*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **6(1),** 18-21, January **(2017)** *Int. Res. J. Environment Sci.*

Rapid microbiological examination of water quality in ponds of Vadodara city, Gujarat, India

Tailor Manthan A.* and Vidhi Modi
Dept. of Environmental Studies, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India
manthantailor@gmail.com

Available online at: www.isca.in, www.isca.me
Received 13th October 2016, revised 4th December 2016, accepted 14th January 2017

Abstract

Fresh water is one of the most important resources without which life would not exist on planet Earth. The exponential growth of human population has caused deterioration of global resources with conditions most severe in under developed and developing countries. Physical and chemical contaminants entering in ponds, lakes and other freshwater reservoir have caused devastating effects on floral and faunal diversity of the system. In addition to this, the biological contaminants in general and pathogens in particular are also of prime importance for qualitative analysis of the water quality. Presence of pathogens may cause severe health issues such as infection, diarrhoea, vomiting etc. The issue is very serious specifically in the case of developing countries due to lack of sanitation and prevalence of unhygienic conditions. The current study was aimed to assess biological contamination with special emphasis on coliform E. coli and MPN (per 100 ml). The water samples were drawn from 6 ponds of Vadodara city, Gujarat, India. Out of the 6 ponds studied, 4 showed MPN (per 100 ml) to be 1100 and above showing heavy microbial contamination. Moreover, all of the ponds under investigation showed presence of E. coli which is indicative of faecal contamination. The results of the rapid study provides basis for further expansion of the study with more emphasis on public health risk.

Keywords: Exponential growth, Biological contaminants, Diarrhoea, *E. coli,* Health risk.

Introduction

The contamination of freshwater resources of potable as well as non-potable quality is a major issue as far as public health is concerned. A greater fraction of the diarrhoeal diseases are caused due to unsafe water sources, and lack in sanitation and hygiene[1]. In developing countries the diseases of biological origin which are spread by water is a great health burden and is considered to be one of the leading factors associated with deteriorated health of the society[1]. It is also evident that despite of having municipal water supply systems in India, some regions have lopsided supply and are forced to rely on microbiologically unsafe water[2]. Such situations prevailing in the developing countries cost nearly 17% of deaths of children under the age of 5 years[3]. Though the water bodies selected for the study are not directly used for water supply to urban regions[4], they may pose threat to the reliant population as previous review of literature indicate that diarrhoeal disease can spread by multiple pathways and not only by microbiologically contaminated drinking water supply[3]. Microbiological assessment having direct or indirect influence on surrounding population is thus warranted to identify their potential threat to the surrounding population. The current study encompasses examination of six surface water bodies under various degree of anthropogenic pressure with respect to microbial quality.

The vulnerability of surrounding population is dependent upon the severity of contamination as well as the time of exposure. The severity of contamination in turn is dependent upon the type of pathogenic organism involved[5]. The presence of coliform bacteria in water bodies may be attributed to faecal contamination by discharge of faeces by humans and other animals in water either directly or indirectly by surface runoff from surrounding areas. The members of family *Enterobacteriaceae* are included in the coliform group of organisms some of which are *Escherichiacoli* (*E. Coli*), *Enterobacter aerogenes*, *Salmonella* and *Klebsiella*[5]. These bacteria from 10% of the intestinal microbes of humans and other animals. *E. coli* lose its viability at slower rate in freshwater and thus can be used as an indicator organism to detect faecal contamination[6]. The major pathway of infection is by direct consumption. However, when contaminated water comes in contact with hands, the disease may spread as the pathogens may enter via oral route and cause disease.

The study, due to the above stated issues, was important with reference to public health risk. The aim of the study was rapid examination faecal contamination in water bodies of Vadodara city, Gujarat. The results of the study may provide basis for corrective actions to safeguard community wellbeing from waterborne pathogenic diseases.

