Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. 4**(ISC-2014),** 313-316 **(2015)** *Res. J. Recent. Sci.*

Analysis of Quality of Drinking Water of Private Bore-well and Piped water Supply in Jaipur city, Rajasthan, India

Namita Soni and Anju Bhatia
Department of Home Science, University of Rajasthan, Jaipur, INDIA

Available online at: www.isca.in, www.isca.me
Received 18th July 2014, revised 11th March 2015, accepted 9th May 2015

Abstract

The study aims to find out the quality of drinking water at household level in Jaipur city of Rajasthan. In, Jaipur the main source of water supply is ground water. It is either supplied by the piped line by the Public Health and Engineering Department (PHED) or the households have their own personal bore-wells at their premises. For the study, 20 samples were collected from 10 randomly selected wards; one each from bore-well and piped water supply. Samples of water were collected from households for physic-chemical and E-coli analysis. The quality of water was compared with Bureau of Indian Standards (BIS) norms of potable water. Results revealed that water samples did not fully meet the BIS norms of potable water. The samples of bore-wells were worse in quality than piped water supply. Fluoride and nitrates were found in private bore-well samples. Drinking water was contaminated with E-coli in both types of sources. The study concluded that in order to get quality of potable water at household level, water treatment is necessary.

Keyword: Drinking water, Quality of water, Quality parameter, Household level, PHED, Bore-well supply.

Introduction

Water is one of the nature's most important gifts to mankind. It is an essential element for survival of human being. One can survive for a month without food but cannot survive a few days in the absence of water. Quality of drinking water is important to be studied when the overall focus is sustainable development keeping human being at focal point[1]. The quality of water is of significant importance in any water supply planning, especially for drinking purpose. The physical-chemical characteristics of water determine its usefulness for municipal, commercial, industrial, agricultural and domestic purpose. The solutions are usually very expensive, time consuming and not always effective. Water quality is slowly but surely decreasing everywhere. Jaipur city is capital of Rajasthan and situated in semi arid zone (Longitude: 95 24' E; Latitude: 27 18' N). The water used for drinking purpose should be free from any harmful elements, living and nonliving organisms and excessive amount of minerals that may be hazardous to health. Major problems in quality of water are difficult to detect and hard to resolve. Urbanization and population growth has led to immense pressure on water resources of the city and has resulted in deterioration of quality of water in the Jaipur city[2]. Therefore a study is designed to assess quality of water in Jaipur city, Rajasthan.

Methodology

For the study, 20 drinking water samples 10 from piped water supply and 10 from private bore-well supply from 10 different areas (Murlipura, Jhotwara Urban Area, Panipech, Johari Bajar, Ramgarh Mod, Malviya Nagar, Shyam Nagar, Chandpol, Galta Gate, Jawahar Nagar and C-Scheme) of the city were collected for the analysis by systematic random sampling method. The drinking water samples were collected in pre-cleaned plastic bottles and sent to PHED laboratory for quality analysis on the following parameters: pH, Total Dissolved Solids, Fluoride, Nitrate, Turbidity, Total alkalinity, Total hardness, Calcium, Chloride and Sulphate.

Results and Discussion

The study throws light on quality of drinking water supplied either by PHED or private bore-wells. Prominently supply of water was through ground water in city area, Bisalpur Jaipur Project is the only source of surface water and its supply is available for a few wards of Jaipur city. Maximum residents use municipality water for domestic and drinking purposes.

Results revealed that 60 per cent samples of the city were not potable and quality of water supplied through piped water supply were better than quality of water of private bore-well. According to a study[2] ground water quality of Jaipur city is under permissible limit whereas the present study reveals that the quality of water is found beyond permissible limit in 7 areas. The quality of drinking water at different parameters is incorporated in table 1. and discussed below:

pH: Generally, geology of catchments area and buffering capacity of the water influences pH of water. As shown in table 1 pH value is varying from 6.6 -9.5 in 10 area and was under permissible limit which is 8.5. But in two area pH level was found to be higher than recommendation of B.I.S. standard. One

sample from piped water and one bore-well sample slightly alkaline in nature remaining were under permissible limit.

