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Water Quality Assessment of River Haora in Agartala Stretch During Durga Idol Immersion

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Abstract: Durga puja is the main festival of residents of Tripura (Bengali Community). After predetermined time, idols are immersed in Haora River every year. As the extent of idol immersion increases with increasing population which is alarming situation. In the present study, one sampling station Dashamighat was selected for physiochemical parameters and metals concentration determination of water samples. The analysis was carried out for temperature, pH, turbidity, alkalinity, DO, BOD, TSS, TDS, total hardness and chlorides under physiochemical parameters and metals such as magnesium, calcium, cadmium, chromium, lead, iron and arsenic. The result obtained reveals that Haora river water become acidic after idol immersion and all the physiochemical parameters were found within the permissible limit with a few exceptions. The concentrations of metals were found within the permissible limits except for chromium, iron and lead which is slightly higher than the permissible limit. The trend of increasing such parameters indicates that idol immersion activity affect the water quality to the extent with respect to self-purification of the water and flow of the stream of the river.
Keywords : *Durga puja, idol immersion, Haora River, physio-chemical parameter, metal ions.*

1.Introducton

The well known fact is that the existence of life on the earth planet is mainly due to presence of water. It provides sustenance to plants, animals, aquatic organisms and support human needs likes agriculture and industries**.** From ancient times, rivers are used as fresh water resources for human beings. The quality of usable water is degrading due to the overexploitation caused by increase of population and its anthropogenic activities. Water bodies get polluted regularly by the dumping of domestic, hospital and industrial wastes. On the other hand, our religious rituals are also responsible for water quality deterioration as most of the rituals are performed near the bank of river and water bodies (1, 2).

Majority of our population believes in idolatry and idol immersion has become a cause of water pollution during festive seasons. Water pollution caused by idol immersion has social, religious, scientific and environmental dimensions. Idols are made of clay, clothes, straw, bamboo, plaster of paris, nails and are decorated by natural and synthetic paints and colors. The constituting materials of idols degrade the quality of water on immersion (3).

Tripura, one of the north-eastern states of India, situated in the eastern part of India and surrounded by Bangladesh on the West, South and North side. Only North-eastern and Eastern boundaries are separated by Assam and Mizoram respectively. The state lies between 22°56' to 24°32' North latitudes and 91°09' to 92°20' East longitudes spread over 10,491.69 sq. km. with population as per the 2011 census data is about 3,671,032. The State is characterised by a warm and humid sub-tropical climate with five distinct seasons namely, spring, summer, monsoon, autumn and winter. The average annual maximum and minimum temperatures are 35 and

10^0C respectively with average annual rainfall recorded is about 1,881mm (4). Tripura is well gifted with surface water resources and all major rivers of Tripura bring about from hill ranges and occurrences like typical lattice and dendrite pattern. During rainy season the river water being in flurry while in summer month they remain almost in dry condition. Out of ten major rivers in the state, River Haora is the lifeline of Agartala city, capital of Tripura state because it fulfils the major demand of drinking water as well as water for other purposes of the entire population of the city and its surrounding areas from Champaknagar to Bangladesh border. Haora River is a sub-basin of the River Titas of Bangladesh (5). The River originates from the eastern side of the Baramura range flowing westerly through the alluvial plains and passes by the southern bank of the capital city of Agartala before finally flowing down into Bangladesh. Formerly Haora river water was pollution free due to less anthropogenic interferences. But nowadays numbers of inhabitants on the banks of the river are increasing very rapidly which deteriorates the quality of river water and put it into a distressing condition.

The people of Tripura are always exited about festivals and various festivals are observed throughout the year. Among them Durga Puja is the greatest one which is celebrated every year in the month of September to October. During this festival, lot of Durga idols are immersed into the Haora River at selected immersion site which is responsible for adding pollution load in the water bodies of Haora River. So, it was thought to assess the Water quality of Haora River in Tripura to evaluate the nature and extent of pollution during idol immersion during Durga puja (12 to 22 October) 2015 in order to take appropriate control measures to reduce short term deterioration of water quality due to their decay. The results of our investigations are presented in this article.

Study Area:

The study area of Dashamighat Idol immersion site in Haora River, Agartala, Tripura is geographically located at Latitude: 23º 49´ 742´´ N and Longitude: 91º 15´ 838´´ E where lots of Durga idols were immersed during the Puja festival. Figure 1 showing the location taken up for idol immersion study in the Haora River.

