

Chemical Analysis of Drinking Water Samples of Some Primary Schools from Magura District, Bangladesh

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Abstract: In order to ascertain water quality for human consumption, major and minor ions were evaluated in the drinking water supplied to the primary school students of Magura district in Bangladesh. Standard methods were used for determining physical and chemical characteristics of the water samples. Arsenic (As), Iron (Fe) and Manganese (Mn) contents of the drinking water samples were also analyzed by atomic absorption spectrophotometer (AAS). The data showed the variation of the investigated parameter in water samples as follows: pH 7.29 to 8.93, Electrical Conductivity (EC) 343 to 3000 $\mu\text{S}/\text{cm}$, chloride 10 to 725 mg/l, hardness 130 to 790 mg/l as CaCO_3 , Total Dissolved Solids (TDS) 178 to 1530 mg/l, As Below the Detection Limit (BDL) to 0.012 mg/l, Fe 0.03 to 3.79 mg/l and Mn 0.03 to 0.66 mg/l. The concentrations of testing parameter in the drinking water samples were not permit all the sources of the World Health Organization (WHO) and Bangladesh Drinking Standards (BDS) water quality guideline values.

Keywords: Drinking Water, Primary School Students, AAS, Metal Ions, Water Quality

1. Introduction

From time immemorial, water assessment has always been a major concern. Today, the principal difficulty with which we are confronted is not so much access to water but more precisely the access to suitable water for drinking. Water can be the vehicle of a very high number of pathogenic agents voided into the external medium by the human or animal faeces and can thus be at the origin of many waterborne diseases. In 1996, WHO quantified to 4 billion, the number of diarrhea episodes which occurred in the world, and were responsible for the death of 3.1 million people of whom the large majority were children less than five years [1]. In the light of these figures, one realizes the importance of the problem of drinking water assessment and the capital need to seek solutions to improve the situation in this sector. The natural water analysis for physical, chemical properties including trace element contents are very important for public health studies especially for children. These studies are also a

main part of pollution studies in the environment [2-4]. The 5-10 ages children are drinking water in the investigated water sources. The determinations in drinking water have been performed using classical analytical techniques including titrimetry, gravimetry and modern instrumental techniques such as atomic absorption spectrophotometry (AAS), inductively coupled plasma-mass spectrometry (ICP-MS), UV-Vis spectrometry, etc. Because of the low cost and easiness in usage, atomic absorption spectrophotometry is the main instrument for the determinations of the trace metal ions in drinking water in the analytical chemistry laboratories [5-7]. Every year approximately five thousand children are studying in these schools. Not only the children but also the local villagers were drinking water of these water sources (Tube-wells). According to our literature review, no report has been published concerning the trace metal ions of these areas.

In the Present work arsenic, iron and manganese in drinking water samples from the water sources of different primary schools in Magura district were determined by atomic absorption spectrophotometer. Physical and chemical

properties of the samples were also determined by using standard analytical methods.

2. Materials and Method

2.1. Sample Collection

The drinking water samples were collected in prewashed (with detergent, doubly de-ionised distilled water, diluted HNO₃ and doubly de-ionised distilled water, respectively) high density polyethylene (HDPE) bottles from twenty different primary schools around Magura district in June 2013. The sampling locations were shown in Table-1. pH and electrical conductivity (EC) of the samples were measured while collecting the samples. Two liters (one liter for the

determinations of main ions and one liter for metal determinations) of each water sample was taken in duplicate at two different sampling periods approximately 1 month apart. The determinations of the major ions of the water samples were performed within one week after sample collection.

The distances of laboratory from Magura district are approximately 40 kilometers. The samples were obtained directly from the water pump after allowing the water to run for at least 25 minutes. The samples for metal determinations were filtered through a Millipore cellulose membrane of 0.45 µm pore size and were stored in 1 liter HDPE bottles and acidified to 1% with nitric acid. These samples were subsequently stored at 4°C for as short a time as possible before analysis to minimize physicochemical changes.

Table 1. The locations of the collected water samples.