Turbidity: Suspended matter, such as clay, silt, finely divided organic and inorganic matter causes turbidity in water. It was observed that turbidity was found in only one sample in Galta Gate area from bore well supply. Remaining collected samples were free from turbidity and under permissible limit.

Total Hardness: Hard water is not suitable for domestic use such as washing and laundering. In the present study total hardness is varying from 70- 650 mg/L and it is clear from the laboratory testing that in 2 samples from piped water supply total hardness was found beyond the permissible limit of 600 mg/l recommended by B.I.S. Calcium and magnesium contents are the main cause of total hardness in drinking water. Hard water is harmful upon the health of consumer. Use of hard water increases capacity of soap consumption in home, laundries and textile[3].

Total Dissolved Solids (TDS): TDS is an important indicator of overall water quality. It is a measure of inorganic and organic materials dissolved in water. High TDS concentration may cause a bad odour or taste to drinking water, as well as cause scaling of pipes and corrosion. TDS reduces the potability of water for drinking purposes in

The total dissolved solids in water are represented by the weight of residue left after evaporated water. Results show that TDS varies from 376- 2180 mg/l. It is depicted that 8 bore well samples were under permissible limit of 500-1500 mg/l, but Murlipura, and Malviya nagar areas were affected with the problem of TDS in drinking water. Whereas all piped water samples had not higher concentration of TDS.

Fluoride: Highest fluoride content was found in Joshi Marg, Panipech,Malviya Nagar and Galtagate area in bore well samples. Fluoride was at alarming rate in Joshi Marg at 3.6 mg/lits of fluoride was assessed. Piped water samples were under permissible limit and had no high concentration of fluoride. Piper water Samples were free from fluoride concentration. The Permissible limit of fluoride concentration is 1.5 mg/l according to B.I.S. Similar findings were observed in a study that near Jhotwara fluoride content was higher than permissible limit and high fluoride content was seen in hard water[4]. The presence of fluoride in ground water may be attributed to the localized effects of natural sources. Fluorine is widely distributed in nature and is a normal constituent of bones. Excessive fluorine intake leads to a decay of teeth and bones and fluorosis. Small dose of fluoride less than 1mg/l in drinking water reduces the incidence of dental carries when the maximum levels exceeds 1.5mg/l causing major health hazards. At the same time a concentration of fluoride less than 0.8mg/l results in dental caries. Hence it is essential to maintain the fluoride ion concentration between 0.8 to 1.0 mg/l in drinking water[5].

Calcium: Calcium concentration was varied from 25- 460mg/l. All samples were under permissible limit but one bore well samples had calcium concentration higher than permissible limit (200 mg/l). Due to calcium hardness of water increases.

Sulphate: The analysis shows that sulphate concentration in water was varying from 4- 130 mg/l. All samples were under permissible limit of 200 mg/l prescribed by BIS similarly [2] result was found in a study that in Jaipur city sulphate concentration in under permissible limit**.** The primary health concern regarding sulphate is the cause of catharsis and gastrointestinal irritation.

Nitrate: Nitrate content in drinking water is considered harmful due to its adverse health problems. The occurrence of high levels of nitrate in ground water is a prominent problem in many parts of the country. Water samples were also assessed for nitrate concentration and it is revealed that in 4 areas nitrate was higher than permissible limit of 45 mg/l in bore-well water. In higher concentrations, nitrate may produce a disease known as methaemoglobinaemia (blue babies) which generally affects bottle-fed infants. Repeated heavy doses of nitrates on ingestion may also cause carcinogenic diseases. It was found that 2 piped water samples were beyond permissible limit.

Total alkalinity: The total alkalinity is ranged from 80 to 660 mg/l in study area. High alkalinity of water is recorded in Galta Gate (600 mg/l) and Ramgarh Mod (645mg/l)area in bore-well water, whereas in piped water high alkalinity was found in Ramgarh mode. It is clear from the results that in this area bore-well and piped water both supplies were contaminated in Ramgarhmode area. The Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of carbonates, bicarbonates and hydroxides compounds of Ca^{2+}, Mg^{2+} and Na+ [6].

