Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. **1(6),** 62-65, June **(2012)** *Res.J.Recent Sci.*

Short Communication

Physico-Chemical and Microbiological Analysis of Underground Water in and Around Gwalior City, MP, India

Parihar S.S.[1]*, Kumar Ajit[2], Kumar Ajay[1], Gupta R.N.[1], Pathak Manoj[1], Shrivastav Archana[3] and Pandey A.C.[4]
[1]Department of life sciences, ITM University Gwalior, MP, INDIA
[2]Centre for Biotechnology, MD University, Rohtak, Haryana, INDIA
[3]College of life sciences (CHRI), Gwalior, MP, INDIA
[4]Department of P.G. Studies and Research Chemistry, Govt. S.L.P. College, Gwalior, MP, INDIA

Available online at: www.isca.in
(Received 13th March 2012, revised 27th March 2012, accepted 29th March 2012)

Abstract

In the present study, physico-chemical and microbiological characteristics of the drinking water, were determined in July 2009 from different location in Gwalior region, M.P., India. Total 16 water samples were collected from different locations in and around Gwalior city. Electrical conductivity, total dissolved solids, total aerobic microbial count and most probable number were maximum in S-3 sample. pH, hardness and DO were observed higher in S-6, S-8, S-10 samples. Enteric pathogen E. coli and Enterobacter were found in samples viz S-5, S-11 and S 1-4, S-10, S-12-13 respectively. No coliforms were observed in samples S-6-9 and S-14-16. The physico-chemical and microbiological characteristics of different water samples showed that maximum samples were not suitable for drinking purpose.

Keywords: Ground water, water quality, coliforms, physico-chemical parameters.

Introduction

Ground Water is the major source of drinking water in both urban and rural areas. The importance of ground water for the existence of human society can not be over emphasized. Ground water crisis is not the result of natural factors. It has been caused by human action much of ill health which effects humanity, especially in the developing countries can be traced to lake of safe and whole some water supply[1]. Prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health problems[2]. Water of good drinking quality of basic importance to human physiology of man's continued existence depends very much on its availability[3]. Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consummation, transportation and waste disposal[4-6]. Water quality means the physical, chemical and biological characteristics of water[7]. Our dependence on fresh water resources has acceralated in last century due to rapid growth in world population and economic development[8]. This has resulted in increasing numbers of cases of water borne diseases and other health hazards[9]. Ground water contains high amount of various ions, salts etc. so if we were using such type of water as potable water then it leads to various water-borne diseases[10]. Unsafe drinking water contributed to numerous health problems in developing countries such as the one billion or more incidents of diarrhea that occur annually[11].

According to world health organization (WHO), there were estimated 4 billion cases of diarrhaea and 2.2 million deaths annually. The consumption of unsafe water has been implicated as one of the major causes of this disease most gradual deterioration of water quality was resulted by the increase in human population and urbanization[12]. Water is the most basic and vital resource of our planet. According to the United Nation Report consumable water level are up to 2-7% of the total water content. 1% of the ground water level is threatened either directly or indirectly by pollution[13]. Non pathogenic faecal organisms are best indicators of faecal pollution. However in all cases faecal coliform contents and *E.coli* is used as the major tool in the assessment of the health risk borne by pathogen in water[14].

Therefore, it has become necessary to monitor water quality to observe the demand and pollution level of ground water. Several water analyses have been regularly conducted by different scientific groups across the country. The present work is a primary attempt to examine the water quality of various potable water resources in and around Gwalior city of M.P., India.

Material and Methods

Sample Collection: Total 16 water samples were collected in July 2009, from different locations (Rairu, Jaura, Noorabad, Madhavpura, Banmore, Gole ka Mandir, Thatipur, C.P. Colony, K.S.Oils Ltd, Birla Nagar, Shinde Ki Chawani, Railway Station (Morena), Maharajpura, Pintoo Park and Guda Gudi Ka Naka) in Gwalior, MP, India, (table-1). All the samples were collected in sterilized bottles and were stored at 4°C till further investigation.