SI No	Upazilla	Union	Village	Sampling Location	GPS	
					Latitude (N)	Longitude (E)
1	MaguraSadar	BeroilPolita	Dighalkandi	Dighalkandi Govt. Primary School	23°21'23"	89°30'44"
2	MaguraSadar	Chaulia	Chandpur	ChandpurPurboparaRegd. PrimarySchool	23°27'06"	89°29'12"
3	MaguraSadar	Kuchiamora	Kuchiamora	KuchiamoraGovt. Primary School	23°20'37"	89°26'17"
4	MaguraSadar	Atharokhada	Madhabpur	Madhabpur Govt. Primary School	23°32'13"	89°25'55"
5	MaguraSadar	Moghi	TitarKhaPara	TitarKhapara Regd. Primary School	23°25'28"	89°23'16"
6	Mohammadpur	Binodpur	Kalukandi	Kalukandi Regd. Govt. Primary School	23°26'34"	89°32'12"
7	Mohammadpur	Balidia	Charborboria	Charbororia Regd. Primary School	23°22'56"	89°34'02"
8	Mohammadpur	Mohammadpur	Raipur	Raipur Regd. Primary School	23°25'49"	89°35'19"
9	Mohammadpur	Polashbaria	Bathari	Bathari Regd. Primary School	23°20'08"	89°33'21"
10	Mohammadpur	Rajapur	Rajgonj	Rajgonj Govt. Primary School	23°23'13"	89°31'12"
11	Salikha	Gangarampur	Bamonkhali	Bamonkhali Govt. Primary School	23°15'34"	89°26'43"
12	Salikha	Dhaneswargati	Dhaneswargati	Dhaneswargati Community. PrimarySchool	23°25'17"	89°18'15"
13	Salikha	Dhaneswargati	Tilkhari	Tilkhari Govt. Primary School	23°22'56"	89°17'09"
14	Salikha	Talkhari	Chandra	Chandra Govt. Primary School	23°21'03"	89°18'12"
15	Salikha	Satakhali	Kholabaria	KholabariaRegd. Primary School	23°18'32"	89°19'52"
16	Sreepur	Sreekol	Sreekol	Sreekol Govt. Primary School	23°36'49"	89°21'44"
17	Sreepur	Goespur	Joka	Joka Govt. PrimarySchool	23°36'41"	89°22'35"
18	Sreepur	Amolsar	Kodla	Kodla Govt. PrimarySchool	23°39'05"	89°25'58"
19	Sreepur	Dariapur	Char Chougachi	Charchougachi Regd. Primary School	23°37'59"	89°27'22"
20	Sreepur	Kadirpara	Gashiara	Gashiara Govt. Primary School	23°33'32"	89°29'14"

2.2. Reagent and Solutions

Analytical grade reagent chemicals were employed for the preparation of all solutions. Freshly prepared double de-

ionised distilled water, from a quartz still, was used in all experiments. Hydrochloric acid (5M), Sodium Borohydride reagent (0.6% NaBH₄ solution), Potassium Iodide (20% KI) solution as a reductant, Inert gas Argon (as a carrier gas) for

HVG system (determination of As), Air-Acetylene as a fuel gas for direct flame system (determination of Fe and Mn), Commercial grade Standard solutions(CRM) of As, Fe, Mn solutions were used throughout the experiments.

2.3. Apparatus

Prior to analysis, all instruments were calibrated according to manufacturer's recommendations. pH was measured by using SensION™-MM340 digital meter. Conductivity was determined using an Electrical Conductivity meter CM-21 P. The meter was calibrated by using standard EC=1214 $\mu\text{S}/\text{cm}$. Chloride was determined using the Argentometric Method. Determination of hardness was done by EDTA titrimetric methods. Atomic absorption spectrometer (Shimadzu-AA7000) equipped with deuterium background correction, double beam system were used for the analysis of Arsenic (Hydride Vapour Generated Method), Iron and Manganese (direct flame method). All examine were conducted according to American Public Health Association Standard Methods [8].

