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Original Research Paper

Management of Drinking Water Quality at Malviya National Institute of Technology, Jaipur-A Case Study

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ABSTRACT

Water quality of drinking water sources and the distribution system of MNIT, Jaipur campus was comprehensively studied for physical, chemical and bacteriological parameters as some incidences were reported related to waterborne diseases. The results showed that all physical and chemical parameters were within the limits but the biological parameters deviated from the prescribed standards of the BIS: 10500. Bacteriological analysis was carried out using Colilert18 and cross checked by the standard pour plate method. Results obtained after pour plating method showed the presence of 33% *Serratia*, 33% *Citrobacter*, 18% *Klebsiella*, and 18% *Enterobacter* among the pathogens analysed in the most contaminated sample obtained from a residential apartment of the campus. Presence of high level of bacterial count in drinking water indicates the contamination of drinking water distribution system by sewage. In light of these findings, appropriate remedial measures were taken by the authorities supplying water to the campus in terms of cleaning of sewer lines and refurbishing of tube wells followed by regular disinfection of drinking supplies. After the refurbishment, bacteriological test results of water samples collected from various locations covering the entire campus revealed complete absence of coliforms representing a good quality of water.

INTRODUCTION

Drinking water is indispensable for human existence. Still more than 1 million people all over the world do not have ready access to safe water supply. The condition becomes worse when we utilize the available freshwater resources indiscriminately for the human consumption and other activities. According to World Health Organization (WHO 2000) there are about 4 billion cases of diarrhoea and 2.2 million deaths annually across the world. Water related ailments are responsible for almost 85% of the prevailing diseases in our country, with the majority being caused by biological contamination of drinking water by microorganisms such as bacteria, viruses or small parasites. Presence of coliforms in drinking water acts as an indicator of contamination due to sewage, which may bring a plethora of pathogens that can cause diseases like typhoid, diarrhoea, cramps, fever, and nausea. The need for the present study was felt when a few cases were observed among the residents of staff colony in MNIT, Jaipur campus, related to some common waterborne diseases. The drinking water system including the sources of water (7 tube wells), the ground level reservoir and the tap water supplied to the houses was thoroughly analysed for physical, chemical and microbiological quality to identify the problem, and measures were taken to ensure that the standard parameters are duly met with.

MATERIALS AND METHODS

Study area: Jaipur is situated in northern India at a distance of around 260 km south of Delhi. The Institute, Malviya National Institute of Technology (NMIT) is located in Malviya Nagar on Jawaharlal Nehru Road, Jaipur. Institute was established in 1963 as a joint venture of the Government of India and the Government of Rajasthan. The campus is spread over 125 hectares of lush greenery. The total water requirement of MNIT campus is catered by 7 tube wells installed in the campus at different locations. The water is first collected in a ground level reservoir, where it is disinfected by chlorination. The water is then lifted to an elevated service reservoir for further distribution through gravity.

Sample collection: Samples were drawn from different sources of water in the institute, ground level reservoir and a few residences from where the complaints were received. These were transported and preserved by the methods mentioned in the standard methods (APHA 1998). Random sampling method was adopted for the study. Physical, chemical and bacteriological analysis of collected samples were conducted for all routine parameters in the environmental laboratory at MNIT Jaipur, within half an hour after collection of samples. The locations and sampling sites are shown in Fig. 1. Large circles denote the tube wells, and small circles the other sampling sites. Care was taken to obtain a sample that truly represents the existing condition in such a way that it does not deteriorate or become contaminated before it reached the laboratory within half an hour of collection (Kavitha & Siva Priya 2005).

