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Physico-Chemical Analysis of Potable Water Quality of Machna River at District Betul (M.P.)

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Abstract: ***Water quality monitoring is an important aspect of water management concerning to the pollution control. The present study was aimed to estimate current status of physico-chemical characteristic of Machna river at district Betul (M.P.). Monthly changes in physico-chemical parameters such as Temperature, Colour, Odour, pH, Turbidity, Electrical Conductance, Total Hardness, Ca-Hardness, Mg-Hardness, Total Dissolve Solids, Total Suspended Solids, Total Solids, Total Alkalinity, Chloride, Nitrate, Dissolve Oxygen, Biochemical Oxygen Demand and Chemical Oxygen Demand of water samples from four important sampling stations of Machna river at district Betul (M.P.) were analysed for a period of one year from Mar.2019 to Feb. 2020. The results of the present study revealed that most of the studied physico-chemical parameters of the water samples were within the permissible limits suggested by WHO and river water can be used for domestic and irrigation purpose after proper treatment.***

Keywords: Water quality monitoring, water management, physico-chemical parameters, permissible limits, WHO, Machna river

1. Introduction

Water plays an important role in human life. In many countries including India too, the rivers are not only being exploited but are also used as dumping place for sewage, domestic and industrial wastes. Direct or Indirect addition of solid waste and other pollutants are badly affecting and deteriorating the river water quality. The Machna river is lifeline for the city of Betul but due to joining of domestic sewage, industrial sewage, religious and other human activities the water of river gets polluted. In the present study, an attempt has been made to assess the water quality of Machna river at Betul city.

Study Area- The Betul city is administration centre of Betul district located in Southern Madhya Pradesh with Latitude: $21^0$55'12.00" and Longitude: $77^0$54'0.00".The Machna river is originates from village Sasawad near tehsil Amla, District Betul (M.P.) and joins the Tawa river near Hoshangabad.

2. Material and Methods

The Machna river samples were collected from four main sampling stations namely S1,S2,S3 and S4 in between the months of Mar.2019 to Feb.2020 on monthly basis. The sampling points were chosen considering the location of nearby villages, bathing zone area, domestic and agricultural and industrial wastes which joins the river water and are responsible for pollution load in the river water. Samples were collected in acid clean one litre polyethylene bottles in the morning hours in between 7.00 AM to 10.00 AM. Some of the studied parameters were recorded at the sampling stations whereas the analysis of other physico-chemical parameters followed by the method prescribed by APHA (1995).

3. Results and Discussion

The physico-chemical parameters such as Temperature, Colour, Odour, pH, Turbidity, Electrical Conductance, Total Hardness, Ca-Hardness, Mg-Hardness, Total Dissolve Solids, Total Suspended Solids, Total Solids, Total Alkalinity, Chloride, Nitrate, Dissolve Oxygen, Biochemical Oxygen Demand and Chemical Oxygen Demand were analysed for the water samples collected from the Machna river. All parameters with the Maximum Value, Minimum Value, Average, Standard Deviation and Standard Error were calculated as shown in the Table1.

Temperature - Temperature is considered as to be one of the most important factors in an aquatic ecosystem. Water temperature is an important factor for aquatic flora. It depends on solar radiation, evaporation, wind, length of the day, relative humidity and cloud cover. The most suitable temperature for plant growth is 20°C-35°C. Temperature over 30°C may cause regression in plant growth and decay in plant. During the present study, the range of river water temperature has been found to vary between 17°C to 31°C with standard deviation (4.60±1.15). The maximum value of water temperature was recorded in the month of May and the minimum in the month of Feb. The variation in temperature was observed due to change in season, and rainfall pattern. The temperature started falling from rainy season to winter season and then started increasing towards summer.

Colour– The presence of colour in water and waste water even in a small amount is highly visible and affects the aesthetic value. Colour is often caused by organic matter. High levels of colour in water have an impact on photosynthesis activity by reducing the penetration of sunlight to lower levels in the water body affecting aquatic life. Colour imparted in water is due to decaying of vegetable or organic substances dissolved in it. Colour caused by suspended matter is called as apparent colour. In the present study, the colour of river water is found almost colourless except in the month of Jul. and Aug. when it is recorded brownish due to the addition of flood water into the river.

Odour– The odour in water is due to the presence of mineral salts, domestic sewage, decomposing organic matter, industrial wastes and chemical compounds etc. As temperature changes, the odour of water is also change. In the present study, the odour of river water is recorded odourless in all the months of study period.

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pH- pH is defined as the intensity of the acidic or basic character of a solution at a given temperature. pH is the negative logarithm of hydrogen ion concentration. pH=-log [H+].The pH of water is important for the biotic communities as most of the plant and animal species can survive in narrow range of pH from slightly acidic to slightly alkaline condition. In study period from Feb. 2019 to Jan 2020, pH value ranged from 7.2 to 8.4 with standard deviation (0.38±0.096).The minimum pH was reported in the month of May due to the low water levels and concentration of nutrients in water and maximum was recorded in the month of Aug. due to the dilution of water by addition of rain water.

