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Drinking Water Quality at Academic Institutions of Tangail Municipality

M. Sultana, A. S. M. Saifullah, M. B. Latif, S. A. Mamun and D. S. Sultana

Department of Environmental Science and Resource Management, Mawlana Bhashani Science and Technology University, Tangail-1902, Bangladesh

Abstract: An experiment was conducted to explore the drinking water quality at some selected academic institutions of Tangail municipality during the period of August to September, 2012. For this, an investigation was carried out to study the standard water quality parameters such as pH, EC, TDS, Pb, As, Fe and E. coli concentration of the five academic institutions. In general, there were no major differences found in pH, EC and TDS values among the studied stations and not exceeded the recommended thresholds. In case of heavy metal content, very trace amount of Arsenic (0.0071ppm) was recorded from all selected institutions. In contrast, average lead concentration (0.307xppm) was much higher than all acceptable standard limits and most risky position was taken by station-3 (0.46ppm). Similar to Pb, average Fe concentration (0.255ppm) was five times higher than the acceptable value of EU standard but not exceeded BD standard value. All the samples were *E.Coli* bacteria free.

Key words: Arsenic, E. coli, Heavy metal, Tangail, Water quality

Introduction

Diseases related to contamination of drinking-water constitute a major burden on human health in Bangladesh (i.e. Arsenic is the largest poisoning of a population in history in Bangladesh, with a millions of people exposed). Whereas, it is estimated that of the 125 million inhabitants of Bangladesh between 35 million and 77 million are at risk of drinking contaminated water (Khan, 1997). Historically, surface water as a source of drinking water in Bangladesh has been contaminated with microorganisms, causing a significant load of disease and mortality. Infants and children suffered from acute gastrointestinal disease resulting from bacterial contamination of stagnant pond water. Consequently, tube-wells have been used in Bangladesh since the 1940s to provide ‘‘pure water’’ to prevent morbidity and mortality from gastrointestinal disease (Smith, *et al.*, 2000). From then, in Bangladesh, the water from millions of tube-wells that were installed was not tested for contamination. Whereas, water may contains natural contaminants, particularly inorganic contaminants that arise from the geological strata through which the water flows and, to a varying extent, anthropogenic pollution by both microorganisms and chemicals. Notwithstanding, an adequate supply of safe drinking water is one of the major prerequisites for a healthy life and also a significant economic preference in many subsistence economies.

The great majority of evident water-related health problems are the result of microbial (bacteriological, viral, protozoan or other biological) contamination. Nevertheless, an appreciable number of serious health concerns may occur as a result of the chemical contamination of drinking-water.

Tangail municipality is an important place for educational purposes within Bangladesh. There are several types of educational institutions and in these institutions about one lac students are studying from different districts of Bangladesh. So drinking water is a vital factor of these academic institutions. Still no study has been carried out about the heavy metals content and microorganisms’ presence in drinking water of these academic institutions in Tangail municipality. For this reason, to ensure the safety of drinking-water supplies, an experiment was conducted to assess the chemical properties (pH, TDS, EC) and heavy metals like Pb, As and Fe and microorganisms like E.coli in drinking water.

Materials and Methods

Study Site

The research work was conducted in the municipal areas of Tangail which town area is around 29.43 km^2 that was established in 1 July, 1887. There are 10 college, 39 high school, 156 primary school, 12 madrasa, 5 technical institution and 1 law college are situated (Banglapedia, 2006). The area has subtropical humid climate and characterized by high and low temperature accompanied by high humidity and heavy precipitation with occasional gusty winds (August- September). Average annual temperature: maximum 33.3°C, minimum 12°C and annual rainfall 1467 mm (Banglapedia, 2011).

The water samples were collected from ten different water pumps, located in different academic institutions around Tangail Municipality during 18th August, 2012 to 16 September, 2012. For this reason, five prestigious academic institutions namely

Sample-1)-B.B. Govt. Girls' High school,
Sample-2)-B.B. Govt. Boys' High school,
Sample-3)-Vivekananda School and College,
Sample-4)-Shahin Pre-cadet School, and
Sample-5)-Model Primary School

were selected and in each institution samples were collected from two different points.

Sample collection

The data collected through direct site inspection. When the samples collected from the different tube-wells, Color, Turbidity, Transparency and Odor were observed. The water samples were collected in 100 ml plastic bottles. Before collecting, bottles were cleaned with diluted hydrochloric acid (1:1) and washed with tap water followed by distilled water. However, bottles were rinsed again 3 to 4 times with sampling water before collection. To provide the necessary information for each sample such as date of collection, location, source of water, depth of tube-ell etc. were recorded in a note book. After collection, all the water samples were carried to the laboratory of NGO Forum in Dhaka within six hours of sample collection. After taking it to the laboratory, all samples filtered (Whatman no.1 filter paper) to remove unwanted solid and suspended materials before analysis.

Than the water quality parameters such as pH, electrical conductivity (EC) and total dissolved solid (TDS) were detected by respective digital meter. Than the water transferred into another 100ml bottle which contained 10 ml 2M hydrochloric acid solution to protect water samples from any fungal and other pathogenic attack for heavy metal test. For microbial test, the sample water was collected directly from the tube-well into another 100ml bottle. The water sample was collected carefully that the water should not be drop-up from the bottle that was contained 10 ml 2M hydrochloric acid solution and put the sample battles into ice in an ice box which contains 2 kg ice.