The present study was carried out in Vadodara city, Gujarat which is located between 22° to 22°30' N latitude and 73° to 73°15' E longitude (Figure-1) covering an area of 158 Sq. km. with elevation ranging from 20 m to 40 m[7]. And the population

of the city in the year 2011 was approximately 41.5 Lakh individuals[8]. For the rapid microbial analysis of water quality a total of six fresh water ponds of Vadodara City, Gujarat were selected which were Bapod Pond, Sama Pond, Harni Pond, Gotri Pond, Danteshwar Pond and Sarasiya Pond (Figure-2). The basis of selection of was the frequency and degree of anthropogenic activities on the periphery as well as use of pond water by the adjoining community. The ponds under microbiological investigation were similar in the properties. However, two of them namely Harni pond and Gotri Pond visually appeared to be heavily contaminated which was marked by the presence of floating solid waste and excessive growth of aquatic weeds. The major anthropogenic activities observed at these ponds were bathing, washing of cloths, dumping of solid waste, immersion of religious items etc.

Methodology

The rapid microbiological study was carried out from January, 2016 to April, 2016. Water samples were collected during the morning hours from the ponds under investigation. A total of 6 water samples were randomly collected from each pond and a composite was prepared. The samples were sooner brought to the laboratory after collection. Out of the composite sample 100 ml of the homogenised sample was used for subsequent microbiological analysis.

Microbiological analysis: The Most Probable Number (MPN) method was used to detect the presence of lactose fermenting and gas producing microorganisms and the coliform MPN in 100 ml of water samples. 3 DSLB (Double Strength LST Lactose Broth) and 6 SSLB (Single Strength LST Lactose Broth) tubes containing Durham tubes were used for assessing gas production and calculation of MPN. Samples were vigorously shaken before inoculation into the test tubes to maintain homogeneity of the sample. All the tubes (3 DSLB tubes containing 10 ml sample each; 3 SSLB tubes containing 1.0 ml sample each and 3 SSLB tubes containing 0.1 ml sample each) were incubated at 35°C temperature for 48 hours[9]. The tubes showing presence of trapped gas in the Durham tubes are to be considered as positive tubes. For confirmation of *E. coli*, one positive tube (one with gas trapped in the Durham tube) was selected and streaking of content was carried out on Eosin Methylene Blue (EMB) agar plate[10,11]. These plates were incubated for 24 hours at 35° C temperature and checked for the *E. coli* colonies having green metallic sheen. MPN was determined using MPN Table[9].

Results and Discussion

All the positive test tubes of water samples from the ponds under rapid microbiological investigation showed green metallic colonies on the EMB agar plates (Figure-3). The green metallic colonies were of E. coli. Presence of E. coli other coliforms in surface water bodies is indicative of faecal contamination of the waterbody[5]. Pathogenic organisms from surrounding area may reach to the surface waters by surface runoff, sewage disposal or even by open defecation near the water body.

Figure-1: Ponds of Vadodara City (Gujarat) under microbiological examination. A. Bapod pond, B. Sama pond, C. Harni pond, D. Gotri pond, E. Danteshwar pond, F. Sarasiya pond.