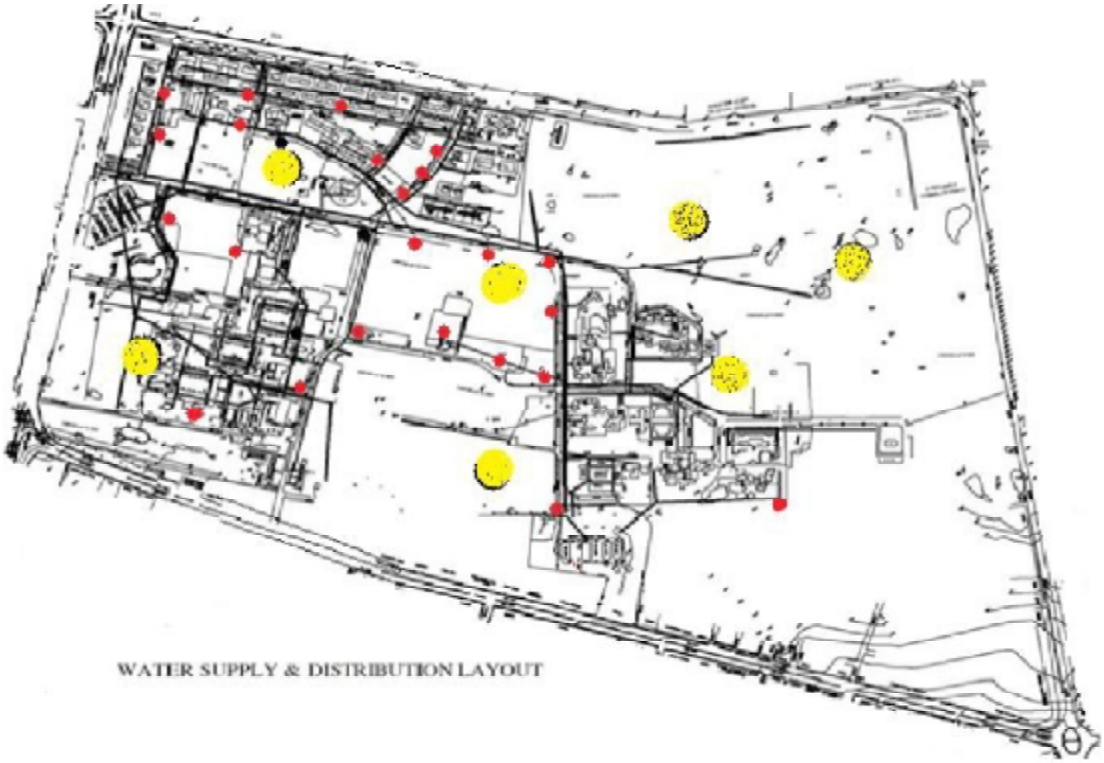

Fig.1: Map showing the sampling sites in MNIT Jaipur.

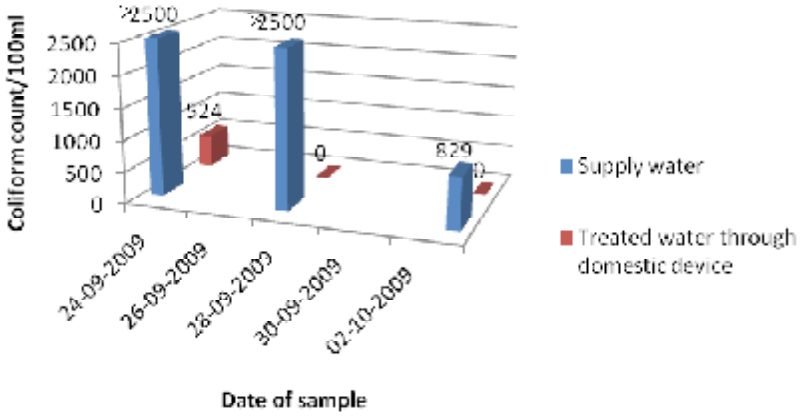

Fig. 2: Microbiological quality of a sample from a faculty residence.

Methods used in bacteriological analysis: Standard pour plating and Colilert18 method have been adopted for qualitative and quantitative bacteriological assessment of the collected samples.

Pour plate method: In this method, original sample was diluted many times to reduce the microbial population sufficiently to obtain separate colonies when plating, in the range of 30 to 300 cells per plate. For this study, XLD Agar media (Xylose Lysine Deoxycholate Agar) and EMB Agar media (Eosin Methylene Blue Agar) were used. XLD Agar was used for the identification of both *Salmonella* and *Shigella* and EMB Agar was used for the detection of gram negative coliforms. One mL of diluted sample was inoculated onto the surface of agar and spread in circular motion manually. Diluted samples of raw water were spread on the XLD agar and EMB Agar in duplicates to check out the reproducibil-

Table 1: Physical and chemical quality drinking water in MNIT campus.

