An analysis of the increasing organic contents in the Mansi Ganga Lake in District Mathura (India) and its impact on some selected planktonic populations

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ABSTRACT

Mansi Ganga is a small lake in the Goverdhan town in the District Mathura (India). It has a great religious importance being associated with the childhood activities of Lord Krishna. The lake is grossly polluted due to religious activities and also with the continuous mixing of sewage and domestic waste. An attempt was made to analyze the organic pollutants in the lake. Important physico-chemical quality parameters of the lake water were tested over an entire year from January 2018 to December 2018. Simultaneously, the planktonic population of some selected microbes was also recorded to observe correlation between pollution load and survival rate of aquatic microbes.

The study reveals that the lake is grossly polluted with organic waste. A very high values of BOD, ammonia and sulphides contents were recorded. The condition was most deplorable in summers. The test organisms, especially Chlorella, Scenedesmus Spirogyra spp. exhibited a positive trend with rise in organic load. On the other hand, Paramecium, Vorticella and Paranema spp. exhibited a severe negative trend with the rise in pollution load.

Keywords: *Organic pollutants, sewage, B.O.D., Coliform, ammonia, planktons*

Introduction

Water is the prime necessity of life. But greedy activities of man, such as unmanaged industrialization, improper removal of wastes etc., have resulted in the massive pollution of our water resources like rivers, ponds and lakes. The addition of sewage and other animal waste into the water stock has resulted in much severe problem of 'Eutrophication' which is harmful to aquatic biota [1].

'Mansi Ganga' is a holy lake, located at Govardhan (Distt. Mathura, India). It is an important water lake of great religious importance. It is grossly polluted with disposed waste and sewage. Being related with the activities of lord Krishna, the holy lake is visited by millions of pilgrims every year. Due to rituals and beliefs, the pilgrims use to take bath in the lake and offer *pooja samigri*. They also offer milk to lord Krishna, which directly goes into the lake water. The sewage waste is also being indirectly drained, which badly affects the water quality of the lake. The natural aquatic biota, especially planktonic population is adversely affected due to increasing organic load in the lake [2].

An attempt was therefore made to access the organic load the lake and its impact on some selected planktons.

Materials and Methods

The water sampling was done on 1st of each month in year 2018. Three samples of the lake water were collected from three different sites of the lake in cleaned glass bottles with capacity 1000 ml. pH was noted on the spot with the help of portable digital pH meter. Other parameters, such as B.O.D., sulphides, ammonia, phosphate contents were tested in the laboratory, according to the standard methods, prescribed by APHA [3]. The average of the three samples was used in the analysis process.

Coliform bacterial count is a key indicator for sewage and organic waste in the water bodies [4]. So, coliform population was also recorded using MPN number method. Some common planktons, present in the lake were also considered as test organisms. These included species of *Chlorella, Scenedesmus Spirogyra, Paramecium, Vorticella* and *Paranema.*

The water sample for determining the population of these organisms was taken separately in 1 litre glass bottles. Samples were preserved at 4ºC in 4-5 % buffered formaline solution. For the assessment of population count, microscopical counting method was used. The sample was concentrated using planktonic nets of different sizes and was then stored in a closed and labelled glass vials. It was mixed properly by thorough shaking and 0.2 ml of the sample was pipette with a fractional pipette on a clean glass slide. The slide was examined microscopically. Counting and enumeration was done with the help of an ocular micrometer. The entire procedure was repeated thrice for each sample and then averages were noted for more reliable results.

Results and Discussion

The monthly observations for physico-chemical parameters and for planktonic population count have been shown in following table.

Table - 1

Parameters / planktons	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pH	7.8	8.3	8.1	8.4	8.7	8.6	8.4	8.1	8.3	8.1	8.3	8.0
BOD (mg/L)	112	115	134	175	211	225	198	159	189	139	147	121
Ammonia contents (mg/L)	1.28	1.67	1.69	1.78	2.09	2.35	1.99	1.61	1.77	1.46	1.37	1.18
Phosphate contents (mg/L)	65	78	75	79	94	113	124	91	101	95	82	77
Sulphide contents (mg/L)	6.78	7.28	7.19	8.69	8.40	9.58	9.25	8.16	7.27	8.28	7.22	6.71
Total Coliform (MPN) $x10^3$	34.5	36.5	33.8	47.5	55.9	66.2	68.2	58.5	49.5	39.5	44.9	35.2
Chlorella spp.	37	42	63	35	60	69	47	31	28	46	35	48
Scenedesmus spp.	15	18	27	25	31	35	36	29	32	19	22	18
Spirogyra spp.	47	52	43	49	61	74	68	52	60	49	45	39
Vorticella spp.	35	38	35	29	19	12	08	16	22	24	31	29
Paramecium spp.	18	14	15	12	11	06	07	09	11	17	15	13
Paranema spp.	18	12	16	12	04	06	09	11	15	13	18	15

Above observations clearly indicate that the water of Mansi Ganga lake is severely polluted and rich in organic content. A very high BOD was noted throughout the year (112 to 225 mg/l).

The condition was the worst in summers. High degree of BOD clearly indicates the accumulation of high amount of organic load in the lake water [2]. It is directly linked with the poor oxidation of organic matter [7]. The reason for the high organic matter was found to be the addition of large amount of religious activities, *pooja samigri* offered by the pilgrims and mixing of milk. Furthermore, regular mixing of sewage contents into the lake was another major reason of this high organic load [4]. The reason for excessively high organic load in summers was the presence of lesser amount of water in the lake [5]. Due to poor dilution, the pollution was severe. The water even exhibited a pungent smell in summers.