Figure 1: Idol immersion and Sampling site

Material and Methods:

Experimental:

To study the water quality of Haora River during Durga idol immersion, the water samples were collected from surface area water during morning hours at different intervals. The samples were collected and preserved at the site of immersion, Dashamighat of Haora River, Agartala during the Durga puja festival in the

month of October, 2015 at different intervals i.e. pre-immersion, immersion and post-immersion periods. Pre-immersion and post-immersion water samples were collected a week before and after of idol immersion with a daily intervals while during immersion period samples were collected on the day of immersion activities. All samples were collected in high density polypropylene bottles (Teflon make) which were cleaned properly first with dilute nitric acid and then with distilled water. The measurement of temperature and fixation of dissolved oxygen were completed at the site and analyses of other parameters were carried out in the research laboratory of Department of Chemistry, Tripura University and Tripura State Pollution Control Board, Agartala. These composed samples were subjected to analyze the physiochemical parameters like pH, Temperature, Dissolved oxygen, Total hardness, Total alkalinity, Biochemical Oxygen Demand, Total dissolved Solids, Total Suspended solids etc. In addition heavy metals like chromium, lead, cadmium, Arsenic were analysed according to standard methods prescribed in APHA, 2005 (6). The heavy metals were preserved by adding 1N HNO_3 and making the pH to near about 4 and analyzed using Atomic Absorption Spectrometer (Perkin Elmer A Analyst 700).

Result and Discussion:

The analytical data of water samples of Haora River for temperature, pH, turbidity, Dissolved oxygen (DO), Biochemical oxygen demands (BOD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), alkalinity, Total Hardness and chloride are given in Table-1 and figure-2. The analytical data for metals in water samples of Haora River are given in Table-2 and figure-3. All results were evaluated with reference to BIS and ICMR (7, 8).

Table: 1: Showing Physio-chemical parameters of Haora River water during Durgotsav-2015.

Parameters	Pre- immersion	During immersion	Post- immersion	Standard as per BIS and ICMR
Temperatures (^{0}C)	27.0-29.0 (27.666±0.666)	28.0-29.0 (28.500±0.333)	29.0-30.0 (29.333±0.333)	-
pH	7.05-7.17 (7.110±0.034)	6.7-6.8 (6.766±0.033)	6.3-6.8 (6.600±0.152)	6.5-8.5
Turbidity (NTU)	77.8-98.2 (86.066±6.198)	81.3-86.6 (84.366±1.585)	122-137 (128.333±4.484)	5.0
Dissolved Oxygen (mg/L)	5.6-6.1 (5.833±0.145)	5.2-5.8 (5.566±0.185)	5.1-5.3 (5.233±0.066)	5.0
Biochemical Oxygen Demand (mg/L)	0.7-1.3 (1.066±0.185)	0.9-1.3 (1.100±0.115)	1.1-3.8 (2.333±0.788)	5.0
Total Alkalinity (mg/L)	73.1-78.1 (76.433±1.666)	68.2-73.1 (71.466±1.633)	57.5-68.3 (62.366±3.163)	120
Total Hardness (mg/L)	49.0-58.8 (52.266±3.2667)	49.0-58.8 (55.533±3.266)	56.1-58.8 (57.900±0.9170)	300
Total Suspended Solids (mg/L)	48-68 (56.000±6.110)	48-72 (58.666±7.055)	52-88 (69.333±10.413)	-
Total Dissolved Solids (mg/L)	98-112 (102.666±4.666)	98-122 (107.333±7.4238)	102-148 (120.666±13.968)	500
Chloride (mg/L)	21.5-23.7 (22.766±0.656)	24.07-28.8 (27.223±1.576)	24.07-36.1 (29.656±3.449)	250

Data shown in table are minimum-maximum (mean± standard error)

Table: 2: Metal concentration in Haora River water during Durgotsav-2015.