Urban ponds which are the shallow water bodies may serve for recreation and aquaculture as well as they influences the health status of the surrounding population. Microbiological examination of such water bodies, thus, is of prime concern with respect to public health primarily governed by presence or absence of pathogenic organisms[12]. Rapid urbanization and growth of urban population leads to pressure on the natural resources and may lead to deterioration in the quality and/or quantity of the same[13]. The same is applicable to the urban water resources of Vadodara city as well. Rapid population growth has led to encroachment of open fields as well as shallow water bodies with faster disappearance of shallow ponds. In line with encroachment for space, uncontrolled and illegal dumping of solid waste (as in the case of Harni pond, Sarasiya pond and Bapod pond in this study) has led to accelerated eutrophication which makes the ponds shallower and limits their ability to hold larger volumes of water. Presence of faecal coliforms in urban ponds may be attributed to untreated sewage discharge contaminated with pathogens[14]. The ponds studied showed the gas production as the gas was trapped in the inverted Durham tubes (Figure-3). Based on the number of positive tubes the MPN values were identified from the MPN table[9]. The values ranged from 43/100 ml to 1100+ /100 ml of sample. Bapod pond, Sarasiya pond, Harni pond and Gotri pond showed very high MPN index (Table-1). In a study carried out in rural areas of Northern Rajasthan all the water bodies the MPN (per 100 ml) ranged between 25 to 41[5]. Higher MPN count in monsoon season is generally attributed to the surface runoff from surrounding area which may bring the pathogens to the surface water bodies[15]. However, the current study was carried out during January – April where no substantial rains recorded in the study area which would lead to entry of pathogens in the water body from surrounding area. This indicates the existence of other point and non-point source of faecal coli forms leading to contamination of ponds which is a matter of concern with respect to public health. The presence of pathogens in water bodies is a major source of threat to those who are directly or indirectly exposed to such water[16]. Though the ponds under investigation do not serve as a source of fresh drinking water, accidental contact or consumption of this water may lead to infection, diarrhoea, vomiting etc.[5]. Urban runoffs, illegal discharge of sewage, improper sanitation practices as well as high intensity of anthropogenic activities are the major factors contribution to deterioration of water quality[17]. Similar may be the case with the ponds under current investigation. Serious interventions are to take actions to bring the water quality of urban ponds to a safe level so that public health is not compromised.

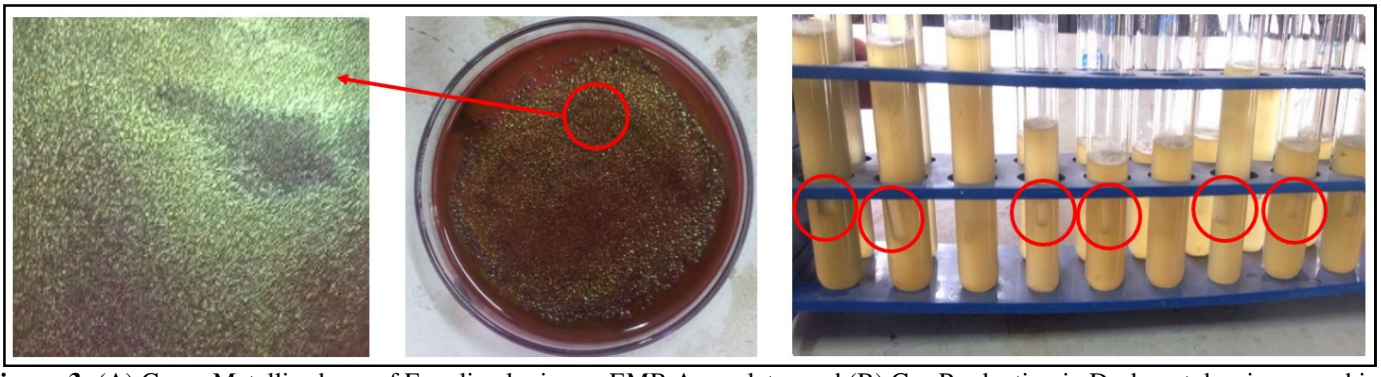

Figure-3: (A) Green Metallic sheen of E. coli colonies on EMB Agar plates and (B) Gas Production in Durham tubes immersed in DSLB and SSLB

Table-1: MPN and examination of *E. coli*

Sr. No.	Pond	Number of Positive Tubes out of three tubes in Dilutions			MPN per 100 ml	*E. coli*
		10 ml (DSLB)	1.0 ml (SSLB)	0.1 ml (SSLB)		
1	Bapod pond	3	3	3	1100 +	+
2	Danteshwar pond	3	1	1	75	+
3	Sarasiya pond	3	3	3	1100 +	+
4	Harni pond	3	3	2	1100	+
5	Sama pond	3	3	2	1100	+
6	Gotri pond	3	1	0	43	+

Conclusion

All the six water bodies under examination showed the presence of faecal contamination during the study period. This indicates untreated and illegal sewage discharge into water bodies. Open defecation at the periphery is one of the major influencing factors causing faecal contamination. Proper hygiene and sanitation practices are immediately required to mitigate potential health risk in the surrounding population. Urban ponds must be given an due consideration as a part of "Swacchha Bharat Abhiyan" with emphasise on biological contamination to avoid potential threat to community health.

