Punjab Univ. J. Zool., Vol. 26(2), pp.125-132, 2011

AN ASSESSMENT OF GROUND WATER POLLUTION IN LAHORE, PAKISTAN

GULL-E-RANA, JAVED IQBAL QAZI* AND SHAGUFTA SHAHJAHAN

Department of Zoology, University of the Punjab, Lahore (GR, JIQ), Environmental Protection Agency, Lahore (SS), Pakistan

Abstract: Like many other cities of Pakistan, ground water serves as main drinking as well as industrial source for the Lahore city. Ground waters are affected by surface runoff of domestic and industrial effluents. Tubewell, hand pumps and some tap water samples collected from different locations of the city were evaluated for physical, heavy metals and coliform bacterial content. Majority of the waters were found positive for the presence of coliform bacteria indicating the influence of sewage pollution. Some of the samples expressed alarming levels of cyanide, cadmium and fluoride. These results advocate the needs of water purification and future monitoring practices for provision of safe drinking water to the masses.

Key words: Drinking water pollution, coli form, metal pollution

INTRODUCTION

Ground water supplies about 75% of the drinking water in Europe, 51% in United States, 32% in Asia and 29% in Latin America. In this connection a serious threat to human health is that of polluted ground water. The contaminations may include petrochemical, organic solvents, pesticides, arsenic, lead and fluoride *etc.* Due to slow flow rate, usually less than 0.3m/day, much smaller populations of decomposing bacteria and its cold temperature, the contaminated ground water would require hundreds to thousands of years to clean itself of degradable wastes, whilst non-degradable wastes may stay there permanently (Miller, 2003).Public health authorities are concerned about quality of drinking water. In developed countries, drinking water supply must pass through strict monitoring and certain defined physiochemical and biological standards. Unfortunately, in developing countries like Pakistan, ground water is supplied for drinking purposes after minor treatment including

0079-8045/11/0125-0132 $ 03.00/0
*Corresponding author: qazi@scientist.com

occasional chlorination. Secondly, industrial effluents are soon discharged to adjoining areas without proper treatments. Depending upon the soil nature, underground water gets contaminated with industrial and domestic effluents sooner or later. Consequently, drinking water procured from such underground sources may contain deleterious chemicals including heavy metals to objectionable levels. In developing countries where environmental legislation either does not exist or is not implemented to be desired standards, the groundwater situation is alarming. For example, Das *et al.* (2004) demonstrated that arsenic contamination of groundwater in Bangladesh is one of the largest environmental health hazards in the world. Besides the chemical pollutants, groundwater of big cities wherein untreated domestic sewage leakage is prevalent may also contain objectionable microbial contaminations. Samples taken from ground waters of Lahore have been shown to harbor heavy loads of coliform bacteria (Qazi *et al.,* 2006). This information justifies need of frequent monitoring of the ground water samples to assess their chemical and bacteriological pollutants' levels.

The present communication reports physiochemical and coliform status of some groundwater samples of Lahore city. The information is relevant for speculating future urban and industrial pollutants loads and their effects on the underground drinking waters of Lahore. The observations are also suggestive for taking remediation measures immediately.

MATERIALS AND METHODS

Water samples were collected from different localities of the city Lahore (Table I). The waters were sampled in sterile glass containers and nature of the facility for obtaining the ground water *i.e.,* tube well and hand pumps were recorded. The water samples were soon transported to the laboratory and processed for determination of their physical, features including pH, colors, odour and taste. Whereas, total dissolved solids (TDS) and turbidity were recorded by employing gravimetric and nephelometric techniques, respectively. Regarding chemical analyses standard methods used at the analytical laboratory of Environmental Protection Agency, Lahore were applied. Coliform bacteria were detected by Millipore filtration technique followed by the incubation of membranes on endoagar medium.

RESULTS AND DISCUSSION

All the samples appeared transparent, odorless and had non-objectionable taste. All tube well water samples were found slightly alkaline in nature having pH range of 7.22 to 8 (Table I). Total dissolved solids (TDS) ranged from 180 to 600 mg/l for tube well water samples, while the tap water had TDS ranging from 200 to 880 mg/l (Table II) whereas WHO recommended limit for the parameter is up to 1000 mg/l.

Table I: Some features of the tube well water samples

Sr. No.	Locality	pH	TDS	Turbidity	Conductivity	Total hardness
		-	mg/l	NTU	mg/l	mg/l
1	Shahdrah	7.7	200	0	280	122
2	WAPDA colony	7.8	210	0	300	108
3	Misri shah	7.7	600	0	720	290
4	Sanat nagar	7.8	180	0	310	120
5	Sherakot	Nil	Nil	Nil	nil	Nil
6	Bund road	7.9	390	0	600	140
7	Railway workshop	8	290	0	460	100
8	Bagbanpura	7.8	280	0	450	200
9	GT road	Nil	Nil	Nil	nil	Nil
10	Sader cantt	7.2	380	0	610	180
11	Kot lakhpat	nil	Nil	Nil	nil	Nil
12	Lajpat road	nil	Nil	Nil	nil	Nil
13	Saanda	nil	Nil	Nil	nil	Nil
14	Model town	8	400	0	520	100
15	Pindi Qenchi	7.9	580	0	810	160
16	Defence road	nil	Nil	Nil	nil	Nil
17	Gulberg	7.7	300	14	450	300
18	Mohanwal	nil	Nil	Nil	nil	Nil
19	Multan road	8	400	0	760	100

