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Bacterial assessment of ground water : A case study of Nanded city

M.P. Chitanand*[1], G. Gyananath[2] and H.S. Lade[2]

[1]Department of Microbiology, N. S. B. College Nanded - 431 601, India
[2]School of Life Sciences, Swami Ramanand Teerth Marathwada University, Nanded - 431 606, India

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Abstract: *Ground water is one of the main source of drinking water in Nanded city. City has witnessed a tremendous increase in population. This has lead to establishment of new colonies. A large section of residents live in the newly established crowded colonies under unhygienic conditions. The public bore wells, located in these areas are the main source of drinking water. The present study was carried out to monitor the suitability of raw ground water for safe drinking purposes and to investigate the status of these sites for bacterial contamination throughout the year. The results of this study revealed significant increase in the concentration of indicator organisms in all the samples during monsoon season. As a result the potability of ground water has become a severe concern in such localities of Nanded.*

Key words: *Indicator organisms, Water quality, Ground water*
PDF of full length paper is available with author ***(*janhavidigraskar@gmail.com)***

Introduction

Ground water is an important source of drinking water and much of the world's population depends on this important natural resource for human consumption. The quality and purity of ground water has direct effect on human health. The problem of ground water quality is more acute in areas that are densely populated (Gupta *et al.,* 2004; Prakash and Somashekar, 2006; Nair *et al.,* 2006). Lack of proper amenities in many housing societies and apartments has rendered the water unsafe for drinking as well as for domestic purpose. This has resulted in the contamination of ground water supplies with different bacteria including pathogens. There is a common misconception among people that groundwater is generally safe for human consumption. However, it is not correct to presume that ground water is generally safe owing to qualitative changes in ground water, especially in the high-density residential areas where sewage disposal practices are not proper (Blueford *et al.,* 1996; Anand *et al.,* 2006; Krishnan *et al.,* 2007).

Nanded is an important holy city of Marathwada region. The rapid development in city has resulted into the establishment of new housing societies in and around the city (Islam and Gyananath, 2002). Majority of the people of new housing colonies use ground water for domestic purpose. In this context, the present study was aimed to check the suitability of ground water for drinking purpose by considering various bacteriological parameters like total coliforms, fecal coliforms, fecal streptococci and presence or absence of *Salmonella.*

Indicator organisms are commonly used to assess the bacteriological quality of water. Fecal coliforms and fecal streptococci are the most commonly used bacterial indicators of fecal pollution. They are found in water that is contaminated with fecal wastes of human and animal origin. The ratio between fecal coliforms and fecal streptococci gives a fecal index, which indicates the origin of pollution (human, animal or mixed). Total coliforms comprise bacterial species of fecal origin as well as other bacterial groups commonly occurring in soil. The coliforms are indicative of general hygienic quality of the water and potential risk of infectious diseases from water. High FC and TC counts in water are also indicative of presence of enteropathogens in the water (Fatoki *et al.,* 2001). In view of this, the parameters selected will give the information about the quality of ground water.

Materials and Methods

Ten different localities of Nanded city were selected for collection of water samples (Fig. 1). Samples were collected from the areas where people are using ground water for drinking purpose. The method prescribed by APHA (2005), was used for collection of water samples. Ground water samples were collected in replicates from tube wells and hand pumps from each site during winter, summer and monsoon seasons in the period from October 2003 to September 2004. This was done with a view to obtain a comparable data in different seasons throughout the period of study. Samples from each site were assessed for total coliforms (TC) count, fecal coliforms (FC) count, fecal streptococci (FS) count and presence or absence of *Salmonella* (Edberg *et al.,* 1997).

All the samples were analysed for TC count by multiple fermentation tube method (APHA, 2005). Fecal coliforms count and fecal streptococci count was determined by inoculating tenfold serial dilution of water samples on turgitol-7 agar plates (Hi-media Pvt. Ltd.