Acknowledgement

The authors are thankful to the Offg. Head, Department of Environmental Studies, New Science Block, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara for providing laboratory facility. Author Tailor Manthan A. would also like to express gratitude to Dr. P. C. Mankodi, Professor and Head, Department of Zoology, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara for continuous encouragement and moral support.

References

1. Petersen P.E. (2003). The World Oral Health Report 2003: continuous improvement of oral health in the 21st century–the approach of the WHO Global Oral Health Programme. *Community Dentistry and oral epidemiology*, 31(s1), 3-24.

2. Clasen T., McLaughlin C., Nayaar N., Boisson S., Gupta R., Desai D. and Shah N. (2008). Microbiological effectiveness and cost of disinfecting water by boiling in semi-urban India. *The American journal of tropical medicine and hygiene*, 79(3), 407-413.

3. Clasen T., Schmidt W.P., Rabie T., Roberts I. and Cairncross S. (2007). Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis. *Bmj*, 334(7597), 782.

4. Parikh Ankita N. and Mankodi P.C. (2012). Limnology of Sama Pond, Vadodara City, Gujarat. *Res. J. Recent Sci*, 1(1), 16-21.

5. Suthar S., Chhimpa V. and Singh S. (2009). Bacterial contamination in drinking water: a case study in rural areas of northern Rajasthan, India. *Environmental monitoring and assessment*, 159(1), 43-50.

6. Prescott L.M. (2002). Microbiology 5th edition. The McGraw- Hill Companies, 1-1147. ISBN: 0-07-282905-2

7. Bindu B. and Janak J. (2009). Identifying Malaria Risk Zones Using GIS-A Study of Vadodara City. *J. Commun. Dis*, 41(4), 239-248.

8. State, District and Taluka wise Salient Features of Population Statistics (2001 and 2011). Gujarat, Directorate of economics and statistics, 2013. retrieved at http://gujecostat.gujarat.gov.in/wpcontent/uploads/2013/Dist_Salient_Pop_Stat_2011.pdf on 10/10/2016.

9. Pepper I.L., Gerba C.P. and Brendecke J.W. (1995). Environmental microbiology: a laboratory manual. Academic Press, San Diago, 15.

10. APHA (1998). Standard Methods for examination of Water and Wastewater. 20th edn. American Public Health Association, New York. 1 – 2670, ISBN 0-87553-235-7.

11. Gautam S.P., Reeta K., Suniti P., Basu D.D. and Kamyotra J.S. (2005). Guide manual: water and waste water analysis. *Central Pollution Control Board, Ministry of Environment & Forests, Government of India.*

12. Gopal B. and Zutshi D.P. (1998). Fifty years of hydrobiological research in India. *Hydrobiologia*, 384(1-3), 267-290.

13. Hoekstra A.Y., Mekonnen M.M., Chapagain A.K., Mathews R.E. and Richter B.D. (2012). Global monthly water scarcity: blue water footprints versus blue water availability. *PLoS One*, *7*(2), e32688.

14. Das J. and Acharya B.C. (2003). Hydrology and assessment of lotic water quality in Cuttack city, India. *Water, Air, and Soil Pollution*, 150(1), 163-175.

15. Safari D., Mulongo G., Byarugaba D. and Tumwesigye W. (2012). Impact of Human Activities on the Quality of Water in Nyaruzinga Wetland of Bushenyi District Uganda. *Int. Res. J. Environment Sci*, 1(4), 1-6.

16. Srinivasan J.T. and Reddy V.R. (2009). Impact of irrigation water quality on human health: A case study in India. *Ecological Economics*, 68(11), 2800-2807.

17. Shah K.A. an Joshi G.S. (2015). Evaluation of water quality index for River Sabarmati, Gujarat, India. *Applied Water Science*, 1-10.