Physico-chemical and Microbiological Parameters: The collected water sample were analyzed for various physico-chemical and microbiological parameters. The procedure for analysis was followed as per standard methods of analysis of water and wastewater[15]. The parameters analyzed were temperature, pH, conductivity, hardness, total dissolved solids (TDS) and dissolved oxygen. Total aerobic microbial count (TAMC), most probable number (MPN) of coliform bacteria and IMViC test for differentiation in coliform bacteria were also determined in collected sixteen water samples.

Chemical Reagents: All the chemicals and reagents used for the study were of analytical grade and instruments were of limit of precise accuracy.

Results and Discussion

The examined physico-chemical and microbiological parameters showed considerable variations in different samples. The observations are depicted in table-2.

Temperature: The temperature was found in the range of 28-31^{o}C in month of July. The variation in the water temperature may be due to different timing of collection and influence of season[16]. Water temperature varies with changing climatic condition. Hutchinson[17] stated that temperature is important in controlling both the quality and quantity of plankton flora.

pH: pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water. Any alteration in water pH is accompanied by the change in other physic-chemical parameters[18]. pH maintenance (buffering capacity) is one of the most important attributes of any aquatic system since all the biochemical activities depend on pH of the surrounding water. It was concluded that the pH of water were slightly alkaline (7.5 to 8.7) and were within the maximum limit set for domestic use as per APHA. High value of pH may results due to waste discharge, microbial decomposition of organic matter in the water body[19]. The high pH in this case may be attributed to sewage discharge by surrounding human population.

Conductivity: Electrical conductivity is a measure of water capability to transmit electric current and also it is a tool to assess the purity of water. Electrical conductivity found in the range 1504 – 3660 mho/cm. One of the reason of salinity is the high concentration of cations such as sodium, calcium and magnesium whereas chloride, phosphate and nitrate as anions[20] and further it is noted that the electrical conductivity is higher in the month of July.

Hardness: Hardness is an important parameter in decreasing the toxic effect of poisonous element. The hardness was found to be in the range of 152 – 332 mg/lit. It is within desirable limit. The hardness of water increases in the polluted waters by the deposition of calcium and magnesium salts[21].

TDS: The most remarkable observation of investigation was the alarmingly high level of total dissolved solids (TDS). The TDS of all the samples were in range of 600- 2600 mg / lit. while the maximum permissible limiting value of TDS for potable water is 500 mg/ lit., according to WHO. High level of TDS in water used for drinking purposes leads to many diseases which are not water-borne but due to excess salts[22]. The present investigation has provided a good platform for further study to analyze the types and amount of cationic/ anionic salts.

Dissolved Oxygen: DO is a very important parameter of water quality and an index of physical and biological process going on in water. In the present study, the maximum concentration of dissolved oxygen was observed in the month of July after heavy rainfall, which favours solubility of oxygen among the study sites. The highest concentration (7.4 mg/l) was recorded on S-10 but the range was not narrow for other sites. A definite trend in DO concentration was observed on all the sites showing highest values in S-10 and lowest in S-5 and S-9. DO is of great importance to all living organisms. It may be present in water due to direct diffusion from air and photosynthetic activity of autotrophs. Concentration of DO is one of the most important parameters to indicate water purity and to determine the distribution and abundance of various algal groups[21].

Coliforms (total and faecal) and total plate count: The microbiological analysis of the water is also showed in the table-2. The total aerobic microbial count (TAMC) indicate that the highest microbial load 1650 cfu/ml in S-3 after 24 and 48 h incubation and minimum load 128 cfu/ml in S-13. The microbiological observations reflect the presence of *E.coli* in S5 (Banmore) and S11 (Shinde Ki Chawani) whereas *Enterobacter* was found in S1, S2, S3, S4, S10, S12 and S13. MPN indexing of analyzed water samples showed wide variation and were in range of <2 to >2400. The results showed that almost all water samples were not fit for drinking purposes as per WHO recommendations. The coliform bacterium is the primary bacterial indicator for faecal pollution in water[23-24].

