

Analysis of WASA Supplied Drinking Water Around Dhaka City from Laboratory Analysis Perspective

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Abstract

To investigate the toxic chemicals and microbial pathogens in Dhaka WASA drinking water, 25 sampling area was chosen from different thana of Dhaka city depending on the WASA supplied drinking water. Toxic metals were analyzed by Atomic absorption spectrophotometer, Phenolic compounds were analyzed by HPLC followed by solid phase extraction method and separated Bacteriological quality of water was determined by drop plate method for total bacterial counts and fecal coliform counts. The concentration of toxic metals was below the value of WHO guide line. Pentachlorophenol (PCP), content in all areas exceeded (0.08-0.22mg/L) the maximum level of WHO guide line value (0.001mg/L). Total coliform count (c.f.u/100mL) in the water sample of Bangshal, ShagunBagichaa, Jatrabari, Mohammadpur, Panthapath and Lalbagh areas were <1. Fecal coliform count (c.f.u/100mL) in the water collected from Dhaka University, Dhaka Medical Collage Hospital, SegunBagichaa, Jatrabari, Mohammadpur, Panthapath, Lalbagh and BIRDEM Hospital areas were <1. But total bacterial count in all areas were exceeded (5.0×10^3 - 5.2×10^6 c.f.u/100mL) the maximum level of Bangladesh EQ Standard ECR, 1997 Guideline Value 10 c.f.u/100mL. In conclusion the Dhaka WASA drinking water quality was assessed as deteriorate to the existed pathogenic bacterial contamination and in addition of toxic PCP contamination which is alarming to the public health.

Key Words: Toxic metal, Pentachlorophenol, solid phase extraction, HPLC. Microbial Contamination

Introduction

Water contamination creates serious health hazard for Bangladesh. Access to safe drinking water has improved steadily and substantially over the last decades in almost every part of the world^{1,2}. Dhaka, one of the mega cities of the world, has a population of about 12.5 million in metropolitan area³. Dhaka

Water Supply and Sewerage Authority (Dhaka WASA) is the responsible body to supply drinking water to huge population in Dhaka city. As the water level of Dhaka city is being lowered day by day, it is high time to consider surface water treatment as the primary source. For surface water treatment, the main sources of raw water are rivers around Dhaka city. But the water quality of these rivers has severely damaged in recent years due to municipal and industrial untreated wastewater that are discharged into this river^{4,5}.

The occurrence of toxic metals like arsenic (As) lead (Pb), cadmium (Cd), and chromium (Cr) in drinking water was considered an important pathway of potential exposure for citizens of the United States and many other nations⁶. Phenolic compounds are a group of organic pollutants present in the environment as a result of various processes such as industrial, biogeochemical and as pesticide degradation products⁷. Phenols are harmful to people, dangerous to the environment, and can impart a metallic taste and odor to water when it is chlorinated. Another pollutant in water is Microbial Pathogens. Drinking water contaminated with these organisms can cause stomach and intestinal illness including diarrhea and nausea, and even lead to death. These effects may be more severe and possibly life threatening for babies, children, the elderly or people with immune deficiencies other illnesses⁸. It was reported⁹ that distribution lines of Dhaka WASA supply chain might be the main source of microbiological contamination of drinking water. Recently another report¹⁰ was that the quality of treated water sample from WASA was found to be microbiologically acceptable. But there was no report of phenolic compound analysis found in Dhaka WASA supplied drinking water.

Therefore the aim and objectives of this study was to analyze physical water quality parameters, toxic metal contaminants, Phenolic compound and microbial parameters of the Dhaka WASA supplied drinking waters of the selected area of Dhaka cities.

Material and Methods

Twenty five sampling area was chosen from different thana of Dhaka city depending on the WASA supplied drinking water. The samples were collected in May, 2011. For toxic metal analysis the water samples were collected in polyethylene bottle of 1.5L capacity. Before sampling, the bottle was washed thoroughly with the detergent, 5% HNO₃, distilled de-ionized water and finally with the WASA supplied water at the sampling site for several times. This water samples was preserved within the pH range 2-3 by adding HNO₃ and then transported to the laboratory for future analysis. After sampling the bottles were screwed and marked with the respective identification number. Sampling and sample pre-treatment for phenolic compound, the collected sample was filtered through 0.45 μm membrane filter, acidified with HCl to pH < 2 and refrigerated at 4°C until analysis. Sampling for bacterial test, the bottle

was sterilized by 121°C in 15 minutes and water sample was collected in the container. The microbiological experiment was started within 2-4 hours

Physicochemical analysis:

The physical water quality indicators, pH and specific conductance were measured by Digital pH meter (Systronics Type-335) and Digital conductivity meter (Systronics Type-304) respectively.