Parameters	Pre- immersion	During immersion	Post-immersion	Standard as per BIS and ICMR
Calcium (mg/L)	7.1-8.5 (7.800±0.404)	7.2-9.3 (8.600±0.000)	8.3-11.7 (9.933±0.983)	75
Magnesium (mg/L)	2.6-3.9 (3.466±0.433)	2.6-4.3 (3.666±0.536)	3.6-4.1 (3.866±0.145)	30
Chromium (mg/L)	0.015-0.031 (0.020±0.005)	0.010-0.035 (0.021±0.007)	0.051-0.083 (0.065±0.009)	0.05
Lead (mg/L)	0.011-0.064 (0.038±0.015)	0.021-0.073 (0.046±0.015)	0.109-0.241 (0.160±0.040)	0.05
Cadmium (mg/L)	0.002-0.008 (0.004±0.001)	0.003-0.019 (0.012±0.004)	0.005-0.031 (0.017±0.007)	0.01
Arsenic (mg/L)	0.008-0.016 (0.011±0.002)	0.009-0.016 (0.012±0.002)	0.015-0.028 (0.020±0.003)	0.05
Iron (mg/L)	0.83-1.10 (0.936±0.829)	0.94-1.16 (1.020±0.070)	0.98-1.19 (1.070±0.062)	0.3

Data shown in table are minimum-maximum (mean± standard error)

Physiochemical parameters:

Temperature: Temperature of water is an important parameter which affects dissolved oxygen (DO) and is related to tolerance in aquatic life. In the present study the temperature was measured on the spot of immersion. The temperature found in the ranges 27.0 to 29.0^{0}C, 28.0 to 29^{0}C and 29.0 to 30^{0}C for pre-immersion, immersion and post-immersion of idols respectively. A slight rise in temperature recorded after immersion period is probably due to chemical as well biological reactions in the water and contributes in depletion of dissolved oxygen[1].

pH: It is an important parameter that determines the suitability of water for various purposes. The pH ranges between 7.05 to 7.17 for river water during pre-immersion which showed slight decrease during immersion (6.7 to 6.8) and still decreased (6.3 to 6.8) during post-immersion sessions of idols. The data suggest that acidic materials were released from the idols during the immersion sessions (9).

Turbidity: Turbidity is caused by a wide variety of suspended particles that range in size from colloidal to coarse dimensions depending upon the degree of turbulence. Idol immersion add large quantity of inorganic (clay, silt etc) and some organic materials (straw, jute, flowers, leaves and germinated grains) to the river thus contributing to the turbidity (3). The measured values for turbidity of water samples suggest the increase in the turbidity in the range 122 to 137 NTU for post-immersion session of idols. It was mainly due to dispersion and sedimentation of particles from decay of idols.

Dissolved oxygen (DO): It is an important parameter which reflects physical and biological process in water body. It is directly linked to the metabolism of all aquatic organisms (10). During immersion period, DO was found in the range of 5.2 to 5.8 (5.566±0.185) mg/L which is slightly lower than the pre-immersion 5.6 to 6.1 (5.833±0.145) mg/L and slightly higher than post-immersion 5.1 to 5.3 (5.233±0.066) mg/L values.

Biochemical oxygen demand (BOD): It is one of the important parameter of water which gives information about bio-degradable (Organic matters) pollution load of water. It represents the quantity of oxygen consumed in course of aerobic decomposition of organic materials caused by microorganism (11). The observed values of BOD of water samples were highest for post-immersion sessions of idols, 1.1 to 3.8 (2.333±0.788) mg/L with respect to pre-immersion 0.7 to 1.3 (1.066±0.185) mg/L and during immersion, 0.9 to 1.3 (1.100±0.115) mg/L sessions. This suggests that water body receives organic materials due to immersion of idols and deteriorates the quality of water (12).

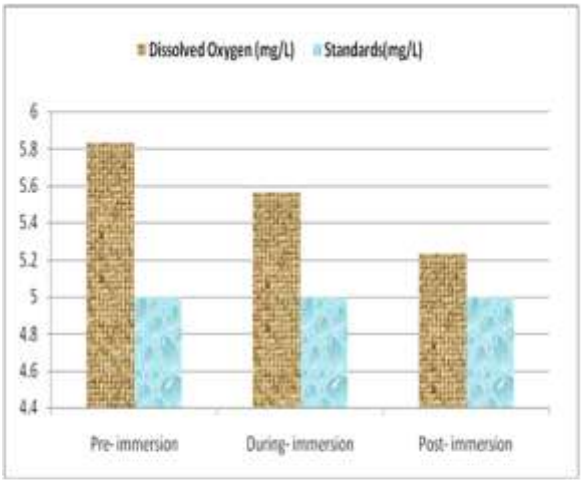
Total Alkalinity: Alkalinity of natural waters is primarily due to the salts of weak acids as well as strong bases. Presence of bicarbonate in water is mainly responsible for its alkalinity. In the present study, the data obtained show decreasing trend from pre-immersion, immersion and post-immersion sessions of idols in the ranges, 73.1 to 78.1 (76.433±1.666) mg/L; 68.2 to 73.1 (71.466±1.633) mg/L; and 57.5 to 68.3 (62.366±3.163) mg/L; respectively.