2.4. Analysis for TDS and Metal Ions

Total Dissolved Solids were analyzed by the use of multimeter using respective standards solutions. Arsenic, Iron & Manganese were analyzed by Atomic Absorption Spectrophotometric Method. As(V) is reduced to As(III) using potassium iodide and sodiumborohydride reagent to form arsine vapour and detect the total arsenic. Here inert gas argon is used as a carrier gas. This process is called Hydride Vapour Generation (HVG). On the other hand iron & manganese is analyzed by atomization process creating a flame by the combustion of air & acetylene gas (flame temperature nearly about 2200°C).

3. Results and Discussion

3.1. Physical and Chemical Properties of the Samples

The main physical and chemical properties of the drinking

water samples including pH, electrical conductivity, chloride, hardness and Total Dissolved Solids (TDS) from Magura districts were given in Table-2. The pH values in the range of 7.29 to 8.93 (lowest in Gashiara Govt. Primary School, highest Charborboria Regd. Primary School). The ranges for electrical conductivity were 343 to 3000 $\mu\text{S}/\text{cm}$. The lowest level of the chloride in Raipur Regd. Primary School and Chandra Govt. Primary School as 10mg/l, the highest level of the chloride was found in Bathari Registard Primary School as 725 mg/l. The hardness of the samples was in the ranges of 130 mg/l to 790 mg/l as CaCO_3 . The Total Dissolved Solids (TDS) of the samples were in the range of 178 to 1530 mg/l. The drinking water quality standard guideline of hardness in Bangladesh is 500 mg/l as CaCO_3 and Total Dissolved Solids (TDS) is 1000 mg/l. Dighalkandi Govt. Primary School and Bathari Regd. Primary School does not permitted these two parameter. The Bangladesh Drinking Standards (BDS) for pH is 6.5-8.5 whereas Chloride is between 150-600 mg/l. No standard guideline value is proposed for Electrical Conductivity .

3.2. Trace Metal Ions

The drinking water samples collected from the twenty water points in Magura were analyzed by atomic absorption spectrometry in triplicate to determine arsenic, iron and manganese. The concentrations are given in Table-3.

The lowest level of Arsenic (BDL) was detected in Bathari Regd. Primary School, Mohammadpur Upazilla and the highest level in Kalukandi Regd. Govt. Primary School as 0.012 mg/l. Bangladesh standards for drinking water quality of arsenic is 0.05 mg/l but WHO guideline is 0.01 mg/l. So, as can be seen in Table-3, in the locations Kalukandi Regd. Govt. Primary School and Charchougachi Regd. Primary School permitted BDS guideline value but does not WHO guideline [1].

Table 2. The physical and chemical properties of drinking water samples.

Sl No	Type of Tube-wells	Depth (m)	Sampling Location	pH	EC ($\mu\text{S}/\text{cm}$)	Chloride (mg/l)	Hardness (mg CaCO_3/l)	TDS (mg/l)
1	Tara Deep	164.63	Dighalkandi Govt. Primary School	7.70	3000	517	790	1530
2	Tara Deep	167.68	Chandpur Purbopara Regd. Primary School	8.41	496	20	220	258
3	Tara Deep	167.68	Kuchiamora Govt. Primary School	8.03	851	64	260	443
4	Tara Deep	163.10	Madhabpur Govt. Primary School	8.52	457	40	210	238
5	Tara Deep	164.63	Titar Khapara Regd. Primary School	8.70	367	15	210	191
6	Tara Deep	149.28	Kalukandi Regd. Govt. Primary School	8.62	402	15	190	210
7	Tara Deep	171.28	Charborboria Regd. Primary School	8.93	1030	144	150	536
8	Tara Deep	167.28	Raipur Regd. Primary School	8.76	343	10	130	178
9	Tara Deep	159.28	Bathari Regd.	8.15	2520	725	600	1310

