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Bacteriological Analysis of Drinking Water from Different Sources in and Around Ranchi, Jharkhand

Priscilla Kerketta*, Ravuri Halley Gora, Sushma Lalita Baxla, Suruchi Kumari and Rajendra Yadava

Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Ranchi, Birsa Agricultural University, Kanke, Ranchi - 834 006, Jharkhand, India.

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To determine bacteriological analysis of drinking water samples taken from various sources like hand pumps, wells, taps, river and ponds in and around Ranchi, Jharkhand, India. Bacteriological analysis includes MPN of coliform and MPN of feacal streptococci. Presence of coliform was detected in 53% of the water samples and the maximum MPN of coliform estimated was 1800+. Faecal streptococcus was detected in 20% of water samples and the maximum MPN of feacal streptococci estimated was 120. The poor microbiological quality of drinking water samples revealed in this study is the matter of public health concern and proper treatment of water is required before its consumption.

Key words: bacteriological analysis, coliform, drinking water, *E.coli,* feacal streptococci, MPN.

Water is the most vital resources for all kinds of life on this planet and essential for ensuring the integrity and sustainability of the earth's ecosystems. An adequate, safe and accessible supply of water is necessary for all creatures. Improving access to safe drinking water can result in significant benefits to health. Every effort should be made to achieve a drinking water quality as safe as possible. During last decade, it has been observed that the ground water gets polluted drastically because of increased human activities. Consequently number of cases of water borne diseases has been seen which is a cause of health hazards. Water pollution causes a number of diseases like diarrhea, jaundice, typhoid, etc. Consequent to the realization of the potential health hazards contamination of drinking water from any source is therefore of primary importance because of the danger and risk of water borne diseases (Edema *et al.*, 2001; Fapetu, 2000).

* To whom all correspondence should be addressed.
E-mail: priscillak802@gmail.com

The World Health Organization estimated that up to 80% of all sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. Various water borne diseases like typhoid, cholera, dysentery, hepatitis as well as many protozoan and helminthic infestations are transmitted through contaminated water (WHO, 1997). These diseases are caused by microscopic organisms including bacteria, virus, fungi, and single celled protozoan. They eventually results in crippling, devastating and debilitating effect on rural residence and further exacerbate the already strained health burden and facilities in the country (Adejuwon and Adelakun, 2012).

MATERIALS AND METHODS

Collection of samples

A total number of 100 water samples from different sources like hand-pumps, wells, taps, ponds and rivers were collected in and around Ranchi at varying interval for the present study.

Method of sample collection

Water samples were randomly collected from different sources at varying interval in thoroughly washed and sterilized bottle. The water sampling bottles meant for bacteriological examination were added with small crystal of sodiumthiosulphate. The bacteriological analysis was conducted within 4 to 6 h of sample collection. From running taps, the water was collected after allowing the tap to run for 5 minutes. Prior to this the nozzle were cleaned and then washed with an appropriate disinfectant like ethyl alcohol. It was more convenient to flame the nozzle for few seconds to disinfect it. A little space was left while collecting samples to allow mixing as and when required.

Bacteriological analysis

The bacteriological quality of water was assessed as per method recommended by APHA (1995).

Most Probable Number (MPN) of Coliform

The presumptive test was performed by inoculating 10 ml of water from each sample into a set of 5 tubes each containing 10 ml of double strength MacConkey broth with inverted Durham's tube. 1 ml and 0.1 ml of water from each sample were inoculated into set of 5 tubes each containing 5 ml single strength MacConkey broth with inverted Durham's tube. All tubes were incubated for 24 h at 37°C, after which production of gas in the Durham's tube were noted. The production of gas was considered as positive where as absence of gas production in 24 h was taken negative.

Confirmed test was applied to the presumptive positive tubes of two highest dilutions by streaking a loopful from each tube on a Eosin Methylene Blue Agar plate and the plate were incubated at 37°C for 24 h. The development of typical nucleated colonies with or without metallic sheen after 24 h incubation was taken positive.

Most Probable Number (MPN) of faecal streptococci

Most probable number of faecal streptococci was determined by five tubes, multiple tube fermentation technique. Tube of single strength and double strength bromocresol purple azide broth were incubated at 37°C for 48 h after inoculation with sample. Change in colour of broth from purple to yellow was taken as positive for the presence of faecal streptococci.

Confirmatory test was applied to the presumptive positive tubes of the two highest dilutions by transferring loopful of inoculum into Bile Esculin Agar, BHI broth and BHI broth with 6.5 % NaCl and simultaneously inoculation of BHI agar slants. BEA and BHI broth with 6.5% NaCl tube were incubated at 37°C for 24 h whereas BHI broth tubes were incubated at 45°C for 24 h. Brown colouration on BEA were noted as positive and in BHI broth and BHI broth with 6.5% NaCl turbidity were noted positive. The organisms so isolated on agar slants were studied for their morphology and biochemical reactions.