Toxic metal analysis:

Some heavy metals (Cadmium, Chromium and Lead) in drinking water were analyzed by Flame-Atomic absorption spectrometer (F-ASS). Arsenic was measured by Graphite Furnace Atomic absorption spectrometer (GF-AAS) technique.

Phenolic compound analysis:

Phenolic compound in water were measured by High performance liquid chromatography HPLC followed by solid phase extraction method¹¹. The HPLC system consisted¹² of a binary pump (Shimadzu LC6A); a wavelength ultra violet (UV) detector (Shimadzu SPD) stationary-phase column was a Shimadzu Shim Pac C8 column (3.9 ×150 mm id, 5.0µm particle diameter) supplied by Shimadzu Japan).

Microbial analysis:

The standard methods¹³ were followed for the microbial analysis of the piped water samples. The study was carried out by drop plate method for total bacterial counts using Micropipette, test tube rack, colony counter and membrane filter paper method using one liter suction flask for total coliform counts and fecal coliform counts.

Results and Discussion

Results obtained during the analysis were shown in the following Table.

Table -1: pH value and specific conductance content in WASA supplied water

Sample No	Locations	pH	S.Conductance ×10(mS/cm)	Sample No	Locations	pH	S.Conductance ×10(mS/cm)
01	Dhaka University	7.54	3.4	14	Shampur	7.66	1.8
02	Bangshal	7.53	1.5	15	Kamrangirchor	7.07	3.4
03	DMCH	7.19	5.1	16	Kawranbazar	7.49	4.0
04	Basabo	7.49	2.8	17	Lalbagh	7.72	2.0
05	Komlapur	7.69	2.8	18	Hagaribugh	7.25	3.9
06	Badda	7.30	3.4	19	Gulshan	7.69	3.0
07	Sobujbagh	7.18	3.4	20	Sutrapur	7.00	6.2
08	Shagun Bagichaa	7.11	6.2	21	Pallabi	7.54	3.0
09	Demra	7.58	2.8	22	Uttara	7.32	3.6
10	Jatrabari	7.43	2.0	23	Mirpur	7.40	3.3
11	Mohammadpur	7.22	3.0	24	Kafrul	7.49	2.9
12	Panthopath	7.58	1.8	25	BIRDEM Hospital	7.43	2.7
13	Elephant Road	7.22	4.4				

Table -2: Lead, Cadmium, Chromium and Arsenic content in first 14 water samples

Sample No.	Sampling Area	Pb content (mg/L)	Cd content (mg/L)	Cr content (mg/L)	As content (µg/L)
1	Dhaka University	0.52	0.05	BDL	0.78
2	Bangshal	BDL	0.03	BDL	0.43
3	DMCH	BDL	0.04	BDL	0.25
4	Basabo	BDL	BDL	BDL	5.12
5	Komlapur	BDL	BDL	BDL	0.21
6	Badda	BDL	0.04	BDL	1.29
7	Sobujbagh	BDL	0.04	BDL	0.42
8	Shagun Bagichaa	BDL	0.06	BDL	BDL
9	Demra	0.46	0.07	BDL	0.44
10	Jatrabari	0.51	0.07	BDL	0.15
11	Mohammadpur	BDL	0.07	BDL	0.53
12	Panthapath	BDL	0.07	BDL	0.29
13	Elephant Road	0.53	0.08	BDL	0.10
14	Shampur	BDL	0.08	BDL	0.56