Chloride: Excessive intake of chloride in drinking water tends to increase the asthmatic pressure of extra cellular fluid, this is closely related to the sensation of thirst, thus the regulation of the body fluids & electrolytes is achieved by the kidney and it is harmful for kidneys. Chloride in the form of chloride ion is one of the major inorganic ions in water. Unusual concentration may indicate pollution by organic waster[2]. All water samples had chloride falling under permissible limit (200-1000mg/l) of bore-well supply but only one area had high chloride content.

E-coli: It is evident from the table 1 that micro-organism were present in water in 3 samples of urban area rest drinking water samples were free from microbial growth. The microbial contamination in water is always presented more if water is not stored properly. It was observed that where E-coli were found the storage area was not properly cleaned and a glass without handle was used to take out water from the vessel. The vessel by which water was collected from source to house was not being cleaned before the collection of water. The water may contaminate during collection of water from contaminated

source or from safe source because of contaminated and unwashed hands[7]. Due to poor maintenance of water supply network microbe may entered the pipeline and contaminate water during its lateral travel towards consumer point area[8].

A century of industrialization and technical development has brought rapid growth in urbanization and increase in population. The urbanization pattern in the larger cities is growing at much faster rate. Due to this phenomenon ground water is over exploited and quality of drinking water is decreasing in the areas where no other water sources are available. Quality of water has great concern in present century. So an attempt was made to compare the quality of water with the standards of B.I.S. Table two shows Number of areas having high concentration of different parameters.

As far as quality of water is concerned it was found that fluoride and nitrate in drinking water were beyond permissible limit in bore well and it is hazardous for human health. Different organizations' standards of physical chemical parameters of drinking water are shown in table-2. According to this table quality of drinking water was compared with these standards and it is concluded that in C-Scheme, Joshi Marg, Johari Bazar, Panipech, Ramgarh Mode, Malviya Nagar and Galta Gate areas fluoride, nitrate, were beyond permissible limit and quality of water was found not potable. These chemicals are hazardous for human and causes of adverse effect on health. Methods are usually practiced at domestic level viz. straining, boiling was not enough to remove these harmful chemicals. Some methods are suggested here for purification of water so at domestic level fluoride and nitrate can be removed.

Table-1
Area wise quality of drinking water supply N=20

S. No.	Ph 6.5-8.5	Turbidity 5-10 NTU	Total alkalinity 200-600 mg/l	Total hardness 300-600 mh /l	Calcium 75-200 mg/l	Sulphate 200-400 mg/l	Chloride 250-1000 mg/l	Nitrates 45 mg/l- No relaxation	TDS 500-2000 mg/l	Fluoride 1-1.5 mg/l	E-coli
B1.	6.7	Nil	80	90	30	4	30	10	2136	0.8	P
B2.	9.1	Nil	100	70	40	18	51	50	785	0.9	A
B3.	7.7	Nil	240	40	20	36	86	135	1050	3.80	A
B4.	6.9	Nil	90	160	60	40	89	35	216	1.8	A
B5.	9.5	Nil	660	53	30	104	102	90	126	1.3	A
B6.	8.3	Nil	90	185	70	70	54	40	2200	1.91	P
B7.	7.8	Nil	120	170	65	8	32	24	154	0.97	A
B8.	6.6	Nil	45	179	40	22	30	25	505	0.90	A
B9.	7.1	Nil	645	180	25	12	60	46	450	1.90	A
B10.	6.9	Nil	125	70	70	35	110	35	300	1.04	A
P1.	7.6	Nil	190	160	80	132	90	30	502	0.9	A
P2.	7.2	Nil	230	120	58	32	60	15	1123	0.8	A
P3.	7.1	Nil	270	590	180	20	50	40	180	1.0	A
P4.	7.8	Nil	120	170	60	8	106	24	173	0.79	A
P5.	8.3	7	600	630	40	37	610	77	386	0.86	A
P6.	7.1	Nil	110	280	45	18	80	40	80	.83	A
P7.	6.9	Nil	30	120	41	11	12	12	120	.80	A
P8.	8.0	Nil	50	580	30	35	179	18	147	0.81	P
P9.	6.9	Nil	70	210	45	61	81	45	119	0.96	A
P10.	7.9	Nil	50	650	210	13	160	80	105	0.70	A