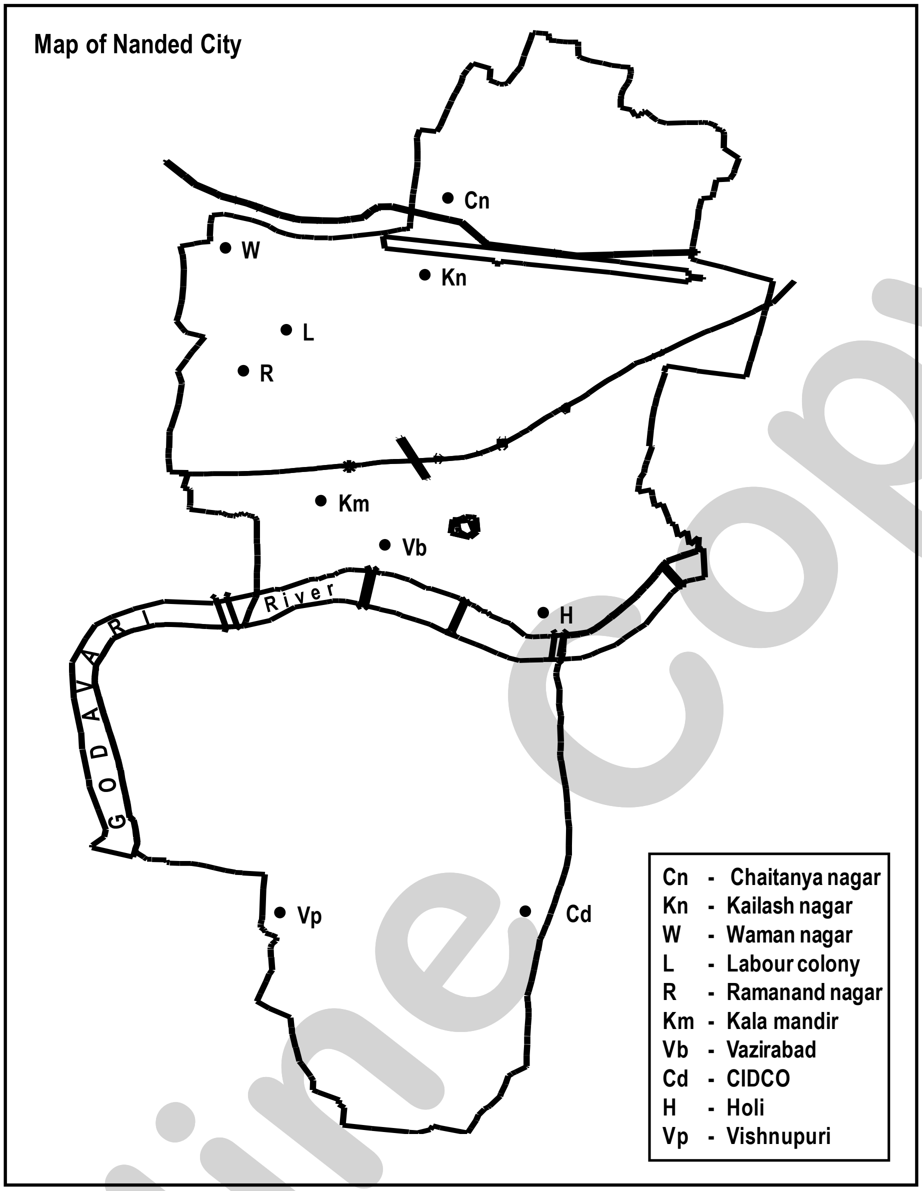

Fig. 1: Sites of sample collection

Mumbai) and KF - streptococci agar plates (Hi-media Pvt. Ltd. Mumbai) respectively (APHA, 2005). The plates were incubated at 37°C for 24 hr and the count per 100 ml was determined. Plates inoculated with standard *E. coli* and *Streptococcus fecalis* were kept as positive control (Vaidya *et al*., 2001; Adeleye and Adebiyi, 2003).

Presence or absence of *Salmonella* in the water samples was checked by enrichment in selenite broth and isolation and confirmation on Wilson - Blair and xylose lysine desoxycholate (XLD) agar plates (Polo *et al.,* 1998). Samples were analyzed for bacterial contamination.

