MICROBIOLOGICAL ANALYSIS IN DRINKING WATER OF DHAMOI RESERVOIR AT JHABUA, M.P.INDIA

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Abstract: Microbiological analyses were performed on the surface water of Dhamoi reservoir at tribal district of Jhabua (M.P) India. The Dhamoi reservoir was selected in this study because it supplies water for many tribal villages for irrigation, drinking and bathing purposes. Water samples were collected from 3 different sites and three different seasons of 2013-2014 and microbiological analysis was performed for bacteriological analysis by MPN method using Endo agar and IMViC tests. The results obtained were compared with reports of WHO and BIS standards. Faecal coliform counts varied from 12 to 180 MPN/100 ml while Escherichia coli counts ranged from 6 to 161 MPN/100 ml for all the sampled sites. Results also indicated that all samples were found contaminated with total coliforms as well as fecal coliforms in the summer and rainy seasons.
The results also revealed that the situation is alarming. A massive bacterial gene pool was obtained after this study was indicative of immense bacterial diversity in the region. The Faecal coliform and the E. coli counts exceeding acceptable limits are pinpointing of pollution from domestic wastes from several informal settlements located around the reservoir. Water uses in the area were determined and were found to be mainly agriculture and domestic. The gross pollution of the reservoir exposes the local people who depend on it for their primary water source to serious health risk. The present study indicated the need for improvement in water treatment plant and or distribution pipeline system.

Keywords: Dhamoi Reservoir, Fecal coliform, Jhabua, Tribal.

Introduction: It is well well-known that contagious diseases are transmitted mainly through water which contaminated with human and animal faeces (WHO, 1993). Rural India has more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. Meeting the drinking water needs of such a large population can be a discouraging task. The health burden of poor water quality is massive. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year. The problems of chemical contamination are also prevalent in India with 1, 95,813 habitations in the country are affected by poor water quality. Despite an estimated total of Rs. 1,105 billion spent on providing safe drinking water since the First Five Year Plan was launched in 1951, lack of safe and secure drinking water continues to be a major hurdle and a national economic burden (www.wateraid.org/). The microbial contamination of drinking water and its management comprise a major global issue because it is still a major source of infection therefore it is required to confirm sources of contamination and need to focus on the treatment procedures.Total coliforms are a group of bacteria that are widespread in nature. All members of the total coliform group can occur in human feces, but some can also be present in animal manure, soil, and submerged wood and in other places outside the human body. Thus, the usefulness of total coli forms as an indicator of fecal contamination depends on the extent to which the bacteria species found are fecal and human in origin. The coliform index is an evaluation of the purity of water based on a count of fecal bacteria. It is one of much analysis done to assure adequate water quality. This test can determine if the water has possibly been exposed to fecal contamination (Lewis, A.M et al, 1986). That is, whether it has come in contact with human or animal feces. It is significant to be familiar with this because many pathogenic micro organisms are shifted from human and animal feces to water, from where they can be ingested by people and infect them. The drinking water may contain mixtures of parasites, bacteria, and viruses which can potentially cause health problems if humans ingest them. Testing water for each of these disease causing pathogens would be complicated and expensive (Manja et al, 1982). There are a variety of different types of disease-causing bacteria which are usually present in low numbers and do not always show up in tests.

The present study aims to study the anthrogenic impacts on the water quality of Dhamoi Reservoir at Jhabua, Madhya Pradesh. It is also aimed to study the seasonal variation of both water physico-chemical parameters and fecal coliform count.

Material and Methods: Study area: The study was carried out at Dhamoi reservoir which is an important water reservoir located about 24km from Jhabua town and 12km away from Para village (Fig.1). It is a man made reservoir and built in 1988-1999.It is about 28.10 meter in height with the catchment area of 61.44sq.km (mpwrd.gov.in). The reservoir is mainly

used for drinking, irrigation and fishing purposes. Hence anthropogenic interference is much more to affect the quality of water. The bacterial analysis of the reservoir has been carried out to know the possible usage of the Reservoir and to plan the remedies for the same. For the selection of sampling sites, several factors chances of variation in faecal contamination from the landmass, silt and sewage discharge through the rivulets of rivers, possibility of variation in hydrographic and physico-chemical parameters, depth of the water etc. were taken into account.