Turbidity– Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in the analysis of quality of drinking water. It is also related to the content of diseases causing organisms in water, which may come from soil runoff. Turbidity indicates the muddiness of water therefore measure the extent to which light absorbed or scattered by fine suspended and colloidal solids and is a measure of resistance of water to the passage of light through it. It can be removed from water by filtration, sedimentation and clarification in water treatment plant process. In the present study, the turbidity in the water of Machna river was recorded ranges from 4.12 to 10.4 NTU with standard deviation (2.38±0.59).The maximum value of turbidity was recorded in the month of Aug. as 10.4NTU because of soil runoff during monsoon season. The minimum value of turbidity was recorded during summer season in the month of May as 4.12NTU.

Electrical conductivity (EC)- Water capability to transmit electric current is known as electrical conductivity and serves as tool to assess the purity of water. This ability depends on the presence of ions, their total concentration, mobility, valence, relative concentrations and temperature of measurement. The electrical conductivity ranged from 74.2 to 268.2 µmhos/cm with standard deviation (65.79±16.44). The maximum value of electrical conductivity was reported during monsoon in the month of Aug. as 268.2 µmhos/cm because of water dilution by rain water and minimum in the month of May as 74.2 µmhos/cm due to the low amount of water in the river.

Calcium Hardness (Ca-H)- Calcium is most abundant ions in fresh water and is important in shell construction, bone building and plant precipitation of lime. The analysis of calcium hardness found a range between 36 to 80 mg/l with standard deviation (11.88±2.97).The maximum value of calcium hardness was recorded in water samples in the month of Jul. as 80 mg/l due to the addition of domestic waste along with rain water and responsible for the increase in amount of calcium. The minimum value of calcium hardness in river water was recorded in the month of May as 36 mg/l due to calcium absorbed by the large number of organisms for shell construction, bone building and plant precipitation of lime.

Magnesium Hardness (Mg-H) - Magnesium is often associated with calcium in all kinds of waters, but its concentration remains generally lower than the calcium. Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of phytoplankton. The amount of magnesium hardness was recorded in the water samples range between 18 to 46 mg/l with standard deviation (8.43±2.10).The maximum value of magnesium hardness in the water samples was found in the Month of Jul. during monsoon season as it is associated with calcium in water and, calcium was found higher in concentration during monsoon season. The minimum value of magnesium hardness was recorded in the month of Jundue to the magnesium essentiality for chlorophyll bearing plant for photosynthesis.

Total hardness (TH)- The total hardness of water is not a specific constituent but is a variable and complex mixture of cations and anions. Principally the water hardness are changed by ions such as calcium and magnesium. The total hardness from the water samples at Machna river ranged between 54 to 126 mg/l with standard deviation (20.6±5.01).The maximum value of total hardness in the water was recorded in the month of Jul. as 126 mg/l due to presence of high content of calcium and magnesium in addition to sulphate and nitrate during rainy season. The minimum value of total hardness was recorded in the month of May as 54 mg/l due to low concentration of calcium and magnesium.

Total Alkalinity (TA) - The total alkalinity of river water is primarily a function of carbonate, hydroxide content and also includes the contributions from borates, phosphates, silicates and other bases. Alkalinity is a measure of capacity of water to neutralize a strong acid. The alkalinity in the water samples ranged from 81 to 134 mg/l with standard deviation (19.08±4.77).The maximum value of alkalinity was recorded in Aug. due to high nutrients in water and minimum value was recorded in the month of May. due to the dilution of river water through rain.

Total dissolved solids (TDS)- Solids refers to the suspended and dissolved matter in water. They are very useful parameters describing the chemical constituents of the water and can be considered as edaphically relation that contributes to productivity within the water body. The total dissolved solids in the sampled water ranged from the 210 to 468 mg/l with standard deviation (65.29±16.32).The maximum value of TDS was reported in the month of Aug. and the minimum TDS was reported in May due to the addition of organic matter and solid waste into the river water.

Total Suspended Solids (TSS) –In the present study, TSS ranged as 118-174 mg/l with standard deviation (18.43±4.60).The maximum value of TSS was recorded as 174 mg/l in the month of Aug. and the minimum of 118 mg/l was found in the month of May.

Total Solids (TS) – In the present study, total solids recorded range from 328 to 642mg/l with standard deviation (81.07±20.26). The maximum value of total solids was found in the month of Aug. during monsoon season. The minimum value of 328 mg/l of total solids was recorded in the month of May due to the less amount of water in the river in summer season.