Total Hardness: Total hardness of water is used in determining the suitability of water for domestic and industrial uses. Generally, the metal ions responsible for hardness are divalent magnesium and calcium, ferrous ion and magnesium ions with anions such as bicarbonate, carbonate, chloride and sulphate. The total hardness values in this study suggest increase in total hardness in water during post-immersion sessions of idols while values remain almost same for pre-immersion and immersion sessions of idols. This clearly indicates that the increase in hardness is mainly due to dissolution of organic and inorganic materials coming out of idols.

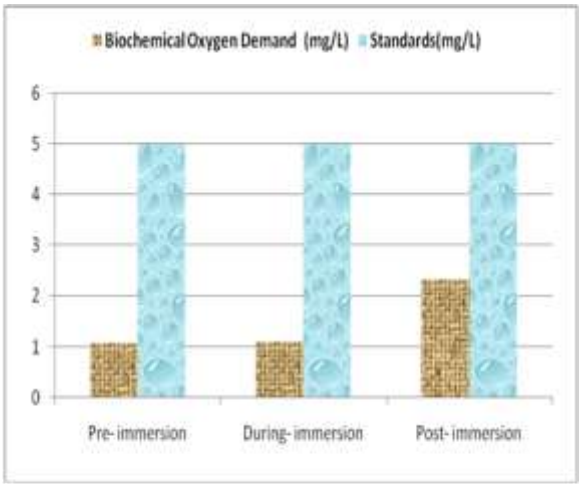
Total Suspended solids (TSS): TSS is aesthetic quality of water. From the data obtained in this exercise, it was found that the value for TSS increased slightly for post- immersion 52.0 to 88.0 (69.333±10.413) mg/L than that of pre-immersion 48.0 to 68.0 (56.000±6.110) mg/L and immersion 48.0 to 72.0 (56.666±7.055) mg/L sessions of idols. The increase in TSS values showed sludge generation from idols immersion thus deteriorated the quality of water.

Total Dissolved Solids (TDS): TDS is another aesthetic quality of water which represents the load of soluble materials in the water which affects its domestic as well as industrial uses. The values were found 102 to 148 (120.666±13.968); 98 to 112 (102.666±4.666) and 98 to 122 (107.333±7.4238) mg/L for post-immersion, pre-immersion and during immersion sessions of idols respectively. The obtained data indicated that quality of water has deteriorated due to idols immersion.

Chlorides: All natural waters contain chlorides and its high concentration is considered to be the indicators of pollution due to organic wastes of animals or industrial origin. High concentrations of chlorides in water are troublesome in irrigation and harmful to aquatic life[13]. The levels of chlorides in present investigation are in higher concentration in samples analyzed for post-immersion of Durga idols that ranging between 24.07 to 36.1 (29.656±3.449) mg/L is within the permissible limits of BIS (7).



(i)



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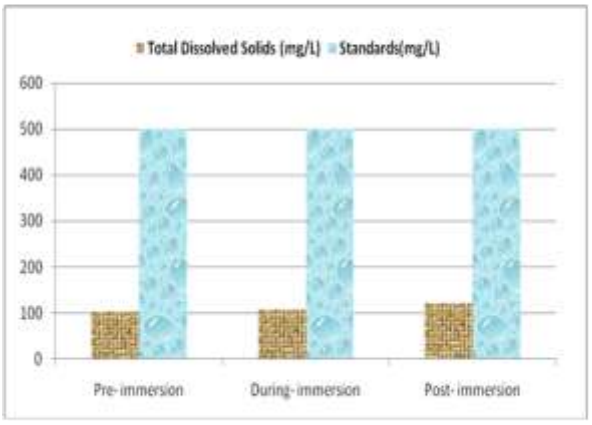