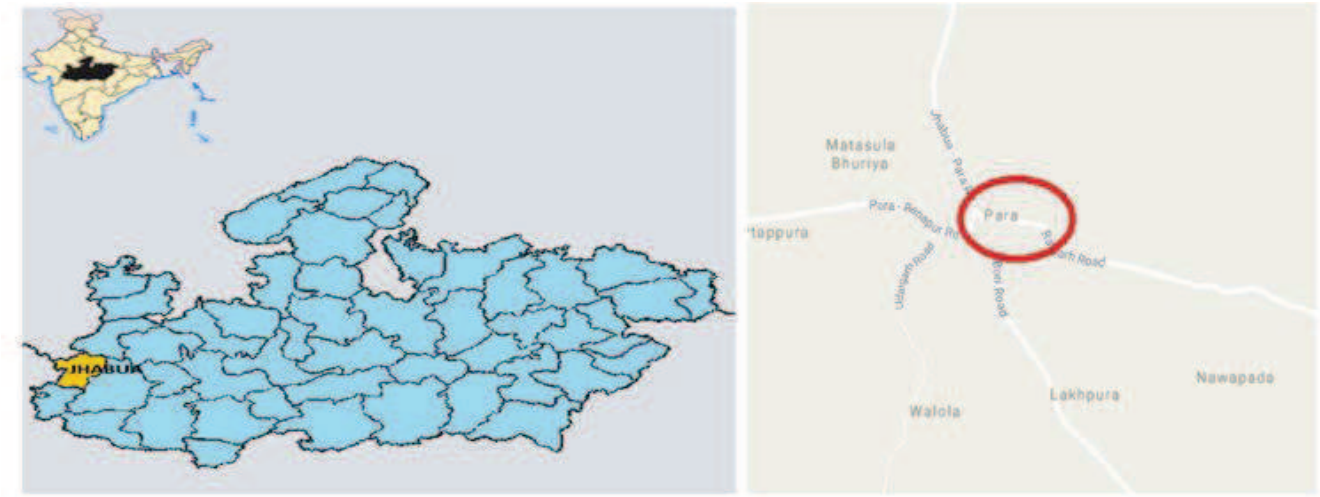

FIG.1. Map showing the sampling locations at Dhamoi Reservoir, Jhabua. M.P

Methodology: The selection of sampling sites was decided by the various uses of water and by their location, relative magnitude and importance. The chance of accidental pollution was also considered for sampling. The water samples were collected from three different points of reservoir and tested for the suitability for drinking, domestic, and irrigation purposes was calculated by comparing the values of different water quality parameters with those of the Bureau of Indian standards (BIS) guideline values for drinking water. Three geographically and ecologically varied stations were selected in Dhamoi reservoir, for the study.

Study station I: Center point: This is the point represent the general water quality of the reservoir. Human activities are reduced here for bathing and fishing. This station was taken as the reference station (control) owing to the absence of sewage discharge into the reservoir from households.

Study station II: The inlet point: This is the point where the feeder opens in the lake. This station is located at northern part of Para village. Domestic waste is drained into this station. Motor vehicles are constantly washed. Also devotees of Goddess immerse their pantheon (pooja material) directly into the reservoir.

Study station III: The outlets point: This is the place where the overflows and outflow occurs.

Sample collection: Sub surface water samples were collected from three different study stations of reservoir on quarterly basis in triplicate in morning hours between 7:00 to 9:30AM, in one liter plastic bottles, which were previously cleaned with dilute HNO_3 and detergent followed by distilled water. Before sampling, they were again rinsed with sampling water. The closed bottle was dipped in the reservoir at the depth of 0.5 to 0.7 m, and then a bottle was opened inside and was closed again to bring it out at the surface.