Name of parameter	Observed value	IS: 10500 Standards
Temperature (°C)	22C	-
Turbidity (NTU)	<5	5-10
Color (Absorbance)	0	0
Taste & Odor (mg/L)	Agreeable	Agreeable
Total Hardness (mg/L)	213.2	-
Ca Hardness (mg/L)	162	-
Mg Hardness (mg/L)	91.2	-
OH^- Alkalinity (mg/L)	0	-
CO_3^{-2} Alkalinity (mg/L)	0	-
HCO_3^- Alkalinity (mg/L)	44	-
Total Alkalinity (mg/L)	44	200-600
pH	7.1	6.5-8.5
EC(mS/)	0.5	-
Flouride (mg/L)	0.51	0.5-1.50
NO_3^- (mg/L)	36.66	45-100
Cl^- (mg/L)	21.19	
Sulphate (mg/L)	17.9	200-400
Ca (mg/L)	48.89	75-200
TDS (mg/L)	245	500-2000

Table 2: Results of well water tested by Colilert18.

S.No.	Date of testing	Well No.	Coliforms count/ 100mL by Colilert18	Status with WHO Standards Less than 10 Coliform count/100 mL of raw water
1.	4/10/2009	1	Less than 1	Within standard
2.	4/10/2009	2	4	Within standard
3.	4/10/2009	3	12	Not within standard
4.	4/10/2009	4	12	Not within standard
5.	4/10/2009	5	1	Within standard
6.	4/10/2009	6	3	Within standard
7.	4/10/2009	7	870	Not within standard
8.	14/10/2009	7	440	Not within standard

ity. Petri plates were incubated at 35°C and observed between 24-48 h as described by Buck & Cleverdon (1960).

Colilert18 hr method with quanti-trays: Colilert18 is used for the simultaneous detection and confirmation of total coliforms and *E. coli* in fresh and marine waters. It is based on IDEXX's patented Defined Substrate Technologyâ (DSTâ), USA (IDEXX Colilert (18 hour) Manual. 100 mL volume of the water sample was poured into a bottle and the dehydrated powdered medium was added to it. After the powder was dissolved, the sample containing the medium was dispensed into a tray. The tray was then heat sealed with the help of Colilert18 instrument. Following incubation at 35°C for 18-22 h, the number of yellow wells and the number of yellow wells that fluoresce were counted. The MPN counts of Coliform bacteria and *E. coli* were then read from the MPN table supplied with the instrument.

RESULTS AND DISCUSSION

All the physical and chemical parameters tested were within prescribed limits, and hence these values are shown in Table 1 without any further discussion. The microbiological quality of one of the faculty residences, from where the complaints were received, was tested during three consecutive weeks for the presence of coliforms with the help of Colilert18 and results are shown in Fig. 2.

Presence of high faecal coliforms count in the sample as exemplified in Fig. 2 probably indicates the contamination of water with spilled sewage from the adjacent sewer line, which was found to be choked. It was important to note that even though a water treatment device was available in the residence, the treated water did not show an absence of coliforms indicating insufficiency of treatment at the observed level of microbiological contamination. After obtaining the results from the affected area, the study was extended to the whole campus to analyse the extent of microbial contamination in the remaining samples of drinking water. Out of seven tube wells installed to supply water to the MNIT campus, well No. 7 was found to be highly contaminated as shown by the biological examination. Water samples of well No. 7 were collected on 4/10/2009 and 14/10/2009 and ana-