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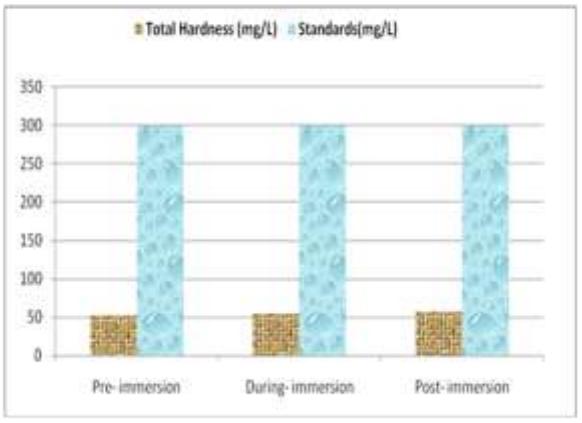

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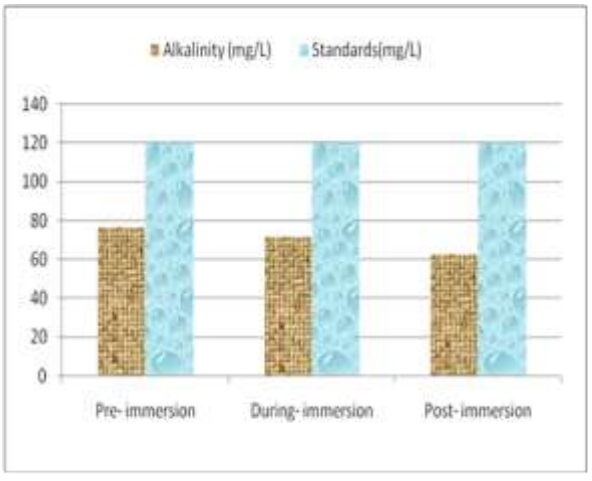

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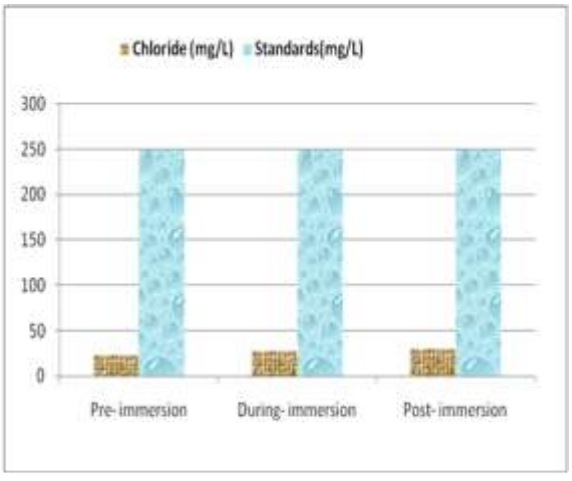

(vi)

Figure 2 : Physico chemical parameters of Haora river water during Durgotsav, 2015