Conclusion

The observation of study strongly suggest that water of Gwalior region is of very high TDS and needs to be lowered down within prescribed limits before using it for drinking purposes. Also, the water samples were showing microbial content beyond the potability range, which needs to be disinfected before consumption to avoid water-borne diseases. Although, the present investigation is essentially a primary work and needs to be further investigated to arrive at specified conclusion with respect to clinical implications.

Acknowledgement

The authors are grateful to the Dr. J.L. Bhatt, Dean, Life Sciences and Dr. Omveer Singh, Registrar, ITM University, Gwalior, MP, India for providing the laboratory facility to

conduct this work. We are also thankful to management for their support.

References

1. Shyamala R., Shanthi M. and Lalitha P., Physicochemical Analysis of Bore well Water Samples of Telungupalayam Area in Coimbatore District, Tamilnadu, India, *Elect. J Chem.,* **5(4),** 924-929 **(2009)**

2. Raja R.E., Lydia Sharmila, Princy Merlin, Chritopher G, Physico-Chemical Analysis of Some Groundwater Samples of Kotputli Town Jaipur, Rajasthan, *Indian J Environ Prot*., **22(2)**, 137 **(2002)**

3. Lamikarna A., Essential Microbiology for student and Practitioner of Pharmacy, *Medicine and Microbiology,* **2nd** Ed. Amkra books Lagos., 406 **(1999)**

4. Mishra K.R., Pradip and Tripathi S.P., Groundwater Quality of Open Wells and Tube Wells, *Acta Ciencia Indica*, XXXIIIC, **2,** 179 **(2002)**

5. Gupta V., Agarwal J. and Sharma S., Adsorption Analysis of Mn(VII) from Aqueous Medium by Natural Polymer Chitin and Chitosan, *Asian J. of Chem.,* **20(8),** 6195-98 **(2008)**

6. Tahir M.A., Rasheed H. and Malana A., Method development for arsenic analysis by modification in spectrphotometric technique, *Drik. Water Eng. Sci. Discuss,* **1,** 135 154, **(2008)**

7. Diersing N., Water Quality: Frequently Asked Questions, *PDA*. NOAA **(2009)**

8. Postel S., Last Oasis: Facing Water Scarcity, W.W. Norton and Company, INC **(1992)**

9. Mishra A. and Bhatt V., Physico-chemical and microbiological analysis of under ground water in V.V Nagar and near by places of Anand district, Gujrat, *Ind. E. J Chem.,* **5(3)** 487-492 **(2008)**

10. Arvnabh Mishra, Vasishta D. Bhatt, Nirav Sevak, Pinal Shah, Kirit Patel and Chaitanya Patel; Comparative Study of Physico-Chemical and Microbial Parameters on Lotic And Ground-Waters In Selected Outlying Areas of Central Gujarat, *J. Chem. Pharm. Res.,* **2(4),** 174-177 **(2010)**

11. Mark W.R., Ximing C. and Sarah A.C., World Water and Food to 2025; dealing with security. International Food Policy Research Institute, NY. Washington, DC. USA, **(2002)**

12. Chan C.L. Zalifah M.K. and Norrakiah A.S., Microbiological and physicochemical quality of drinking water., *The Malaysian J analyt. Sci*, **11(2),** 414-420 **(2007)**

13. Davis M.L. and Cornwell D.A., *Introduction to Environmental Engineering,* McGraw Hill, 3rd Ed., PWS, Publishers, New York, 93 **(1991)**

14. Byamuka D., Kansime F., Mach R.L. and Farantiler A.H., Determination of *Escherichia coli* contamination with chromocult coliform agar showed a high level of discrimination efficiency for differing faecal population levels in tropical waters of Kampala, Uganda, *Appl. Environ. Microbiol,* **66,** 864-868 **(2000)**

15. *Standard methods for examination of waters and waste waters*, **16th Ed**., APHA, AWWA and WPCF Inc. Newyork, 1205 **(1985)**

16. Jayaraman P.R., Gangadevi T. and Vasuena N. T., Water quality studies on Kasmane river, Thiruvanthapuram, district, South Kerela, India, *Poll. Res.*, **32(1),** 89-100 **(2003)**