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Chloride (Cl) - The chloride in drinking water originates from natural sources, sewage and industrial effluents, urban runoff containing de-icing salt and saline intrusion. The chloride concentration in Machna river water was noticed between 20 to 42 mg/l with standard deviation (6.35±1.58).The maximum value of chloride reported in the month of Jul. as 42 mg/l due to frequent run-off loaded with contaminated water from the surrounding slum area and evaporation of water. The minimum value of chloride was determined as 20 mg/l in the month of Jun. due to the dilution of lake water by rain.

Nitrate (NO_3) - Nitrates are contributes to freshwater through discharge of sewage and industrial wastes and run off from agricultural fields. The highest amount of nitrate concentration was known to support the formation of blooms. The amount of nitrate recorded in the water of Machna river ranged from 0.79 to 1.18 mg/l with standard deviation (0.10±0.025).The maximum value of nitrate was recorded in the month of Jul. because of high vegetation during Monsoon which supported the growth of plankton. The minimum value of nitrate in water was recorded during summer season in the month of May due to the utilization by plankton and aquatic plants.

Dissolved Oxygen (DO)- The higher value of dissolved oxygen indicates good aquatic life. The amount of dissolved oxygen of Machna river water samples ranged between 6.2 to 7.9 mg/l with standard deviation (0.54±0.13). The maximum value of DO was recorded in the month of Aug. due to the turbulence of water facilitating the diffusion of atmospheric oxygen and the increased solubility of oxygen at lower temperature. The lowest dissolved recorded in the month of May due to the high temperature and addition of domestic sewage and other waste which can be responsible for low value of dissolved oxygen.

Biochemical Oxygen Demand (BOD) - The biochemical oxygen demand may be defined as the oxygen required for the microorganism to performed biological decomposition of dissolved solids or organic matter in the wastewater under aerobic conditions. The biochemical oxygen demand reported from water samples of Machna river was ranged between 7.2to 10.6 mg/l with standard deviation (1.04±0.26). The highest demand of oxygen in the water was recorded in the month of Aug.as 10.6 mg/l due to the possible addition of high amount of waste and addition of organic waste in river through rain water and by certain human activities which also be responsible for the increase in BOD. The lowest demand was recorded in the month of May as 7.2mg/l due to less vegetation.

Chemical Oxygen Demand (COD) – The chemical oxygen demand is a measure of both the biologically oxidizable and chemically inert organic matters. COD values are generally higher than COD values. It indicates toxic conditions and the presence of biologically resistant organic substances. In the present study, The COD values found in the range of 18 mg/l to 30 mg/l with standard deviation (3.21±0.80).The minimum value of COD was recorded in the month of May due to the less amount and high evaporation rate of water from river and was found maximum as 30 mg/l in the month of Aug. due to the addition of rain water into the river water.

4. Conclusion

In the present study, it has been observed that the drinking water quality in the study area of the Machna river at district Betul (M.P.) is reasonably good and does not show any alarming level of pollutants. However, it need some degree of treatment before consumption. However, some positive steps should be taken by local authority to improve the water quality of river. Local public authority should be aware about the water pollution and adopts some necessary preventive measures for controlling the river water pollution.

Table 1: Range of variation as Maximum, Minimum, Average, Standard Deviation and Standard Error of studied water quality parameters of the Machna river water during Mar.2019 to Feb.2020

S.No.	Parameters	MIN.	MAX.	AV	SD	SE
1	Temp	17 (Feb)	31 (May)	23.16	4.60	1.15
2	pH	7.2 (May)	8.4 (Aug)	7.82	0.38	0.096
3	Turbidity	4.12 (May)	10.4 (Aug)	7.14	2.38	0.59
4	EC	74.2 (May)	268.2 (Aug)	135.25	65.79	16.44
5	Ca-H	36 (May)	80 (Jul)	46.91	11.88	2.97
6	Mg-H	18 (Jun)	46 (Jul)	27	8.43	2.10
7	TH	54 (May)	126 (Jul)	73.91	20.06	5.01
8	TA	81 (May)	134 (Aug)	111.16	19.08	4.77
9	TDS	210 (May)	468 (Aug)	279.08	65.29	16.32
10	TSS	118 (May)	174 (Aug)	142.58	18.43	4.60
11	TS	328 (May)	642 (Aug)	421.66	81.07	20.26
12	Chloride	20 (Jun)	42 (Jul)	26.83	6.35	1.58
13	Nitrate	0.79 (May)	1.18(Jul)	0.88	0.10	0.025
14	DO	6.2 (May)	7.9 (Aug)	7.2	0.54	0.136
15	BOD	7.2 (May)	10.6 (Aug)	8.40	1.04	0.260
16	COD	18 (May)	30 (Aug)	22	3.21	0.80

MIN=Minimum, MAX=Maximum, AV=Average, SD=Standard Deviation, SE=Standard Error

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