Table 3 Cocentration of Phenolic compound in water at different areas

SL. No	Sample ID	Sampling Area	Phenolic compounds (mg/ L)						
			P	2MP	4MP	2-CP	2,4DCP	2,4,6-TCP	PCP
01	01	Dhaka University	ND	ND	ND	ND	ND	ND	0.127
02	02	Bangshal	ND	ND	ND	ND	ND	ND	0.1074
03	03	DMCH	ND	ND	ND	ND	ND	ND	0.179
04	04	Basabo	ND	ND	ND	ND	ND	ND	0.167
05	05	Badda	ND	ND	ND	ND	ND	ND	0.085
06	07	Sobujbagh	ND	ND	ND	ND	ND	ND	0.107
07	08	Shagun Bagichaa	ND	ND	ND	ND	ND	ND	0.167
08	10	Jatrabari	ND	ND	ND	ND	ND	ND	0.190
09	12	Panthapath	ND	ND	ND	ND	ND	ND	0.084
10	13	Elephant Road	ND	ND	ND	ND	ND	ND	0.081
11	14	Shampur	ND	ND	ND	ND	ND	ND	0.210
12	15	Kamrangirchor	ND	ND	ND	ND	ND	ND	0.183
13	16	Kawranbazar	ND	ND	ND	ND	ND	ND	0.129
14	17	Lalbagh	ND	ND	ND	ND	ND	ND	0.220
15	18	Hagaribugh	ND	ND	ND	ND	ND	ND	0.12
16	20	Sutrapur	ND	ND	ND	ND	ND	ND	0.110
17	25	BIRDEM Hospital	ND	ND	ND	ND	ND	ND	0.107
18	11	Mohammadpur	ND	ND	ND	ND	ND	ND	ND
19	22	Uttara	ND	ND	ND	ND	ND	ND	ND
20	23	Mirpur	ND	ND	ND	ND	ND	ND	ND

2MP= 2-Methyl Phenol, 4MP= 4-Methyl Phenol, 2-CP=2-Chloro Phenol, 2,4-DCP=2,4-dichloro Phenol, 2,4,6-TCP=2,4,6-trichloro Phenol, PCP= Penta Chloro Phenol; ND= Not detected

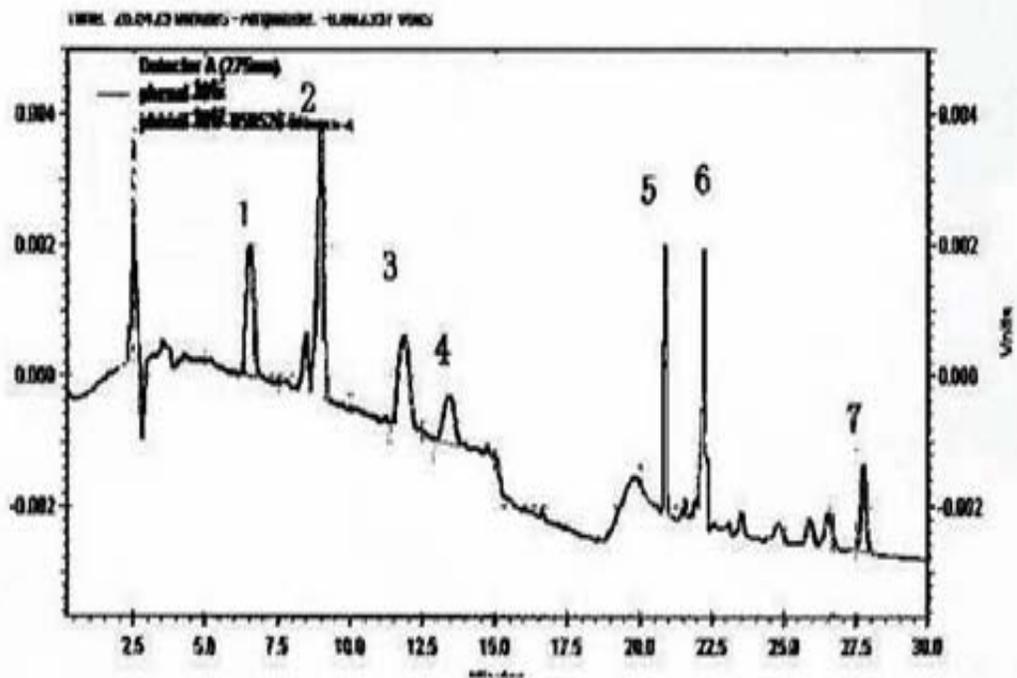


Figure 1 HPLC Chromatogram of 7 types of phenolic compounds in methanol

1. Phenol, 2. 2-Methyl phenol (2MP), 3. 3- methyl phenol (3MP), 4. 2-chlorophenol (2CP), 5. 2, 4-dichlorophenol (2,4-DCP), 6. 2, 4, 6- trichlorophenol (TCP) 7. Pentachlorophenol (PCP)

Physical parameters

The pH value (Table 1) of water samples taken from the different places of Dhaka city ranges from 7.00 in Sutrapur thana to 7.72 in Lalbagh and was within the normal range of WHO standard¹⁴. The range of specific conductance was 0.15(Lalbagh)-0.62(Sutrapur) mS/cm within the normal range.

