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Microbial Study of Drinking Water in the Government Hospitals of Patna District, Bihar, India

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Abstract

This study was carried out to evaluate the status of drinking water supplied in six different government hospitals of the Patna capital of Bihar, India. A total of 14 drinking water samples was collected aseptically in sterile container during the month of August 2017. Most probable number (MPN) test was done to detect the Coliforms in drinking water samples. A total of 11out of 14 samples shows very high MPN value, which are above the WHO standard of concentration of Coliforms which must be zero in safe drinking water . Analysis was performed by using culture and biochemical methods. This study has therefore shown the need for continuous monitoring of drinking water supply system. This study indicates that regular water monitoring the supply and availability of pathogens free drinking water.

Keywords: Patna; Microbial; Coliform; MPN; Drinking water; Indole; Citrate; Methyl red.

1. Introduction

Bihar is the third largest populated state of the republic of India. Patna is the capital of Bihar which has about 3 million populations, half of the population lived on an average income. Health is one of the key points of any civilized society. People who have low income depends upon government hospitals for their health issues. Government hospitals are cheap and cover a large population.

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Patna has a dozen of Government hospitals where every day thousands of people come to solve their health problem. In the present investigation, 6 government hospitals of Patna urban areas were selected for the study. The selected hospitals included. Total 14 points of drinking water supply inside a hospital campus were chosen.

Most essential natural resources on earth is water. Life on earth exists due to the presence of water. Increasing population and growing industries raise the demand for fresh water [1]. Drinking water obtained from surface and underground sources. These sources could be contaminated by microbial and chemical pollutants [2]. The Water contains a variety of microbes, most of them are harmless, but some kind of specific microbes which are pathogenic causes water born disease. Presence of these types of microbes in water indicator contamination of water supply. Coliforms are the major water pollutants. Coliforms are rod shaped, non-sporing, motile or non motile, gram –ve aerobic and facultative or anaerobic lactose fermenting bacteria commonly found in the intestinal tract of men and animal. It is world wide considered as an indicator for the degree of fecal pollution in water as fecal polluted materials always contain coliforms[3].

Most Probable Number (MPN) test is a specific test for determination of the presence of coliforms in a given sample. Coliforms are lactose fermenting bacteria with the production of gas. Other bacteria do not ferment lactose. Drinking water with the fecal contamination can spread. Diseases like, typhoid, cholera, hepatitis, diarrhea and dysentery. Diarrhea affects 40% children's under 5 year old [4].

Underground, municipal distribution system and sewage system, are very old. Water distribution system is mostly compromised with polluted water through sewage like seeping into the water supplies. It is worthwhile investigating these hospital drinking water or possible bacteria contamination to prevent gastrointestinal infections in the future. Therefore, objective of this study was to assume the bacteriological contamination status of drinking water supplied inside the hospitals.

2. Materials and Methods

A total of 14 drinking water samples was collected from each source according WHO guidelines for drinking water quality assessment [5], a period of the month August 2017. Analytical works were carried out in the laboratory of the Department of Biotechnology, A.N college in Patna.

2.1 Study Site

Study site Patna is situated between 240 97'- 25057" North latitude and 840 44 – 860 49" East longitude at an elevation of about 129 meters above mean sea level. In the national physiographic, its mainland is sandwiched between the high Himalayan ranges in the far north and the hilly tracts of Chota Nagpur in south (now in Jharkhand state). The most significant feature of the city is its linear characters. It is about 20 km long (from east to west) and 4 km width (from north to south). The river Ganga flows all along the north of the city.