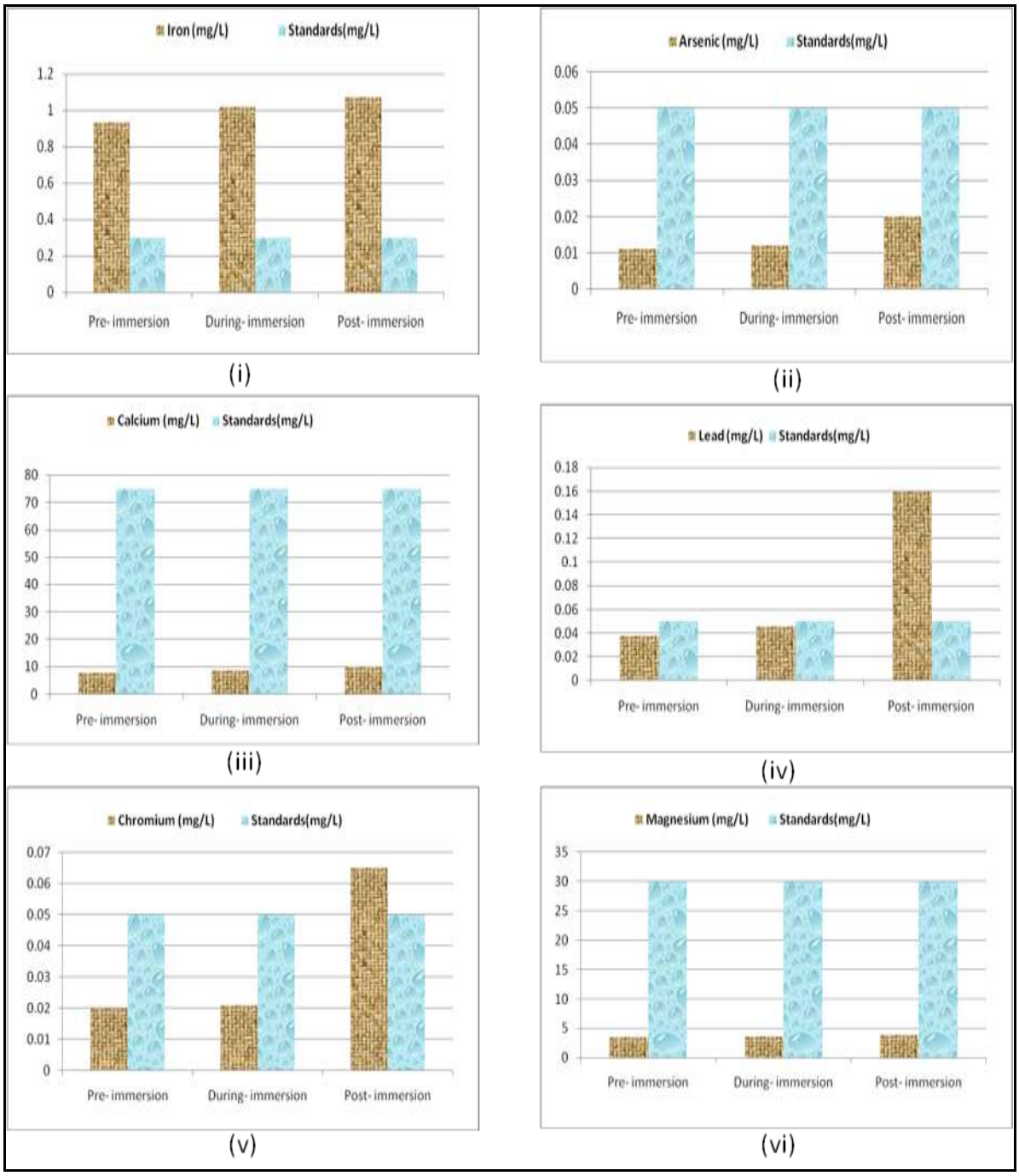

Figure 3: Metal concentration in Haora river water during Durgotsav, 2015

Metals in water

Water contains many metal ions in dissolved form but idols immersion activity during festive sessions enhances the concentrations of common metal ions and introduces heavy metal ions such as cadmium, chromium, lead, iron and arsenic. The presence of heavy metal ions deteriorate the quality of water being toxic even in very small quantity for human being though the process known as Bio-accumulation and Bio-magnifications (14). After immersion of idols, the colours and chemical used in preparation and decoration of idols dissociate slowly leading to significant alteration in the water quality.

Although magnesium and calcium are non-poisonous but are one of causes of water hardness in combination of anions such as bicarbonate, carbonate and/or sulphate. The water analysis in the present study shows the concentration of magnesium and calcium has increased slightly but it was found within the permissible limits.

The study also shows that the concentration of heavy metals such as cadmium, chromium, lead, iron and arsenic has also increased (Table-2). The concentrations found for cadmium and arsenic are within the permissible limit while those of chromium, iron and lead are slightly higher compared to the specifications of highest desirable limits as set by BIS and ICMR (7, 8). These heavy metals are known to persistent and gradually accumulate and magnify through bio-accumulation and bio-magnification, while they move up in the food chain (15).

Conclusion:

The results of water analysis of Haora River suggest the deterioration in the water quality due to idols immersion during Durgotsav-2015 (October, 12 to 22). It has changed the physiochemical data and increased the concentration of metal ions in the Haora river water. Most of the metal ions are within the permissible limit except chromium, iron and lead. It is also expected that quality of water of Haora River will deteriorate more in coming years due to increase in festival activities. To check the deterioration in water quality of water bodies, central pollution control board has formulated guidelines on the practice of idol immersion in lakes, rivers and seas (16). So, it should be followed though state pollution control board.

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