Table II: Some features of the tap water samples

Sr. No.	Locality	pH	TDS	Turbidity	Conductivity	Total hardness
		-	mg/l	NTU	mg/l	mg/l
1	Shahdrah	Nil	Nil	nil	nil	nil
2	WAPDA colony	Nil	Nil	nil	nil	nil
3	Misri shah	7.6	200	0	290	120
4	Sanat nagar	Nil	Nil	nil	nil	nil
5	Sherakot	7.7	320	0	400	210
6	Bund road	Nil	Nil	nil	nil	nil
7	Railway workshop	Nil	Nil	nil	nil	Nil
8	Bagbanpura	Nil	Nil	nil	nil	Nil
9	GT road	7.3	670	0	1090	480
10	Sader cantt	Nil	Nil	nil	nil	Nil
11	Kot lakhpat	7.8	780	0	1120	160
12	Lajpat road	7.8	570	0	800	240
13	Saanda	8	880	0	1650	120
14	Model town	Nil	Nil	nil	nil	Nil
15	Pindi Qenchi	Nil	Nil	nil	nil	Nil
16	Defence road	7.8	440	0	660	220
17	Gulberg	Nil	Nil	nil	nil	Nil
18	Mohanwal	7.6	350	0	470	300
19	Multan road	Nil	Nil	nil	nil	Nil

Higher range of TDS for the tap water than the tube well water may be attributed to evaporation and contamination during tank storage. Elevated levels of TDS appeared for the tube well water samples obtained from Multan Road, Model Town, Pindi Qenchi and Misri Shah having values of 400, 400, 580 and 600 mg/l, respectively. The tap water sample showed highest TDS at defence Road, Lajpat Road, Kot Lakhpat and Sanda having values of 440, 570, 780 and 880 mg/l, respectively. TDS contents are reflective of soil nature of the described area. All of the water samples showed the zero level of turbidity, except that collected from Gulberg which had a value 14 NTU.

In case of conductivity, the tube well water samples expressed a range of 280 to 810 mg/l. The parameter fluctuated from 290 to 1650 mg/l

for tap water samples. Highest conductivity was found for the tube well water sampled from Misri Shah, Multan Road and Pindi Qenchi having values of 720, 760 and 810mg/l, respectively, whereas highest conductivity in tap water samples was found for the GT Road, Kot Lakhpat and Sanda having values of 1090, 1120 and 1650mg/l, respectively. For the total hardness of tube well waters the values ranged from 100-300mg/l, while the tap water samples showed a range of 120 to 480mg/l. The highest value of hardness was found at Gulberg (300mg/l) and GT Road (480mg/l) locations. Regarding the chemical analysis, water samples contained calcium from 20 to 92mg/l. highest value of calcium (72mg/l) in tube well waters was found for the Gulberg and Bagbanpura samples. While highest value of calcium among tap waters was found for Lajpat road and Sherakot samples having values of 92 and 80mg/l, respectively (Table III).The water samples were found to contain magnesium in the range of 2 to 83mg/l. Highest values of the parameter for tube well waters were found at Misri Shah and Gulberg expressing values of 48 and 30mg/l, respectively. In case of tap waters GT Road and Mohanwal had 83 and 30mg/l of Mg, respectively. The WHO guidelines dictate that iron should not be more than 0.3mg/l. All water samples possessed iron in the range of 0.01 to 0.04mg/l. According to WHO, cyanide should not be, more than 0.07mg/l. While the water samples were found to harbor in the range of 0.009 to 0.029mg/l. The tube well water samples possessed highest cyanide content *i.e.*, 0.029mg/l that was recorded for the tube well water from Pindi Qenchi. Whereas the tap water sample collected from Lajpat road expressed cyanide as 0.027mg/l. All the well water samples had non-detectable levels of arsenic. According to WHO, cadmium should not be more than 3.0µg/l. In the present samples level of the element reached up to 6.00µg/l. The highest values of Cd in the tube well water samples were found at Sanat Nagar and WAPDA colony with corresponding figures of 4.5 and 6µg/l, respectively.