Microbiological Analysis of Drinking Water Quality: Water samples were collected in accordance with the standard methods for the examination of water and wastewater (APHA, 2005). 500 ml of water sample was collected from each study station in sterile capped containers from all three study stations of Dhamoi reservoir in all seasons from June/July, 2013 to April/May 2014. Samples were collected in 500 ml sterile glass bottles. To avoid contaminations disposable gloves washed with 1NHCL were dressed during water sampling. After sample collection, a tiny amount of $Na_2SO_3.5H_2O$ solution (18 mg/L) was added to the experimental bottles in order to block the continuous antiseptic action of chlorine in water. They were kept in air tight ice boxes and transported within the 6 hours their collection to the Zoology Department of the Government PG Arts and Science College, Jhabua for bacteriological examination. Enumeration, isolation and characterization of micro organisms were done according to the methods described by Williams (1989) and Aneja (2004) to determine the degree of contamination. Total coliforms, fecal coliforms, and fecal streptococci were counted using Most Probable Number (MPN) method as previously described. The bacteriological

analysis like the number of bacterial colonies, number of total coliform, faecal coliform and faecal streptococci were measured by standard plate count (SPC), most probable number (MPN), faecal coliform count (FCC) and faecal streptococcal count (FSC) respectively. All the collected water samples were analysed within 24 hr. The numbers of bacterial colonies were counted by colony counter. All estimations were carried out using five replicates. The data presented are mean of five independent determinations.

MPN test protocol. Bacteriological analysis was carried out for indicator organisms i.e. total and fecal coliform (E.coli) by most probable number (MPN) method (1, 2,). 15 tubes of MacConkey broth (Hi media, Mumbai) were arranged in three rows. First row containing 10 ml double strength MacConkey broth was inoculated with 10 ml of water sample. Second and third row containing 10 ml single strength MacConkey broth medium was inoculated with 1 ml and 0.1 ml water sample respectively. After incubation at 44O C for 24 hours coliform number was determined by the following formula.

MPN/100ml = No. of + ve tubes * 100

√ (ml of water sample in all tubes) * (ml of water sample in – ve tubes)

Fecal coliform (E.coli) was enumerated by SPC technique using Endo agar as a selective and differential medium for E. coli.

Qualitative analysis: A loopful suspension from positive MPN tube was streaked on Endo agar for confirmation of fecal coliform and IMViC test was performed to confirm presence of E.coli. **Statistical analysis**: The average geometric mean of coliform bacteria per 100 ml was calculated in each sample.

Results and Discussion: Results of evaluation of microbial count in Dhamoi reservoir were presented in Table 1and Fig.1&2. The mean concentration of total coliforms in the water samples was lowest (85.8±1.5 MPN/100 ml) at station 1. The highest concentration, (1276.2±18.6 MPN/100l) was recorded at station 2 in rainy season followed station 3 (1236.0±19.8 MPN/100mls) which is located as an outlet. The total coliforms and faecal coliforms were found to be the highest at station 2 and 3 during monsoon season and less total coliforms count was observed at all stations during 2013-14 summer season (Table 1).

The results also clearly revealed that all the water samples in the three study points and in different seasons were contaminated with high amount of bacterial population than permissible limit and consequently the reservoir water failed to meet the WHO/BIS drinking standards.(zero coliforms per 100 ml). The MPN number was very high in station 2 site indicating the original source of water itself is contaminated with fecal coliforms from human and animal sources. The reason for high number of bacterial colonies might be due to inadequate maintenance of water reservoirs and the entry of sewage into the reservoir.

Table-1 Average geometric mean of Most Probable Number of coliform bacteria (MPN/100 ml sample)

Sampling sites	Rainy		Winter		Summer	
	Total coliforms	Faecal coliforms	Total coliforms	Faecal coliforms	Total coliforms	Faecal coliforms
Station I (Control)	221±7.5	78±3.6	87±4.4	38±2.5	85.8±3.4	41±1.8
Station II	1276±18.6	611±11.2	987±16.4	358±7.1	758±9.7	311±5.5
Station III	1236±19.8	657±1.5	1023±14.2	452±8.4	898±12.3	412±8.5