Parameters like ammonia, sulphides and phosphates were found to be directly related with the rise in pollution load. Ammonia contents exhibited a positive correlation with BOD values. This is because the production of ammonia occurs from un-oxidised organic matter when oxygen availability is very low [8]. The very high values of ammonia were notes (ranging between 118 mg/l to 2.35 mg/l). The maximum values were noted during summers because of accumulation of large amount of organic matter and less amount of water in the lake. High temperature in summer also augments the growth of anaerobic bacteria [7], which further adds to the ammonia.

The values of phosphates and sulphides were also found very high and in perfect correlation with ammonia and BOD values. The high values of phosphates (65 to 124 mg/L) indicates a high degree of sewage and organic waste in the lake water [9]. Similarly, high values of sulphides were noted throughout the year, especially in summers. Sulphide contents are also directly linked with the high sewage contents in the lake water [8].

The most important parameter, which clearly suggests the accumulation of sewage and domestic waste contents is the population of Coliform bacteria (MPN) [1]. A very high Coliform population was recorded (33.8 to 66.2 x 1000 MPN). The coliform number showed a perfect positive correlation with the high BOD and ammonia values. Accordingly, the Coliform population was very high especially during summers (66.2 x 1000 MPN).

The population of phytoplanktons such as *Chlorella, Scenedesmus* and *Spirogyra* spp. exhibited a positive trend with high BOD and ammonia values, but zooplanktonic and non-photosynthetic populations of *Paramecium, Vorticella* and *Paranema* exhibited a strong negative trend with BOD and ammonia values. *Chlorella*, *Scenedesmus* and *Spirogyra* belong to photosynthetic algal group and survive well in water rich in organic contents. In summers, when the organic load was high, a minimum population of *Paramecium, Vorticella* and *Paranema* spp.

was recorded. This was mainly because the high ammonical contents impair the respiration and diffusion capabilities of zooplanktons [11].

The *Paramecium* species were found to be more sensitive to high BOD and low oxygen availability. This clearly indicates that such organisms cannot survive in high BOD environment [12].

Conclusion

From above results and subsequent discussion, it can be concluded that the water of Mansi Ganga Lake is severely polluted and hosts a high load of un-oxidised organic matter. The situation becomes deplorable in summers. The main reasons for this high organic load are -

a. High pilgrimage rate
b. Mixing of *Pooja saamigri* offered by the pilgrims
c. Mixing of milk offered by the pilgrims
d. Entry of a few drains carrying domestic sewage.

It is also concluded that the present condition of the lake is not suitable for the aquatic biota. The lake water is not fit for human consumption in any form. Measures must be taken to maintain the healthy status of the lake.

References

[1] Agrawal P. K., Prabha S. (2000). Water quality of sewage drains entering river Yamuna at Mathura. J. Env. Biol. 21 (4), 375-378.

[2] Agbaire PO and OBI CG (2009). Seasonal Variation of some physico-chemical properties of River Ethiope water in Abraka, Nigeria. Journal of Applied Sciences and Environmental Management 13:55-57.

[3] APHA, (1989). Standard methods for the examination of water and waste water, 17th Ed. Washington D.C., U.S.A.

[4] Hynes, H.B.N, (1978). The Biology of polluted waters, Liverpool University Press.; Liverpool, 200-204 pp.

[5] Gorbi G, Zanni C and Corradi MG (2007). Sulfur starvation and chromium tolerance in Scendesmus acutus, a possible link between metal tolerance and the regulation of sulfur uptake/ assimilation processes. Aqual Toxicol. 84(4): 457-464.

[6] Hopkinson, C.S, (1985). Shallow-water and pelagic metabolism: Evidence of heterotrophy in the near-shore Georgia Bight, Marine Biology, 87, pp 19. 21.

[7] Indian Standard Specification for Drinking Water; IS: 10500: 1992. (Reaffirmed 1993)

[8] Klein, L. (1973). River pollution, II-Causes and effect (5th Ed.), Butterworth and Co. Ltd.

[9] Lieven Bervoets, Guy Knaepkens, Marcel Eens and Ronny Blust (2005). Fish community responses to metal pollution . Environmental Pollution, Volume 138, Issue 2, Pages 191-376 (November 2005)

[10] Redfield, G. W., 1980. The effect of zooplankton on phytoplankton productivity in the epilimnion of a subalpine lake. Hydrobiologia 70: 217–224.

[11] Sharma, K.D., N. Lal and P. D. Pathak, (1981). Water quality of sewage drains entering Yamuna at Agra. Ind. J. Env. Health., 23 (2), 118-122.

[12] Smitha (2013) Physico-chemical analysis of the freshwater at River Kapila, Nanjangudu Industrial Area, Mysore, India. International Research Journal of Environment Sciences 2:59-65.

[13] Verma S. R., A. K. Tyagi and R.C. Dalela, (1978). Physico-chemical and biological characteristics of Khadarabad drain in U.P. Ind. J. Env. H1th., 20 (1), 1-13.

[14] Verma P, Chandawat D, Gupta U and Solanki HA (2012). Water quality analysis of an organically polluted lake by investigating different physical and chemical parameters. International Journal of Research in Chemistry and Environment 2:105-112.

[15] WHO, (1984). International standards for drinking water, Third Ed. Geneva.