2.2 Determination of Bacteriological analysis

Bacteriological analysis was carried out for indicator organism, i.e. Total and Fecal coliform. 10.3 gm of

MacConkey broth were dissolved in 100 ml of distilled water and was autoclaved at 121^0 C for 15 minutes and then cooled at room temperature. 10 ml of this solution was filled in test tubes and a Durham's tube was added in an inverted position in each test tube plugged with non absorbent cotton plug. Again 5.15 gm of MacConkey broth was dissolved in 100 ml of distilled water and was autoclaved at 121^0C for 15 min and then cooled in room temperature, 10 ml of this solution were filled in test tubes and a Durham's tube was added in inverted position in each test tube plugged with non absorbent cotton plug. Fifteen tubes MacConkey broth (Hi media Pvt. Ltd, Mumbai) arranged in three sets of test tubes. First set containing 10 ml of double strength MacConkey broth was inoculated with 10 ml of water sample. Second set containing 10 ml of single strength MacConkey broth was inoculated with 1 ml of water sample. Third set containing 10 ml of single strength MacConkey broth was inoculated with 0.1 ml of water sample, respectively, were incubated, in an incubator at 37^0C for 48 hours. After incubation, the acid and gas production had occurred in the form of the bubble was counted and the MPN of coliform in 100 ml water sample were estimated [6].

The Analysis is usually performed using culture and biochemical (Indole, Methyl Red Test and Cytrate Test) test also.

3. Result

A total of 14 drinking water samples was tested by MPN method. This is listed in table number 1.

After determinant of the MPN number of positive samples, for organism identification do the culture & species identification the biochemical (Indole, Methyl Red Test and Citrate Test) test as per WHO guideline was performed.