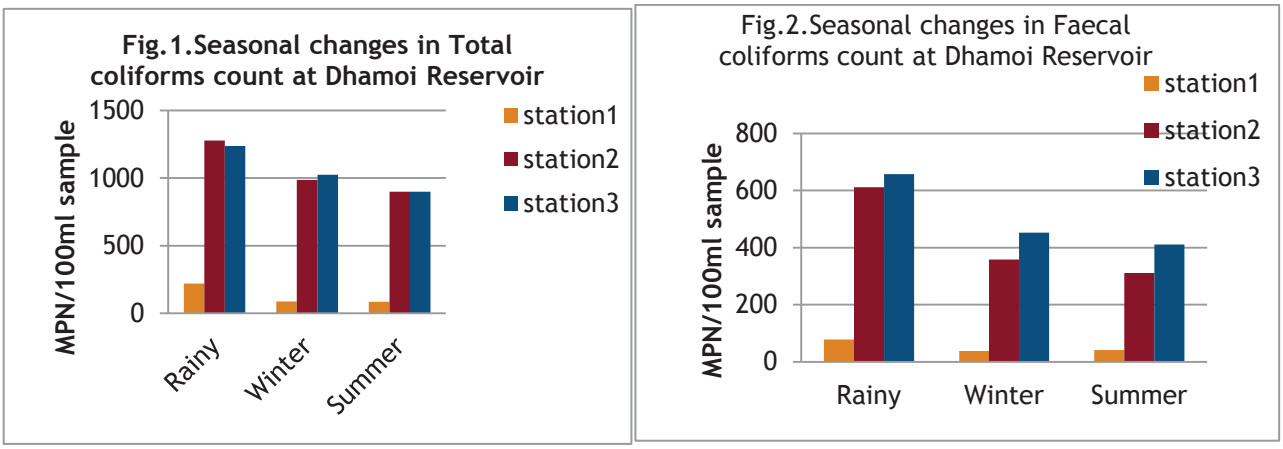

Fig.1&2. Seasonal changes in Total coliforms and Faecal coliform count at Dhamoi Reservoir

The maximum count of coliform in rainy season may be due to sewage drains, increasing human activities, flooded rainy water, and runoff from rural animal husbandry, agricultural fields and open-air defecation

along the margins of reservoir by suburban and rural people. Similar observations were reported by Kataria, (1997) on drinking water at Bhopal city. Lalitha, (2008) at Warangal city and (Das, 2000) on canal water in Cuttack. Besides, the elevated count of faecal coliform bacteria in rainy season might be also due to high turbidity, addition of more sewage and faecal matter through surface runoff. However, the modest bacterial count during the winter could be because of low water temperature, low turbidity and comparatively lower input of organic matter (Lalitha, 2008; Rai and Tripathi, 2007 and Rai et al., 201).

The presence of total coliform and faecal coliform in Dhamoi reservoir may be due to inadequate sanitation and unhygienic conditions of distribution system. Unhygienic conditions of pipelines and leakage with domestic sewage is a major source of microbial contamination of any potable water. This could be a reason for the presence of total coliform in all study stations and in all seasons. However it was found that reservoir waters were slightly alkaline during pre and post monsoon seasons especially station No.2 and 3 were found to be enriched with nutrients like chlorides, sulphates and phosphates in all the seasons (Ranjana Rawat and Dhakad, N.K, 2017). Similar results were obtained by many workers in different parts of India and in different places (Parihar et al, 2003, Mohan et al, 2007, Mishra and Bhat, 2008, Desai, 2012, Srivastava et al, 2013, Sunder and Nirmala, 2015). The reasons for the high number of total coliforms were due to the discharge of human and animal faces into the water bodies.

Conclusions: The water samples of Dhamoi reservoir at Jhabua were showing microbial content beyond the standard limits which may be due to ineffectiveness or malfunctioning of the treatment process or lack of water treatment plant. Hence, prior disinfection treatment is required before consumption to avoid water-borne diseases. Besides, the present analysis is essentially a primary work and needs to be further investigated to draw specified conclusions. Authorities may also check randomly samples at all levels to ensure the supply of safe drinking water.

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