Sl No	Type of Tube-wells	Depth (m)	Sampling Location	pH	EC ($\mu\text{s}/\text{cm}$)	Chloride (mg/l)	Hardness (mg CaCO_3/l)	TDS (mg/l)
10	Tara Deep	153.28	Primary School Rajgonj Govt. Primary School	8.30	686	25	250	357
11	Tara Deep	135.67	Bamonkhali Govt. Primary School	8.72	993	129	210	516
12	Tara Deep	150.91	Dhaneswargati Community. Primary School	8.87	424	45	210	220
13	Tara Deep	166.15	Tilkhari Govt. Primary School	8.71	440	25	210	229
14	Tara Deep	149.39	Chandra Govt. Primary School	8.62	348	10	160	180
15	Tara Deep	160.06	Kholabaria Regd. Primary School	8.57	549	20	250	285
16	Tara Deep	179.87	Sreekol Govt. Primary School	8.12	877	89	280	456
17	Tara Deep	164.63	Joka Govt. Primary School	7.79	1212	141	440	630
18	Tara Deep	161.58	Kodla Govt. Primary School	8.22	848	103	280	440
19	Tara Deep	158.53	Charchougachi Regd. Primary School	8.15	593	19	220	308
20	Tara Deep	158.53	Gashiara Govt. Primary School	7.29	1042	76	410	542

The highest iron level was found in Tilkhari Govt. Primary School in Salikha Upazilla as 3.79 mg/l and lowest in Rajgonj Govt. Primary School as 0.03 mg/l in Mohammadpur Upazilla. Regarding iron, it can be seen that maximum water points (twelve sources out of twenty-60%) exceeded the Bangladesh Drinking Standards as well as WHO Standards [1], which agree with results obtained by other authors in other countries [9-11]. The BDS of iron is 0.3-1.0 mg/l.

The highest manganese concentration was detected in Gashiara Govt. Primary School in Sreepur upazilla as 0.66 mg/l and lowest in Kalukandi Regd. Govt. Primary School as 0.03 mg/l in Mohammadpur upazilla. The acceptable limit of Manganese in Bangladesh is 0.1 mg/l. So, eight water points out of twenty (40%) containing higher than the BDS guideline value.

Table 3. The concentrations of trace metal ions in drinking water samples.

Sl No	Sampling Location	As (mg/l)	Fe (mg/l)	Mn (mg/l)
1	Dighalkandi Govt. Primary School	0.003	0.05	0.09
2	Chandpur Purbopara Regd. Primary School	0.003	1.04	0.16
3	Kuchiamora Govt. Primary School	0.004	1.36	0.07
4	Madhabpur Govt. Primary School	0.006	0.71	0.04
5	TitarKhapara Reg. Primary School	0.004	2.01	0.04
6	Kalukandi Reg. Govt. Primary School	0.012	0.33	0.03
7	Charbororia Reg. Primary School	0.004	1.30	0.29
8	Raipur Reg. Primary School	0.004	0.32	0.04
9	Bathari Reg. Primary School	BDL	0.05	0.08
10	Rajgonj Govt. Primary School	0.001	0.03	0.06
11	Bamonkhali Govt. Primary School	0.004	0.21	0.06
12	Dhaneswargati Community Primary School	0.001	2.38	0.13
13	Tilkhari Govt. Primary School	0.005	3.79	0.18
14	Chandra Govt. Primary School	0.001	2.77	0.16
15	Kholabaria Reg. Primary School	0.009	1.10	0.28
16	Sreekol Govt. Primary School	0.003	0.76	0.04
17	Joka Govt. Primary School	0.002	2.65	0.41
18	Kodla Govt. Primary School	0.002	1.16	0.04
19	Charchougachi Reg. Primary School	0.011	1.35	0.02
20	Gashiara Govt. Primary School	0.005	1.56	0.66

BDL: Below the detection limit.

4. Conclusion

From the above discussion we can conclude that the people of Bangladesh are living with a danger of drinking water. Hence we need to adapt steps to cope the problems. Being a responsible citizen of Bangladesh we should make awareness to the people about harmfulness of heavy metals present in drinking water and inspire community people about sharing of safe drinking water.

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