Results and Discussion

The results of our studies in different seasons are depicted in Table 1. The bacterial contamination was highly concentrated at all sites. Among total ten sites tested all the samples showed TC and FC counts above the permissible limits in winter and monsoon seasons, as per WHO (1984). According to WHO guidelines TC, FC and FS counts should be zero in the water which is used for drinking purpose. In such circumstances, the present results indicate gross pollution of ground water. All the samples from all these sites were positive for fecal coliforms in these two seasons while fecal streptococci were detected in all

Table - 1: Concentration of indicator organisms per 100 ml and presence / absence (P/A) of *Salmonella* in different water samples collected in winter, summer and monsoon seasons

Site of sample collection	Winter					Summer					Monsoon				
	TC	FC	FS	FC:FS	P/A *Salmonella*	TC	FC	FS	FC:FS	P/A of *Salmonella*	TC	FC	FS	FC:FS	P/A of *Salmonella*
Chaitanya Nagar	550	126	84	1.50	+	57	22	9	2.44	-	1000	200	111	1.80	+
Kailash Nagar	35	28	19	1.47	-	11	5	2	2.50	-	46	35	20	1.75	-
Labour Colony	12	6	2	3.00	-	3	2	1	2.00	-	16	8	03	2.67	-
Ramanand Nagar	25	20	9	2.22	-	6	2	0	Nd	-	43	32	18	1.78	-
Waman Nagar	220	98	64	1.53	+	35	19	7	2.71	-	350	190	120	1.58	+
Kalamandir	14	3	0	Nd	-	0	0	0	Nd	-	9	5	2	2.50	-
Vazirabad	25	22	15	1.47	-	3	1	0	Nd	-	46	30	16	1.88	-
CIDCO	11	6	3	2.00	-	4	2	1	2.00	-	25	15	4	3.75	-
Holi area	4	3	0	Nd	-	0	0	0	Nd	-	9	6	3	2.00	-
Vishnupuri	35	26	17	1.53	-	14	3	0	Nd	-	49	35	24	1.46	-

Nd = Ratio not defined
\+ = Presence of *Salmonella*
\- = Absence of *Salmonella*

the samples in monsoon season and in 80% of the samples in winter season. The ratio of FC: FS *i.e.* fecal index at all sites was found in the range from 1.40 to 3.75 indicating a mixed type of pollution due to animal and human fecal contamination. Presence of *Salmonella* was observed only in those samples, which showed high densities of coliforms (Polo *et al.*, 1998), which were seen especially at Chaitanyanagar and Wamannagar sites.

Compared with winter and monsoon seasons, low counts of TC, FC and FS were found in samples collected in summer season. FS were detected in 50% of the total samples while TC and FC were present in 80% of the samples.

The comparative data in all three seasons depicted that there was a twofold to threefold increase in concentrations of all indicator organisms during monsoon season than winter season (Table 1). Higher densities of indicator organisms during monsoon season is attributed to poor filtering action of black cotton soil of Nanded region and more percolation as well as seepage of domestic sewage through the soil. On the contrary depletion in the ground water level and evaporation of domestic sewage due to intense heat of summer are two main factors contributing to very low number of indicator organisms in the samples collected in summer season (Table 1).

Further the data also revealed that the highest proportion of indicator organisms were found in samples at Chaitanyanagar and Wamannagar sites. When these sites were surveyed, it was found that sewage disposal practices like soak pits, pit latrines and septic tanks are in use in these areas. These colonies are newly established and hence municipal drainage facilities are not provided. Low bacterial counts were observed in the samples collected from Kalamandir, Labour Colony and Holi area where well established municipal drainage system was present.

Blueford *et al.* (1996) reported that the contamination of ground water in Pennsylvania and Maryland, USA is due to sewage disposal practices like pit latrine, septic tank and soakage pit system. US Geological survey (USGS, 2006) reported the presence of TC and FC in 30% wells in USA, tested under National Water Quality Assessment Programme. Proximity of contaminating surfaces and interaction with surface water are some of the factors, likely to control the presence and transport of coliform bacteria in ground water.

The present study revealed that most of the ground water samples in Nanded city have failed to meet the bacteriological quality parameters throughout the year. The maximum bacterial contamination was observed in the samples collected in monsoon season. Sewage disposal practices like soak pit system and septic tank near the bore wells are also contributing to increase in the bacterial contamination.

Thus the study reveals that raw ground water is not safe for human consumption. In order to meet the potability of ground water it is recommended that continuous, effective treatment combined with constant monitoring is essential to ensure that it meets the standards of drinking water.

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