PUBLISHED ON 29TH FEB 2012

STUDY ON DRINKING WATER QUALITY FROM SELECTED AREAS OF AHMEDABAD CITY, INDIA

M. B. SUTHAR AND A. R. MESARIYA

DEPARTMENT OF BIOLOGY, K. K. SHAH JARODWALA MANINAGAR SCIENCE COLLEGE, AHMEDABAD- 380008.

sutharmb@yahoo.co.in

ABSTRACT:

Water is a common element in the lives of all people and society. Present study is dealing with tap water quality of municipal and tube well sources, evaluated from 14 samples collected from 7 areas of Ahmedabad city. Ahmedabad is situated at 23.03^0 N and 72.58^0 E. There were eleven (11) drinking water samples from Municipal sources and three (3) drinking water samples from tube-well sources. In total hardness, almost all the samples were within highest desirable limits (HDL). In calcium hardness, most of samples were between highest desirable limits and maximum permissible limits. Magnesium hardness was having most of the samples above highest desirable limits or even crossing the maximum permissible limit. Chlorides and salinity showed tendency towards highest desirable limits. Electrical conductivity and Total Dissolved Solids (TDS) were increased than highest desirable limits or below the maximum permissible limits. All parameters have either positive or negative correlation as per Pearsons' correlation matrix. Classification of ground water based on total hardness indicates that most of the samples were within 150-300 mg/L *i.e.* hard water. Proper water treatment, especially for tube-well water is necessary.

KEY WORDS: Drinking water, Quality, Ahmedabad.

INTRODUCTION :

Water is essential for life. Water is needed in all aspects of our life like for drinking, for food production, for washing and for maintaining our health and dignity. Water is also required for producing many industrial products, for power generation and for transport of people and goods- all of which are important for the functioning of a modern, developed society. Water is essential for ensuring the integrity and sustainability of the Earth's ecosystems (WWDR, 2003).

Kapila and Mehta (2006) evaluated the ground water quality for drinking purpose with various physico-chemical parameters of Amalsad village in Gujarat. They found many parameters like total dissolved solids, total solids, total hardness, calcium hardness and magnesium hardness, pH etc. beyond the Gujarat Pollution Control Board (GPCB) permissible limits. Shelat et al. (2005)

analysed seasonal changes in various parameter of surface water in Bhavnagar. They found that most of the parameters studied were within the permissible limits of drinking water. They found high turbidity and most probable number (MNP) count of *E. coli* and *Enterobacter* in all samples. Vediya and Pandya (2003) correlated cadmium levels with physico-chemical parameters like electrical conductivity (EC), carbonates, bicarbonates, chloride, calcium and magnesium content in Modasa district. Chinoy et al. (2005) reported considerable fluoride content in ground water. Solanki (2007) found various parameters like turbidity, pH, sulphate, chloride, fluoride, calcium, magnesium, total hardness, nitrates etc. in higher amount in riverine water. pH did not show any appreciable changes during all the three seasons. Our previous studies (Suthar et al., 2008a-d; Suthar et al., 2010; Suthar et al., 2011; Suthar and Suthar, 2010) and Verma et al., (2008) showed that various areas of Ahmedabad City have poor drinking water quality. Hence, the present study was carried out as a part of continuous monitoring.

MATERIALS AND METHODS :

The present study is associated with water quality evaluated from 07 areas of Ahmedabad city of Gujarat state. Ahmedabad is the largest city in Gujarat state located on the bank of Sabarmati river. It is located at 23.03^0 N and 72.58^0 E. Total 14 water samples were collected from municipal and tube well sources in the morning and labeled appropriately.

They were from Amraiwadi (4), Maninagar (3), Jashodanagar (2), Rajkot (1), Hatkeshwar (1) and Vatva (1) areas. Sample were analysed for various physico-chemical characteristics by standard method in the college laboratory (Sunilkumar and Ravindranath, 1998). The colour, test and odour were reported by direct seeing, smelling and tasting the water sample before chemical analysis. The chemical parameters analyzed were total hardness (TH), calcium hardness (CH), magnesium hardness (MH), chlorinity (CHL), salinity (SAL), Electrical conductivity (EC), Total Dissolved Solids (TDS) and pH. The data were compared with Gujarat Pollution Control Board (GPCB) drinking water standard as per Kapila and Mehta (2006). These standards are same as IS: 10500 of Bureau of Indian Standard for parameters studied (Shankar and Balasubramanya, 2008). The data were analysed statistically by calculating mean, range (maximum and minimum value), correlation matrix and student's t-test.

RESULTS AND DISCUSSION :

Water is a common element in the lives of all peoples and society. Water has been the foundation of many great civilizations (Khandwala and Suthar, 2007; Suthar and Suthar, 2010). Today, it is essential for the agricultural, economic and industrial activity that helps societies to develop (Matsuura, 2003; Solanki, 2007).