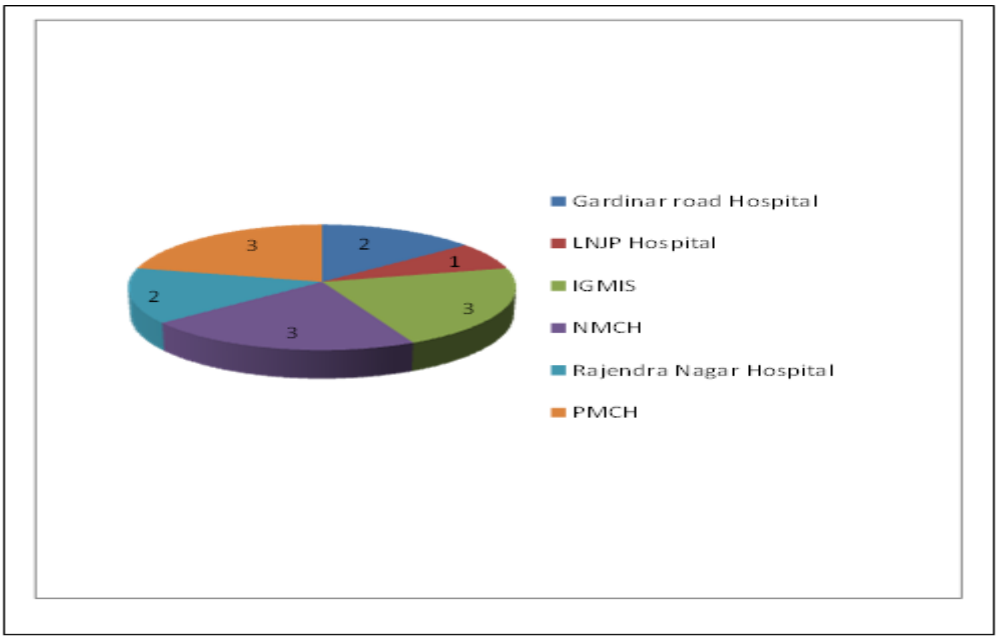

Figure 1: Number of water sample from different Hospital

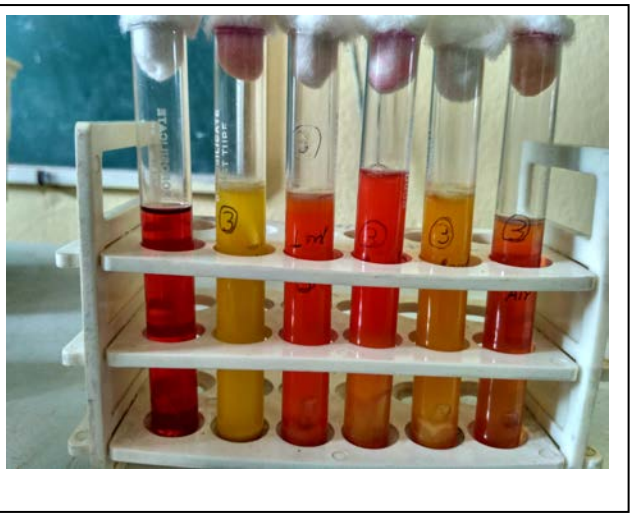

Figure 2: MPN Test

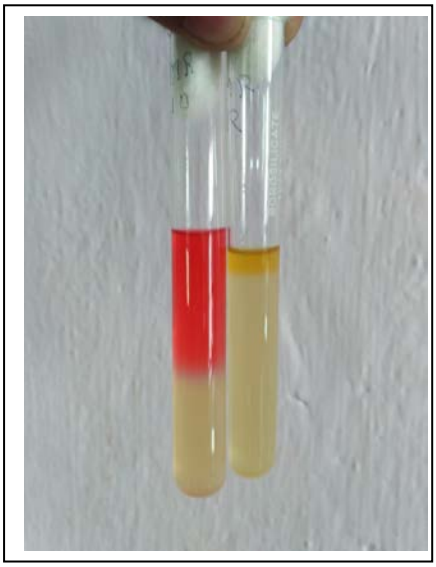

Figure 3: Methyl Red Test

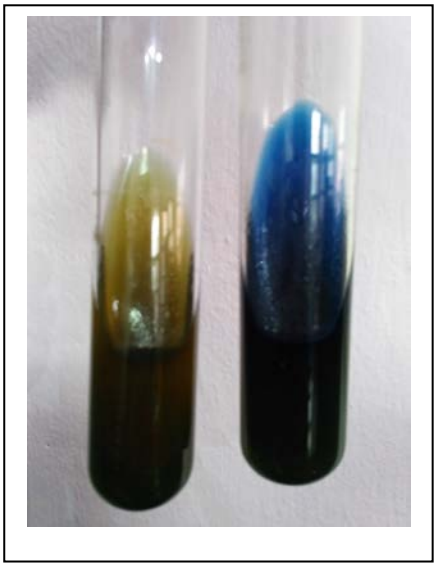

Figure 3 : Citrate Test

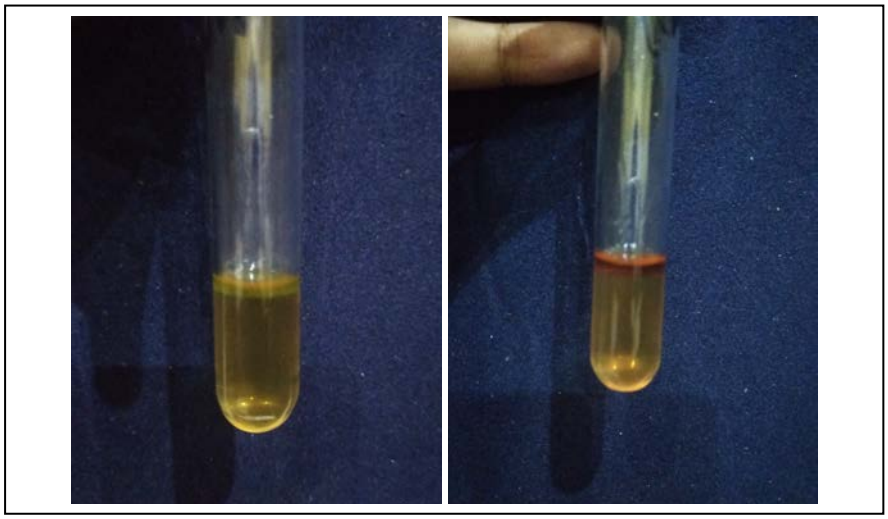

Figure 4: Indole test

Table 1: Findings of Biochemical analysis

S.No	MPN	MPN Index	Indole test	Citrate test	Methyl red test
1	5-5-5	>1,600	-VE	+VE	-VE
2	4-0-0	13	+VE	+VE	-VE
3	5-4-1	170	+VE	+VE	-VE
4	5-5-4	1,600	+VE	+VE	+VE
5	5-5-4	1,600	+VE	+VE	-VE
6	5-3-0	80	-VE	+VE	+VE
7	5-5-1	300	+VE	-VE	-VE
8	5-4-4	350	-VE	+VE	-VE
9	5-5-0	240	-VE	+VE	-VE
10	5-5-3	900	-VE	+VE	+VE
11	5-5-1	300	-VE	+VE	-VE
12	5-3-2	140	-VE	+VE	-VE
13	5-3-0	80	-VE	+VE	+VE
14	5-5-2	500	-VE	+VE	+VE