Toxic metals

The results of metal analysis were shown in the Table 2. The concentration of Lead was 0.53 mg/L in water from Elephant road, 0.52 mg/L from D.U, 0.51 mg/L from Jatrabari, 0.46 mg/L from Demra area. The concentration of Lead in water samples from other area was below detection limit (BDL). The highest concentration of Cadmium was measured in Elephant road and Shampur (0.08 mg/L) and in Shangun Bagichaaa (0.06 mg/L). The result was differing from the previous report¹⁵ of drinking water in Dhaka City which was below the detection limit of WHO guideline value (0.0051 mg/L). The concentration of Chromium in water samples of all areas was below the detection limit. The maximum Arsenic was measured in Basabo area (5.12 µg/L) within acceptable limit. The result was agreed with the other reported¹⁶ results in Bangladesh which was below the WHO guideline value of 10µg/L.

Table 4: Total bacterial count, total coli form count and fecal coli form count in water of different areas in Dhaka cities

SL. No	Sample ID.	Sampling Area	Total Bacterial Count c.f.u./100mL	Total Coliform Count c.f.u./100mL	Fecal Coliform Count c.f.u./100mL
01	01	Dhaka University	4.0×10^5	2.2×10^3	< 1
02	02	Bangshal	2.1×10^4	1	1
03	03	DMCH	1.0×10^4	25	< 1
04	04	Basabo	4.2×10^6	3.1×10^3	2.8×10^3
05	06	Badda	1.0×10^5	5.0×10^2	3.0×10^2
06	07	Sobujbagh	5.2×10^6	4.3×10^3	1.6×10^3
07	08	Shagun Bagichaa	5.0×10^3	5	< 1
08	10	Jatrabari	1.5×10^4	< 1	< 1
09	11	Mohammadpur	5.0×10^3	< 1	< 1
10	12	Panthapath	3.0×10^4	< 1	< 1
11	13	Elephant Road	2.5×10^4	2.1×10^2	36
12	14	Shampur	3.5×10^4	24	6
13	15	Kamrangirchor	1.5×10^4	2.8×10^2	2.1×10^2
14	16	Kawranbazar	4.5×10^4	24	13
15	17	Lalbagh	5.0×10^3	< 1	< 1
16	18	Hagaribugh	2.5×10^4	2.0×10^2	1.6×10^2
17	20	Sutrapur	1.0×10^5	1.22×10^2	62
18	22	Uttara	1.4×10^4	2.2×10^2	12
19	23	Mirpur	4.0×10^4	58	17
20	25	BIRDEM Hospital	1.5×10^4	15	< 1

Phenolic compounds

HPLC Chromatogram of 7 types of phenolic compounds was shown in Fig 1. The result was shown in Table 3. Among the 7 types of phenolic compounds in standard phenol, 2-Methyl phenol (2MP), 3- methyl phenol (3MP), 2-chlorophenol (2CP), 2, 4-dichlorophenol (2,4-DCP), 2, 4, 6-trichlorophenol (TCP) Pentachlorophenol (PCP) only Pentachlorophenol (PCP), content in the drinking water of all areas exceeded (0.08-0.22mg/L) the maximum level of WHO guide line¹⁴ value (0.001mg/L). There was no report of Pentachlorophenol in drinking water found in Bangladesh.

Microbial analysis

Recently it was reported⁷ that the quality of treated water sample from WASA were found to be microbiologically acceptable. In the present study the result (Table 4) was found to be different. According to WHO guideline value, total coliform count (c.f.u/100mL) in Bangshal, Shagun Bagichaa, Jatrabari, Mohammadpur, Panthapath and Lalbagh areas was < 1. Fecal coliform count (c.f.u/100mL) in D.U, DMCH, Shagun Bagichaa, Jatrabari, Mohammadpur, Panthapath, Lalbagh and BIRDEM hospital areas was < 1. Fecal coliform count was highest in Basabo (2.8×10^3 c.f.u/100mL). Total bacterial count

was highest in Sobujbagh (5.2×10^6 c.f.u/100mL) and lowest in Shangun Bagichaaa, Mohammadpur (5.0×10^3 c.f.u/100mL).

Conclusion

On the basis of above test results the presence of toxic metal lead in Elephant road, Dhaka.University, Jatrabari, and Demra area and toxic Penta Chloro Phenol (PCP) and existing pathogenic bacterial load in the WASA supplied drinking water from different areas of Dhaka city were found to be unsuitable for human consumption. WASA authority should treat the supplied water properly to make it free from PCP and microbial contamination especially pathogenic microbes. The print and electronic media also need to take responsibility to aware general public about the quality of water supplied by WASA and its implications on public health.

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