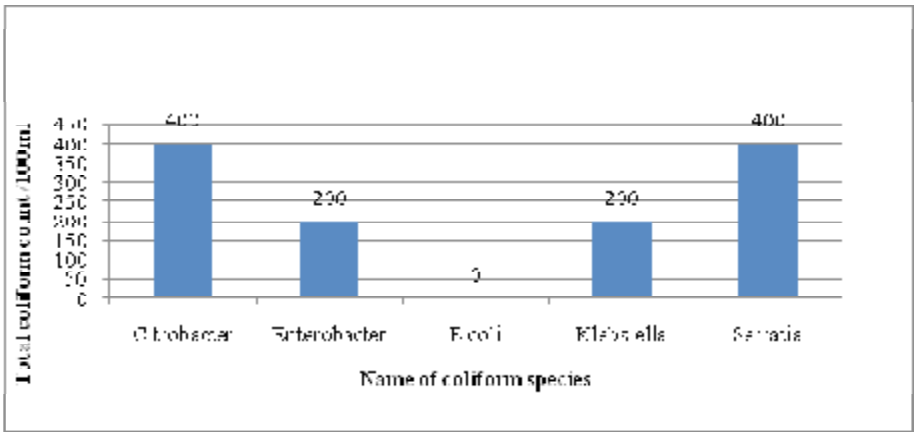

Fig. 3: Bacterial isolates from well No.7 water by pour plate method.

lysed by pour plating method for different pathogens. The results of microbiological examination are shown in Fig. 3. Two wells, well No.3 and well No. 4, were found to be slightly contaminated when tested for coliforms using Colilert18 as given in Table 2.

Total coliform counts of water sample well No.7 as examined by both the methods Colilert18 and pour plating were comparable. But slightly higher count of 1200 per 100 mL was observed with the pour plate method as shown in Fig. 3. The reason for this higher count could be the dilution factor error as the dilution requirement in this method is very high.

The colonies of individual species obtained from pour plating method showed the presence of 33% *Serratia* (causes meningitis, arthritis, lower tract infections, urinary tract infections), 33% *Citrobacter*, 18% *Klebsiella* (causes chronic pulmonary disease, enteric pathogenicity, nasal mucosal atrophy, urinary tract infections in older persons) and 18% *Enterobacter* (causes urinary tract infections, intra-abdominal infections, osteomyelitis) out of total coliform count from the most contaminated sample collected from well No. 7.

In view of contamination detected at source level, appropriate remedial measures were taken by the MNIT authorities supplying water to the campus in terms of cleaning of sewer line and refurbishing of tube wells followed by slightly higher dose of chlorine being used for disinfection of raw water than that used routinely for disinfection. In refurbishment of tube wells, bore well was cleaned by high pressurized air and was also deepened by another 20 feet. After all the system improvement works, the bacteriological test results of water samples collected from various locations including raw water sample from the ground level reservoir, treated water sample from outlet of reservoir, and 26 samples from different locations of distribution line revealed complete absence of coliforms indicating excellent quality of water.

CONCLUSIONS

A regular monitoring of water quality not only prevents disease and hazards but also checks the water resources from further pollution. The control of drinking water quality in distribution networks remains a major challenge in urban areas. The source protection, management of treatment and distribution networks are critical strategies in maintaining and improving piped water supplies. Colilert18 based on IDEXX's patented defined substrate technology, can be routinely used for qualitative as well as quantitative analysis of drinking water as it is very easy to use and possesses a high sensitivity for analysis of coliforms. Indications provided by the routine surveillance using Colialert18 and taking immediate measures to ameliorate the system resulted in bringing the water supplies in the campus to an excellent quality.

REFERENCES

APHA 1998. Standards Methods for the Examination of Water and Wastewater. 20th Edition, American Public Health Association, Washington DC.

BIS 10500: 2003. Edition 2.1 (1993-01), Bureau of Indian Standards, New Delhi.

Buck, J. D. and Cleverdon, R. C. 1960. The spread plate as a method for the enumeration of marine bacteria. Limnol. Oceanogr., 5: 78-80.

IDEXX Colilert (18 hour) Manual available at www.idexx.com.

Kavitha, S. and Siva Priya 2005. Bacterial analysis of packed and bottled drinking water. Journal of Ecotoxicology and Environmental Monitoring, 15(1): 65-68.

Trivedy, R.K. and Goel, P.K. 1986. Chemical and Biological Methods for Water Pollution Studies. Environmental Publishers, Karad. pp 61.

WHO 2000. Guidelines for Drinking Water Quality. 2nd edition. Volume II, Health criteria and other supporting information. World Health Organization, Geneva.