Present study is dealing with tap water quality of municipal and tube well sources, evaluated from 14 samples collected from 7 areas of Ahmedabad city. There are eleven (11) drinking water samples from Municipal sources and three (3) drinking water samples from tube well sources (Table 1). All samples were colourless, odorless and not having any bad taste. In total hardness (TH) almost of all the samples were within highest desirable limits (HDL). In calcium hardness (CH), most of samples are within highest desirable limits and maximum permissible limits (MPL). Magnesium hardness (MH) was having most of the samples above highest desirable limits or even crossed maximum permissible limits. Chlorides (CHL) and salinity (SAL) showed tendency towards highest desirable limits. Electrical conductivity (EC) and Total Dissolved Solids increased than highest desirable limits or below the maximum permissible limits. pH was within the prescribed range (Table-1). Table-2 shows sample sourcewise list of parameters studied. It indicates higher amount of magnesium hardness and total dissolved solids in tube well sources compared to municipal sources. Table-3 shows Pearson's correlation matrix for physic-chemical parameters studied. It indicates that all parameters have significant co-relation with each other positively or negatively. Classification of ground water based on total hardness indicates that most of the samples were within 150-300 mg/L i.e.hard water (Table-4).

In developing nations, water samples are polluted mainly by industrial effluents and untreated sewage. In recent years, there were increased awareness about the pollution among Governments & scientists in most of the countries. Due to which, they have sought to initiate programmes for monitoring and abatement of pollution, especially the seepage of effluents in ground water (Sahayaraj et al., 2002). In the present study, all the samples are from eastern side of Ahmedabad having industrial activity. So, tubewell samples with high rise in magnesium and total dissolved solids might be due to industrial effluents.

In the recent past, calcium (Ca^{++}), Magnesium (Mg^{++}), iron (Fe^{++}), chloride (Cl^{-}) and fluoride (F^{-}) have been proved to be health hazardous, if present in excess in the drinking water (Sahayaraj et al.,2002; Gadhia et al., 2007). Joshi (2004) found higher amount of TDS, fluoride in bore-well water of Mahesana city. Prajapati and Rao (2004) found that sulphate, total iron and most probable number (MNP) counts of cauliforms in borewell water in Himmatnagar City. Vedia and Shah (2003) studied the ground water quality by various physico-chemical parameters of Modasa City and found water suitable for drinking purpose as per World Health Organisation (WHO) standards. In addition, the present findings of various physico-chemical parameters also correlates with results of our studies (Suthar et al., 2008 a-d; Suthar et al., 2011).

Hydrologically, water makes its way from the top of mountains to the sea. During this period, water can be used many times to alleviated thirst, sustain crops, facilitate industry, help to generate

electricity and to support the natural environment (Matsauura, 2003; Khandwala and Suthar, 2007).

CONCLUSION :

Water is an element with multiple uses. It links various activities and people together. For these reasons, it must be managed wisely through an integrated approach which takes care of all uses and users.

ACKNOWLEDGEMENTS :

Authors like to thank Dr. R. R. Shah, Principal, K. K. Shah Jarodwala Maninagar Science College, Ahmedabad and Management of J. L. Trust for providing opportunities and facilities for the present work. Authors are also thankful to Dr. K. V. Kanjariya, Dr. R. S. Patel, K. Y. Dave and H. C. Bhavsar of Biology Department for their encouragement. The sincere and voluntary help of SYBSc (CZ) students of batch 2010 for the collection and analysis of water sample is highly appreciated.

REFERENCES

Chinoy, N. J., Sequeria, E., Narayana, M. V., Mathews, M., Barot, W., Kandoi, P. R. and Jhala, D. D. 2005. A survey of fluoride in 90 endemic villages of Mehsana and Banaskantha districts of North Gujarat. India. *Fluoride*, 38(3): 224.

Gadhia, M., Gandhi, D. S., Tandel, R. and Mehta, Z. 2007. Impact of calcium hardness on hardness of breeding of an ornamental fish *Archocentrus nigrofasciatum*. In : Section : C Animal Sciences. Souvenir of National Seminar on New Horizons in Biological Sciences, 23rd Sept., 2007. NVPAS and GSBTM, Vallabhvidyanagar. Pg. 98.

Joshi, S.D. 2004. Chemical evaluation of borewell water of various places in and around Mehsana. *Advances in Biological Sciences,* 3 : 85-87.

Kapila, M. and Mehta, N. M. 2006. Evaluation of ground water quality of Amalsad village used as drinking water. *International Journal of Bioscience Reporter,* 4(1) : 127-131.