RESULTS

MPN of coliform

The mean values of coliform MPN/100ml of water ranged from 0 to 1800^{+}. Variations in MPN of coliform counts among different sources are reported in Table 1. Estimation of coliform in drinking water revealed that of 100 samples examined 47% samples had no coliform, while in 6% samples the number of organism ranged between 1 to 10, in 7% samples it ranged between 11 to 20, in 19% it ranged between 21 to 100 and in 21% samples it was above 100 coliform per 100 ml of water (Table 2).

MPN of faecal streptococci

The mean values of faecal streptococci (MPN/100ml) of water were between 0 to 120. Variations in faecal streptococci MPN count among different sources are reported in Table 1. Analyses of water samples for the presence of faecal streptococci revealed that out of 100 samples 80% did not show the presence of this group of organisms, whereas in 7% samples the number of organism ranged between 1 to 10, in 8% samples it ranged between 11 to 20, in 2% samples it ranged between 21 to 100 and in 3% samples it was above 100 faecal streptococci per 100ml of water (Table 2).

Statistical correlation between coliform and faecal streptococci were calculated. Further when these correlation were tested for significance it was found that Coliform and faecal streptococci were significant. The correlation was recorded (r=0.854) between coliform MPN/100 ml and faecal streptococcus MPN/100ml.

Table 1. Ranges and Mean values of microbiological quality indicator organisms

S.No.	Station/Place	Source	No. of samples examined	No. of samples giving presumptive test for coliforms	No. of samples giving presumptive test for faecal streptococci	MPN/ 100ml coliform	MPN/ 100ml faecal streptococci
1.	Hatia	Handpump	5	2	-	25-150(87.5)	-
		Well	3	3	1	8-110(59.3)	4
		Tap	2	1	-	8	-
2.	Doranda	Handpump	4	2	-	8-125(66.5)	-
		Well	2	1	-	10	-
		Tap	1	1	-	15	-
3.	Satellite colony	Handpump	4	-	-	-	-
		Well	3	3	1	50-250(143.3)	6
		Tap	2	2	1	13-30(21.5)	12
4.	Ratu road	Handpump	4	1	1	20	11
		Well	2	1	-	70	-
		Tap	2	1	-	25	-
		River	1	1	1	900	45
5.	HEC	Handpump	2	-	-	-	-
		Well	2	1	-	85	-
		Tap	2	1	-	8	-
		Ponds	2	2	2	120-900(510)	4-12(8)
6.	Main road	Handpump	3	1	-	15	-
		Well	1	1	-	95	4
		Tap	2	1	1	35	-
7.	Bariatu	Handpump	5	2	-	10-17(13.5)	-
		Well	3	2	1	95-300(197.5)	17
		Tap	1	-	-	-	-
8.	Namkum	Handpump	2	-	-	-	-
		Well	2	1	-	80	-
		Tap	1	-	-	-	-
		Ponds	1	1	1	425	11
		River	1	1	1	1800	120
9.	Kanke	Handpump	6	2	1	70-140(106.66)	8
		Well	3	2	1	40-115(77.5)	8
		Tap	2	1	-	11	-
		River	1	1	1	1600	115
10.	RVC	Handpump	3	2	-	80-150(115)	-
		Well	1	1	-	65	-
		Tap	1	1	-	14	-
		Ponds	3	3	3	95-1600(748.3)	50-115(78.3)
11.	Jamshedpur	Handpump	2	1	-	80	-
		Well	2	2	1	45-170(107.5)	9
		Tap	1	-	-	-	-
12.	Koderma	Handpump	4	1	-	200	-
		Well	3	3	2	50-130(96.6)	7-10(8.5)
		Tap	3	1	1	35	8

Table 2. Distribution of samples from each station on the basis of the number of organisms