Table III: Chemical and bacteriological analysis of the water samples

Locality	Parameters							
	Ca mg/l	Mg mg/l	Organic carbon mg/l	Cyanide mg/l	Cd µg/l	Hg µg/l	Pb µg/l	coli form
Shahdrah	40	6	601	0.014	5	0.47	5	D
WAPDA colony	40	2	323	0.005	6	0.8	3.1	D
Misri shah	40	48	413	0.01	0	0	13.7	D
Sanat nagar	40	5	120	0.0087	4.5	0.47	0.9	ND
Sherakot	80	3	118	0.011	0	0.09	1.3	D
Bund road	48	5	137	0.015	0	0.35	0.2	D
Railway workshop	32	5	520	0.008	0	0.56	6.9	D
Bagbanpura	72	5	519	0.011	0	0.52	3.9	D
GT road	60	83	317	0.011	0	0.59	3.9	D
Sader cantt	56	10	330	0.008	0	0.08	2.9	D
Kot lakhpat	36	18	94	0.017	0	0	2.5	D
Lajpat road	92	3	240	0.027	0	0.73	0.7	D
Saanda	20	18	110	0.023	0	0.29	8.3	ND
Model town	32	5	89	0.015	0	0	1.5	ND
Pindi Qenchi	36	18	80	0.029	0	0	1.7	ND
Defence road	48	3	360	0.009	2.6	0	0.8	D
Gulberg	72	30	323	0.009	2.8	0.24	2.8	D
Mohanwal	72	30	315	0.016	2.6	0.95	2.7	D
Multan road	32	5	310	0.018	1.4	0.1	3.3	D

Abbreviations used: D, detected; ND, Not detected

All water samples possessed permissible range of Hg *i.e.,* upto 0.95µg/l. The tap water samples possessed lead contents within the safe range *i.e.,* less than 10µg/l. Whereas tube well water samples were found to contain Pb up to 13.7µg/l (Table III). All water samples invariably expressed 0.05mg/l of chromium; the maximum permissible limit for the heavy metal. In majority of the water samples, Ni was non-detectable,

whilst a few contained the metal ranging from 0.002 to 0.006mg/l. The samples showed Zn in the range of 0.02 to 0.05mg/l (Table III). Regarding bacterial contamination, except the samples number 4 and from 13 to 15 all the remaining collections were found positive for the presence of coliform bacteria. Domestic sewage effluent is allowed to run through constructed / natural drainage system without any treatment. This practice has contaminated soil and water resources of the city Lahore like all other cities of Pakistan. This pollution has been confirmed in apparently clean drinking water through the presences of coliform bacteria for various samples taken from different areas of Lahore (Qazi *et al.*, 2006). The present study indicates coliform contamination of groundwater too.

Conclusively, majority of the sample showed the parameters within admissible ranges. However, higher levels of some parameters for tube well and tap water samples especially regarding the cyanide, cadmium and fluoride are alarming. Majority of samples were found positive for the presence of coliform bacteria which indicates the contamination by domestic sewage effluents which are frequently observed in different locations of the city due to improper sewer management. Lee (2002) described that contamination of fecal coliform bacteria in a water system indicates recent fecal contamination which may impose an immediate health risk to anyone consuming the water. In countries with developed public health, after realization of focally contaminated water, soon a Health Advisory is issued within 24 hours to alert all water users that there is a health risk associated with the water supply (Clasen, 2003). Such facilities are far from being considered and practiced in this country. This preliminary report strongly recommends the routine analysis of the ground waters of the city so that seasonal and site wise descriptive data may emerge. It is important to note that in the present study waters free from particulate matter were analyzed whilst many metals occur in colloidal bound from. For instance Jensen *et al.* (1999) while studying speciation of heavy metals in land fill-leachate polluted ground water have reported that heavy metals in leachate-polluted ground water are strongly associated with small size colloidal matter and organic molecules. Further work should address analysis of particulate matter of water samples as well as identification of possible domestic and industrial points responsible for the presence of particular pollutants for a given sample.

REFERENCES

CLASEN, T.F., BASTABLE, A., 2003. Fecal contamination of drinking water during collection and household storage: the need to expand protection to the point of use. *J. Water Health,* **1**(3): 109-115.

DAS, H.K, MITRA, A.K, SENGUPTA, P.K, HOSSAIN, A., ISLAM, F. AND RABBANI, G.H, 2004. Arsenic concentrations in rice, vegetables and fish in Bangladesh: a preliminary study. *Environ. Intern.,* **30**: 383-387.

JENSEN, D.L; LEDIN, A. AND CHRISTENSEN, 1999. Speciation of heavy metals in land fill-leachate polluted ground water: **33**: 2642-2650.

LEE, S.H., LEVY, D.A., CRAUN, G.F., BEACH, M.J., CALDERON, R.L., 2002. Suriveillance for waterborne-disease out break-United States. *MMWR Surveill. Summ.,* **51**(8): 1-47.

MILLER JR., G.T., 2003. *Environmental Science, working with the earth.* Brooks/Cole Thomson learning Canada.

QAZI, J.I., SHAHID, S. AND CHAUDHARY, N. 2006. Occurrence of hemolytic coliform bacteria in drinking water samples of Lahore. *Pakistan J. Zool.,* **38:** 119-123.

(Received: November 15, 2011; Revised: December 21, 2011)