Khandwala, R. V. and Suthar, M. B. 2007. Concept of 'APAH' in Indian Vedic literature- A Comparative study. *International Journal of Bioscience Reporter,* 5 (1) : 1-6.

Matsuura, K. 2003. Water for People Water for Life. The United Nations World Water Development Report, UNESCO.

Prajapati, J. R. and Raol, B. V. 2004. Studies on ground water quality of Himatnagar City, Dist. Sabarkantha, Gujarat, India. *Advances in Biological Sciences,* 3: 63-66.

Sahayaraj, A. P., Arulsamy, K. S. and Senthil, S. K. 2002. Chapter 14. A study on the physico-chemical parameters of the canal water in Trichy. In : Ecology of Polluted Water. Vol. 1 & 2. (Ed. Arvind Kumar). APH Publi. Co., New Delhi. Pp. 151-157.

Shankar, B. S. and Balasubramanya, N. 2008. Evaluation of quality indices for the ground waters of an industrial area in Bangalore, India. *Nature Environment and Pollution Technology,* 7(4) : 663-666.

Shelat, Y. A., Oza, F. B. and Pandit, B. R. 2005. Physicochemical and bacteriological studies of surface water in Bhavnagar region. *International Journal of Bioscience Reporter,* 3 : 266-269.

Solanki, H. A. 2007. Ecological studies of phytoplanktons of Mini Mahi River, Gujarat. India. Vidya, 2(1) : 47-57.

Sunilkumar, M. and Ravindranath, S. 1998. Water Studies : Methods for Monitoring Water Quality. Centre for Environment Education (CEE), Ahmedabad.

Suthar, M. B. and Suthar, T. M. 2010. Status of Ground water quality in urban environment in India during last two decades. *Bioscience Guardian,* 1(1) : 1-23.

Suthar, M. B., Mesariya, A. R. and Prajapati, K. R. 2011. Physico-chemical properties of the drinking water in Ahmedabad City of Gujarat, *Electronic Journal of Environmental Sciences,* 4: 39-45.

Suthar, M. B., Mesariya, A. R. and Ravat, N. M. 2008a. Analysis of water quality from Ahmedabad city (Gujarat) using chemical parameters. *Indian Journal of Environment and Ecoplanning,* 15(1): 171-176.

Suthar, M. B., Mesariya, A. R. and Ravat, N. M. 2008b. Study on drinking water quality from some areas of Ahmedabad city of Gujarat. *Electronic Journal of Environmental Sciences,* 1: 23-27.

Suthar, M. B., Mesariya, A. R., Kanjariya, K. V. and Ravat, N. M. 2008c. Evaluation of drinking water quality of some areas of Ahmedabad city (Gujarat) in the year 2007. *Bulletin on Environmental Science,* 26(1): 51-56.

Suthar, M. B., Mesariya, A. R., Ravat, N. M. and Kalola, S. K. 2008d. The status of drinking water quality from eastern areas of Ahmedabad city, Gujarat. International Journal of Bioscience Reporter, 6(1): 55-59.

Suthar, M. B., Ravat, N. M., Mesariya, A. R. and Kanjariya, K. V. 2010. Alterations in physicochemical characteristics of drinking water collected from some areas of Ahmedabad city. *Nature Environmental and Pollution Technology,* 9(2) : 399-408.

Vedia, S. D. and Shah, P. K. 2003. Physicochemical characteristics of ground water of Modasa town of Sabarkantha district, *Gujarat. Advances in Biological Sciences,* 2: 68-69.

Vediya, S. and Pandya, R. 2003. A Study on Cadmium levels in water samples collected from in and around Modasa, *North Gujarat, India. Current Biosciences,* 1 (3-4): 230-233.

Vennila, G., Subramani, T. and Elango, L. 2008. GIS based ground water quality assessment of Vattamalaikarai basin, Tamil Nadu, India. *Nature Environment Pollution Technology,* 7(4) : 585-592.

Verma, P., Chauhan, D. Karlikar, B., and Solanki, H. 2008. Physico-chemical characteristics of ground water of Satellite area of Ahmedabad city, Gujarat, India. In : Abstract cum Souvenir. Environmental Chemistry Section. State Level Seminar on 'Current Trends in Environmental Sciences' Organised by NVPAS, VV Nagar, 20th September, 2008. Pg. 42.

WWDR, 2003. First UN World Water Development Report : Water for People Water for Life. Part 1. English Version (www.unesco.org / water / wwap / wwdr / wwdr1 / pdf / chap1.pdf).

Table-1 Physico-chemical parameters of water samples collected from different areas of Ahmedabad City.

