56	2.10	7.48	4.62±1.73
6	COD	mg/l	17.73	39.85	27.74±6.43	17.03	38.88	27.44±5.87
7	Electrical conductivity	mmhs/cm	105.00	226.00	174.73±36.21	114.25	236.25	175.83±37.46
8	Alkalinity	mg/l	139.75	180.25	159.60±12.56	139.00	186.00	162.94±13.25
9	Suspended solids	mg/l	56.50	249.00	120.98±69.14	56.50	262.25	128.67±76.57
10	TDS	mg/l	152.50	225.00	181.96±20.17	142.25	236.00	182.02±26.76
11	TS	mg/l	209.00	474.00	303.98±87.07	198.75	498.25	315.42±98.28
12	Calcium Hardness	mg/l	52.00	124.50	81.90±24.53	49.50	126.00	79.65±24.38
13	Mg Hardness	mg/l	2.70	8.80	5.12±1.79	3.38	9.25	5.75±1.89
14	Total Hardness	mg/l	58.25	127.20	87.01±23.02	56.03	129.38	85.39±22.96
15	Chloride	mg/l	0.24	0.63	0.42±0.12	0.30	0.67	0.47±0.12
16	Nitrate	mg/l	13.25	35.75	24.23±6.53	13.75	34.25	23.67±6.21
17	Phosphate	mg/l	0.06	0.29	0.14±0.07	0.06	0.31	0.15±0.07
18	Sulphate	mg/l	11.50	24.25	17.38±4.09	10.00	25.50	17.83±5.12

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