B=Bore-well samples, P=Piped water samples, Samples beyond permissible limit, BIS norms
Areas: 1.Murlipura 2.C-Scheme 3. Johari Bajar 4. Panipech, 5. Ramgarh Mod 6. .Malviya Nagar 7.Shyam Nagar 8. Chandpol, 9.Galta Gate 10.Jawahar Nagar

Table-2
BIS standards of quality of water N=20

S. No.	Parameters	Permissible limits BIS:2012	No. of areas having beyond permissible limit of quality of water	
			B	P
1.	pH	6.5-8.5	2	0
2.	Total dissolved solids (mg/L)	2000	1	1
3.	Fluoride (mg/L)	1.5	4	0
4.	Total hardness (mg/L)	600	0	2
5.	Total alkalinity (mg/L)	600	2	1
6.	Chloride (mg/L)	1000	0	1
7.	Sulphate (mg/L)	400	0	0
8.	Nitrate (mg/L)	45	4	0
9.	Turbidity (NTU)	10	0	1
10.	Calcium (mg/L)	200	0	1

Table-3 describes comparison of quality of drinking water supplied by piped water supply by PHED and private bore well. It is clearly seen that 7 water samples were potable from piped water supply whereas only 3 private bore well samples were potable and remaining were not potable as they had more contamination in water and used directly without treating. So it can be revealed that piped water supply was more reliable and resilience because piped water was supplied after treatment the sample households. In 3 areas piped water supply was not found potable, because of broken pipelines. Bacteriological contamination in the form of E-coli was present in some samples in both sources. It may occur during faulty collection practices and poor storage conditions of water. The possibility of contamination of water supply by sewage discharges which come in contact with supplied water due to leakages in pipes [7]. Quality is directly related with storage practices and conditions and mainly contamination can be taken place due to poor storage practices.

Table-3
Comparison of bore well and piped water supply at domestic level N=20

S. No.	Source	PHED supply N=10	Private bore wells % N=10	Total	
				N	%
1.	Potable	7	3	10	50
2.	Not potable	3	7	10	50
	Total	100	100	20	100

Conclusion

The chief water supply was from ground water and due to over extraction quality of ground water was getting deteriorated. Quality of drinking water is of paramount importance for sustainable quality living. More than one third samples of water could not meet the BIS standards of potable water. The study found that piped water supplied by PHED was less polluted than water fetched from wells bored privately at their premises. Sensitization and education of households regarding the health hazards of polluted water is, therefore, necessary. Further, water treatment is required to be carried out at household level to get safe drinking water.

References

1. Sabal D., Ashutosh and Khan T.I., Ground Water Fluoride Content and Water Quality in Amber Tehsil of Jaipur District, *The Ecoscan*, **2(2),** 265-267 **(2008)**

2. Tatawat R.K. and Chandel Singh C.P., Quality of Ground Water of Jaipur City, Rajasthan (India) and Its Sustainability for Domestic and Irrigation Purpose, *App. Eco and Env. Res.,* **6(2),** 79-88 **(2008)**

3. De A.K., Environment chemistry (III edu.), New Delhi **(1994)**

4. Saini Y., Bhardwaj N. and Gautam R., Physical-Chemical Analysis of Ground Water of Jhotwara Panchayat Smiti, Jaipur (Rajasthan), The Eco-scan **4(1),** 137-139 **(2010)**

5. Tambekar P., Morey P., Batra R.J. and Weginwar R.G., Quality Assessment of Drinking Water: A Case Study of Chandrapur District (M.S.), *J. of Chem. and Pha. Res,* **4(5),** 2564-2570 **(2012)**

6. Pagariya S.K., Analysis of Water Quality Using Physico-Chemical Parameters of Kolura Pond in Post- Monsoon Season, October 2012*, Inte. J. of Chem. and Phys. Sci.,* **1(2),** 48-53, **(2012)**

7. Bhatnagar N., Kulshrestha S. and Bhatnagar P., Microbiological Analysis of Chlorinated Water Supply in Jaipur, *Universal J of Env Res and Tech,* **2(2),** 65-71 **(2012)**

8. Drinking Water Standards., Bureau of Indian Standard, second Revision of IS 10500 **(2004)**

9. Groundwater Quality Series Status of Groundwater Quality in India Part – I, Central Pollution Control Board (Ministry Of Environment and Forests) (10/2007-2008) **(2008)**