No.	TH	CH	MH	CHL	SAL	EC	TDS	PH
1	152	76	76	228	411	0.38	266	6.86
2	300	104	196	292	527	1.09	763	7.39
3	464	284	180	448	808	1.22	854	6.56
4	188	148	40	548	989	1.07	749	7.2
5	172	100	72	220	397	0.73	511	6.58
6	176	96	80	192	346	0.59	413	7.33
7	180	96	84	80	144	1.66	1162	7.33
8	140	72	68	180	325	0.25	175	7.02
9	144	64	80	176	318	0.54	378	7.1
10	160	100	60	80	144	0.22	154	6.9
11	160	120	40	68	123	1.67	1169	6.75
12	300	104	196	292	527	1.02	714	6.74
13	300	140	160	260	469	1.47	1029	7.14
14	256	72	184	68	123	2.00	1400	6.82
Within HDL	13	03	00	09	10	05	05	
Between HDL and MPL	01	10	09	05	04	09	09	
Above MPL	00	01	05	00	00	00	00	
Total Sample	14	14	14	14	14	14	14	
HDL	300	75$	30$	250$	450#	0.70#	500$	
MPL	600	200$	90$	1000$	1800#	2.86#	2000$	

Units of measurements: TH (as $CaCO_3$) mg/L; CH (as Ca) mg/L; MH (as Mg) mg/L; CHL(as Cl) mg/L; SAL g/l; EC mS/ml; TDS ppm. pH (6.5 to 8.5).

Abbreviation HDL=Highest Desirable Limit, MPL = Maximum Permissible Limit, TH = Total Hardness; CH = Calcium Hardness; MH= Magnesium Hardness; CHL= Chlorinity; SAL= Salinity; EC= Electrical Conductivity; TDS= Total Dissolved Solids Min= Minimum; Max= Maximum; AVG= Average/Mean

The samples were collected and analysed in the year 2010.

$ as per Gujarat Pollution Control Board standards.

No GPCB Standards available but calculated values.

Table 2. Sample sourcewise list of physico-chemical parameters studied

	TH	CH	MH	CHL	SAL	EC	TDS	PH
Municipal	203±29.15 (140-464)	115±18.3 (64-284)	89±15.5 (40-196)	228±45.8 (68-548)	412±82.63 (123-989)	0.90±0.157 (0.22-1.67)	599.5±110 (154-1169)	7.0±0.08 (6.56-7.39)
Tubewell	285±14.67 (256-300)	105±19.6 (72-140)	283±14.3* (254-297)	207±69.9 (68-292)	373±126.2 (123-527)	1±0.283 (1.02-2.00)	1048±198* (714-1400)	6.9±0.12 (6.74-7.14)
Total	221±24.7 (140-464)	113±14.7 (64-284)	108±16 (40-297)	224±37.8 (68-548)	404±123 (123-989)	0.99±0.15 (0.22-2.00)	696±106 (154-1400)	6.98±0.0 (6.86-7.39)

Values are Mean ± SEM. Values in parenthesis represents range having minimum and maximum value for each parameter studied. Students t-test*P<0.05 ** P< 0.01***P<0.001
Abbreviation TH = Total Hardness; CH = Calcium Hardness; MH= Magnesium Hardness; CHL= Chlorinity; SAL= Salinity; EC= Electrical Conductivity; TDS= Total Dissolved Solids

Table 3. Pearsons' correlation matrix for physico-chemical parameter studied

	TH	CH	MH	CHL	SAL	EC	TDS	PH
TH	1							
CH	O.783***	1						
MH	O.820***	0.287	1					
CHL	0.498*	0.627*	0.191**	1				
SAL	0.498*	0.626***	0.191***	0.999*	1			
EC	0.415***	0.249***	0.410***	-0.077***	-0.076***	1		
TDS	0.415***	0.249***	0.410***	-0.077***	-0.076*	1.000***	1	
PH	-0.255***	-0.325***	-0.090***	-0.002***	-0.002***	-0.018***	-0.018***	1

**Correlation is significant at the 0.05 level (2-tailed)*
*** correlation is significant at the 0.01 level (2-tiled)*
****correlation is significant at the 0.001 level (2- tailed)*
Abbreviation TH = Total Hardness; CH = Calcium Hardness; MH= Magnesium Hardness; CHL= Chlorinity; SAL= Salinity; EC= Electrical Conductivity; TDS= Total Dissolved Solids

Table 4. Classification of groundwater based on total hardness

Total hardness as $CaCO_3$ (mg\l)	Water class	Number of samples i present study	Percentage (%)
Less than 75	Soft water	00	0.00
Between 75-150	Moderately hard wate	03	21.43
Between 150-300	Hard water	10	71.42
Above 300	Very hard water	01	7.14
Total		14	100

The classification is as given in Vennila et al., (2008); units of measurement for total hardness (as $CaCO_3$) mg/L.