Table 2: Source of water sample from different Hospitals

S.NO	Name of Hospital	Water source
1	Gardiner road Hospital	Hand pump
2	Gardiner road Hospital	RO Machine
3	L N J P Hospital	Vending machine
4	I.G.I.M.S (Ward block)	Vending machine
5	I.G.I.M.S (Restaurant and cafe)	Vending machine
6	I.G.I.M.S (OPD)	Municipal supply
7	NMCH (Child emergency)	RO Machine
8	NMCH (Canteen)	Municipal supply
9	NMCH (ICU)	RO Machine
10	Rajendra Nagar Hospital	Municipal supply
11	Rajendra Nagar Hospital	Tap water
12	PMCH (Blood donation unit)	Municipal supply
13	PMCH (Children ward)	Municipal supply
14	PMCH(OPD)	RO Machine

Table 3: Different Biochemical test and observation

S.NO	Name of test	Colour	Microbes
1	M.P.N Test	(-) Red/ (+) Colour Change	Coliform
2	Indole Test	(-) Pale Yellow/ (+) Red	Enterobacteriaceae
3	Citrate Test	(-) Green/ (+) Blue	Salmonella typhi and Escherichia aerogen
4	Methyl red Test	(-) yellow/ (+) Red	E. coli, Bacillus, Proteus, & Staphylococcus

Out of 14 samples 11samples shows exceeded MPN value, which is an indication of harmful gastrointestinal contamination. 5 samples show positive Indole test which confirms the presence of Enterobacteriaceae. 13 samples show positive citrate test which indicates presence of Salmonella typhi and Escherichia aerogen in drinking water. 5 samples have positive value for Methyl red test which is a test for detection of E.coli, Bacillus, Proteus, & Staphylococcus bacteria.

All the results were enlisted in table no.1 and 3. Results were analyzed according to WHO Guidelines.

4. Limitation

Number of hospitals for this study was very low and our resources were limited. Further we were unable to use molecular techniques for the characterization of the isolated bacteria during this study. In this study we could not study the seasonal variation of the micro-organism present in water. As study of seasonal variation of microbes, large number of samples needed to be processed and for which we have insufficient resources.

5. Conclusion

Assessment of drinking water quality for bacteriological contamination is a very sensitive method, but it does not detect protozoal, viral and fungal contamination. An important health responsibility to safeguard supply of drinking water. Bacteriological assessment under guidelines of WHO. In developing countries about 80% of all diseases caused due to unsafe water supply as per WHO. Water pollutes mainly due to sewage containing dangerous fecal contamination some of the major diseases like typhoid, dysentery, cholera, diarrhea etc. transmitted through contaminated water. Sample received from the hospital shows a mixed population of coliform, Enterobacteriaceae, salmonella typhi, Escherichia coli, etc.

The probable reason may be due to mixing of Sewage water with drinking water through leakage in the pipeline. To prevent diseases and hazards and to stop the water resources for going polluted proper monitoring of water quality is needed. It is a challenging job for a municipal authority to control drinking water quality in the distribution network.

6. Recommendation

The underground water supply line of Patna municipal area are very old, damaged and near sewage line. As an immediate solution for this problem until the new supply system is constructed and starts its full operation of the cities drinking water supply, the responsible authority and the beneficially should efficiently used the following appropriate recommendation in order to maintain the quality of water.

1. Use of disinfectants with a higher dose of chlorine at the treatment plant during rainy seasons.
2. Replacement of old underground water supply system with near one. The oldest underground iron pipes should be replaced with PVC pipes. This is helpful to avoid the rusting problems.
3. Protection of water points through natural vegetation, preventing satiation around water points.
4. Proper monitoring of drinking water should be done in regular interval to avoid health hazards.

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