17. Hutchinson G.E., *A treatise on limnology, Geography, physics and chemistry,* Chapman & Hall, London , Wiley, New York , **1**, 1015 **(1957)**

18. Wetzel R.G., Limology, W.B., Saunders Co., Philadelphia, USA, 743**(1975)**

19. Patil S.G., Chonde S.G., Jadhav A.S. and Raut P.D., Impact of Physico-Chemical Characteristics of Shivaji University lakes on Phytoplankton Communities, Kolhapur, India, *Research Journal of Recent Sciences,* **1(2)**, 56-60, **(2012)**

20. Chauhan R., Chaudhary R., Singh A. and Singh P.K., Salt Tolerance of *Sorghum bicolor* Cultivars during Germination and Seedling Growth, *Research Journal of Recent Sciences,* **1(3)**, 1-10, **(2012)**

21. Bhatt L.R., Lacoul H.D., Lekhak H. and Jha P.K., Physicochemical characteristics and phytoplankton of Taudaha lake, Kathmandu, *Poll. Res*., **18(4),** 353-358 **(1999)**

22. Sabata B.C. and Nayar M.P., River pollution in India: A case study of Ganga river, 33 **(1995)**

23. Parihar V.L., Sharma M.S. and Sharma L.L., Utility of bacteriological parameters for assessing best use and trophic status of seasonal water: A case study from Udaipur, Rjasthan. *Poll. Res*., **22(2),** 163-167 **(2003)**

24. Mohan D., Gaur A. and Chodhary D., Study of limnology and microbiology of Naya Talab, Jodhpur, Rajasthan, *Proceed. Nat. Symp. on Limnology*, 64-68 **(2007)**

Table-1
Sources of different water samples collected from in and around Gwalior city, MP, India

Sample No.	Locations	Sources
S1	Rairu	Handpump
S2	Jaura	Handpump
S3	Noorabad	Handpump
S4	Madhavpura	Handpump
S5	Banmore	Handpump
S6	Gole Ka Mandir	Handpump
S7	Thatipur	Municipal Supply
S8	C.P. Colony	Municipal Supply
S9	K.S. Oli Ltd.	Handpump
S10	Birla Nagar	Handpump
S11	Sindhe Ki Chawani	Municipal Supply
S12	Railway Stations (Moorar)	Handpump
S13	Barrier Chowk (Moorar)	Municipal Supply
S14	Maharajpura	Handpump
S15	Pintoo Park	Handpump
S16	Guda Gudi ka Naka	Municipal Supply

Table-2
Physico-chemical and microbiological parameters of different water samples

Sample No.	Temp. (°C)	pH	Conductivity (mho/cm)	Total Hardness (mg/lit.)	TDS (ppm)	DO (mg/lit.)	TAMC / 100 ml	MPN Index/100ml	IMViC Test (*E. coli* /*Enterobacter*)
S 1	29	7.8	2889	160	1600	5.9	1450	350	*Enterobacter*
S 2	29	8.3	3202	170	1900	6.5	1560	<2	*Enterobacter*
S 3	30	8.1	3660	185	2600	5.9	1650	>2400	*Enterobacter*
S 4	30	8.5	2913	320	1600	7.1	1240	79	*Enterobacter*
S 5	31	8.2	3105	210	1700	5.7	840	920	*E.coli*
S 6	30	8.7	3010	180	1600	7.2	1355	<2	Negative
S 7	29	7.8	1615	152	800	6.8	450	<2	Negative
S 8	31	8.1	2613	332	1300	6.6	510	<2	Negative
S 9	28	7.8	3231	316	2000	5.7	480	8	Negative
S 10	30	7.6	3594	210	2600	7.4	1445	21	*Enterobacter*
S 11	31	7.5	1504	160	600	6.8	380	<2	*E.coli*
S 12	30	8.2	1715	277	900	5.9	840	4	*Enterobacter*
S 13	28	7.5	1498	318	600	6.4	128	8	*Enterobacter*
S 14	28	7.7	1510	298	600	7.1	240	<2	Negative
S 15	29	8.6	1601	320	750	7.2	445	<2	Negative
S 16	30	8.1	1598	275	600	6.9	370	<2	Negative