S.No.	Station / Place	Source	No. of samples analyzed	Coliform MPN/100ml range and no. of samples confirming					Faecal streptococci MPN/100ml range and no. of samples confirming					SPC log_{10} cfu/ml range and no. of samples confirming		
				0	1-10	11-20	21-100	>100	0	1-10	11-20	21-100	>100	<4	4-5	>5
1.	Hatia	Handpump	5	3	-	-	1	1	5	-	-	-	-	4	1	-
		Well	3	-	1	-	1	1	2	-	1	-	-	1	2	-
		Tap	2	1	1	-	-	-	2	-	-	-	-	-	2	-
2.	Doranda	Handpump	4	2	1	-	-	1	4	-	-	-	-	3	1	-
		Well	2	1	1	-	-	-	2	-	-	-	-	2	-	-
		Tap	1	-	-	1	-	-	1	-	-	-	-	1	-	-
3.	Satellite colony	Handpump	4	4	-	-	-	-	4	-	-	-	-	3	1	-
		Well	3	-	-	-	1	2	2	1	-	-	-	2	1	-
		Tap	2	-	-	1	1	-	1	-	1	-	-	-	1	1
4.	Ratu road	Handpump	4	3	-	1	-	-	3	-	1	-	-	2	1	1
		Well	2	1	-	-	1	-	2	-	-	-	-	-	2	-
		Tap	2	1	-	-	1	-	2	-	-	-	-	2	-	-
		River	1	-	-	-	-	1	-	-	-	-	1	-	-	1
5.	HEC	Handpump	2	2	-	-	-	-	2	-	-	-	-	1	1	-
		Well	2	1	-	-	1	-	2	-	-	-	-	-	2	-
		Tap	2	1	1	-	-	-	2	-	-	-	-	1	1	-
		Ponds	2	-	-	-	-	2	-	1	1	-	-	-	1	1
6.	Main road	Handpump	3	2	-	-	1	-	3	-	-	-	-	2	-	1
		Well	1	-	-	-	1	-	1	1	-	-	-	1	-	-
		Tap	2	1	-	1	-	-	1	-	-	-	-	2	-	-
7.	Bariatu	Handpump	5	3	1	1	-	-	5	-	-	-	-	3	2	-
		Well	3	1	-	-	1	1	2	-	1	-	-	1	1	1
		Tap	1	1	-	-	-	-	1	-	-	-	-	-	1	-
8.	Namkum	Handpump	2	2	-	-	-	-	2	-	-	-	-	2	-	-
		Well	2	1	-	-	1	-	2	-	-	-	-	-	2	-
		Tap	1	1	-	-	-	-	1	-	-	-	-	1	-	-
		Ponds	1	-	-	-	-	1	-	-	1	-	-	-	-	1
		River	1	-	-	-	-	1	-	-	-	-	-	-	-	1

9.	Kanke	Handpump	6	4	-	-	1	1	5	1	-	-		3	2	1		
		Well	3	1	-	-	1	1	2	1	-	-	-	2	1	-		
		Tap	2	1	-	1	-	-	2	-	-	-	-	-	1	1		
		River	1	-	-	-	-	1	-	-	-	1	1	-	-	1		
10.	RVC	Handpump	3	1	-	-	1	1	3	-	-	-	-	1	2	-		
		Well	1	-	-	-	1	-	2	-	-	-	-	-	1	-		
		Tap	1	-	-	1	-	-	1	-	-	-	-	-	1	-		
		Ponds	3	-	-	-	1	2	-	-	1	1	1	-	-	3		
11.	Jamshedpur	Handpump	2	1	-	-	1	-	2	-	-	-	-	1	1	-		
		Well	2	1	-	-	-	1	-	1	-	-	-	-	1	1		
		Tap	1	1	-	-	-	-	1	-	-	-	-	-	1	-		
12.	Koderma	Handpump	4	3	-	-	-	1	4	-	-	-	-	3	1	-		
		Well	3	-	-	-	1	2	1	1	1	-	-	-	2	1		
		Tap	3	2	-	-	1	-	3	-	-	-	-	2	1	-		
		Total	100	47	6	7	19	21	80	7	8	2	3	46	38	16		

DISCUSSION

The bacteriological analysis of water was aimed at assessing its suitability for drinking and other domestic purposes and evaluating the efficacy of water treatment procedures. The water meant for human consumption should be free from pathogenic organism, faecal matter, suspended solid, algae, organic matter and harmful chemicals.

MPN of Coliform

These findings are in conformity with the observations of Gupta *et al.* (1978), Battu and Reddy (2009), Shittu *et al.* (2008) and Thakur and Grover (2001) who reported the MPN of coliform in water samples to be 1609, e"1500, 1600 to e" 1800 and e"1800, respectively. The findings are not in accordance with Gupta *et al.* (1984) and Singh *et al.* (1981) who reported the coliform ranging from 0 to >40 and 0 to 65 per 100 ml, respectively.

MPN of Faecal Streptococci

Almost similar findings were observed by Usharani *et al.* (2010) who reported 120/100 ml in river and ground water of Perur, India. The findings are not in accordance with Sayah *et al.* (2005) and Mishra *et al.* (2009) who reported lower value 15.2 and 93 per 100 ml, respectively. The present findings are not in line with Thakur *et al.* (2010) who reported higher number of MPN of faecal streptococci 220/100 ml.

Therefore, it was observed that faecal streptococci enumeration is of greater significance for assessing the sanitary quality of water as compared to the coliforms count, as significant positive correlation was found between enterococci and coliforms and that the coliforms could be derived from sources other than human or animal gut making them non specific indicator.

CONCLUSION

Results indicate higher bacterial contamination of water in ponds and rivers than tap, well and hand pump. Over all incidence of coliform (53%) and *faecal streptococci* (20%) in the water samples. The poor microbiological quality of drinking water samples revealed in this study is a matter of public health concern, warranting proper treatment before its release for public use.

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