Sample analysis

Water pH was measured with the help of a neutralize pH meter (Croning, pH meter 32), the sample water ratio were maintained at 1:2 as stated by Eaton *et al.* (1995). The electrical conductance of samples were determined electrometrically using conductivity meter (Model WPACM 35) according to Tandon (1995). Total dissolved solids (TDS) measured using TDS meter (Model-10-Hi8633, Hanna) according to the method outlined by APHA (1995). Heavy metals were measured by Atomic Absorption Spectrometric method with the help of Atomic Absorption Spectrometer (AAS, UNICAM 969) according to Clesceri *et al.* (1989) and intensity was measured by maintaining a ratio for wave length 193.7nm, 217.0nm and 243.3nm for As, Fe and Pb respectively and finally calibrated with a standard curve. The membrane-filtration method was used for the confirmation of *E. Coli.* bacteria.

Data analysis

After assembling, all the data (Primary and Secondary) through field observations and laboratory investigation have been analyzed and the findings presented in this paper by charts, tables and diagrams by- MS-Word, MS- Excel, scientific calculator (Casio Super FX-100).

Results and Discussion

Chemical quality of drinking water

Figure 1(a) shows that the concentration of pH value of drinking water in different sources was almost neutral as average pH value was 7.18. So we can point out that the water was suitable for drinking purpose according to (WHO, 2011) where WHO they mentioned that the highest desirable and maximum permissible limit of pH for drinking water were 7.0 to 8.5 and 6.5 to 8.5 respectively. Similar trend was also observed by Baten *et al.* (2006). Whereas, the same studies also observed that pH of surface and ground water were almost similar but in Mymensingh.

Concentration of Electrical Conductivity values in different sources of drinking water is shows in Figure 1(b). In general, EC values of different water samples ranged from 0.46 µS cm^{-1} to 0.56 µS cm^{-1} and no marked variation was observed in other institutes. However, it was appreciable to observe that both pH and EC value did not cross the maximum acceptable value of drinking water by WHO, Bangladesh and EU standard as showed in Table 1 which was indicating that collected water was suitable for drinking purpose and free from any contamination. Additionally, studied water samples were also soft according to Alagbe, (2002), who observed that the water was soft with a low electrical conductivity ranging from 0.20-3.29 µS cm^{-1}. The concentration of EC may be fluctuating due to seasonal change and contamination

of ground water as Ahmed, (2012) observed that the EC of tube-well water during monsoon and winter seasons was 0. 46 μscm^{-1} and 0.52 μscm^{-1} respectively.

As TDS refers to the sum of all the components and composed of mainly Na^+ , K^+, Ca^+, Mg^+ . So the lower value of TDS indicates the good water quality (APHA, 1981; Moore *et a.*, 1960). However, in our country standard acceptable value of TDS for drinking water is 500 ppm (ADB, 2004). Here, the TDS values were lower than all acceptable value (table-1), which indicates that the water was good for drinking purpose. Similar trend was also found by Rahman *et al.,* (2004) and Islam *et al.*, (2006) in drinking water of Bangladesh Agricultural University Campus. The value of TDS was close to the sample stations might be due to absence of industrial waste, heavy rainfall and land-based run-off which carrying a large volume of suspended silts and clays.

Heavy Metal Contamination

The speciation of as in ground water is of critical importance because organic and inorganic compounds differ largely in their toxicity (Leonard, 1991). However, from the study, it is found that the As present in drinking water at all academic institutions in Tangail Municipality was very trace in amount (0.0071ppm) although sample water from Model Primary School (0.003ppm) gave little bit higher value than other institutions but always within the recommended and tolerable limit (0.01 and 0.05 ppm) respectively (USEPA, 2002). Similar result was found by Marin *et al.,* (2003) and Islam *et al.,* (2006) where they detected low As in drinking water of Bangladesh Agricultural University campus. Although the average concentration of Pb was higher but it does not affect the EC values.

International Standard for Pb in drinking water for acceptable limit was 0.01 ppm, and maximum limit was 0.1 ppm (WHO, 2011) and Bangladesh Standard level of Pb is 0.05 ppm (Table 1). It was found that Pb concentrations in all the water samples were collected exceed the tolerable level of WHO, EU and Bangladesh Standard. Similar result was found by Islam *et al.,* (2006) where they detected higher Pb in water of tube-well water in Mymenshing. This result was supported by Sattar and Islam (2004) where they detected Pb concentrations as 0.11 to 0.21 ppm from tube-well water at Dhaka metropolitan city.

Equally, average Fe concentration (0.255ppm) was five times higher than acceptable value of EU standard but not exceed our Bangladesh standard value. Because the highest desirable and maximum permissible limits of Fe for drinking water are Bangladesh Standard 0.3 to 1.0 ppm and The EU Standard is 0.2 ppm (Table 02). Nevertheless, most unsafe position was taken by Vebekananda School & College (0.36ppm). Similar result was found by Baten *et al.* (2006) where they detected higher Fe in drinking water of Bangladesh Agricultural University Campus. Quddus and Zaman (1996) indicated that the concentration of Fe in ground water of Meherpur sadar thana varied from trace to 0.05 ppm.

So we cannot postulate that heavy metal contents on drinking water of Vebekananda School & College, Shahin Pre- cadet school and Model Primary school are free from toxicity except As. In contrast, better quality water was observed from station and station-2.

E. Coli contamination*:*

Microorganism (E.Coli) concentrations of drinking water in the selected samples were not detected. It means that the collected water samples were free from E.Coli bacteria.

Table 1: *A comparison of studied parameters with acceptable value of WHO, WHO Bangladesh, and EU standard.*

Parameter	**Mean± sd**	**WHO**	**WHO Bangladesh**	**EU**
pH	7.180 ± 0.19	6.5-9.2	6.5-8.5	-
EC ($\mu S\ cm^{-1}$)	0.496 ± 0.32	250	500	250
TDS (ppm)	194 ± 15.77	-	1000	-
As (ppm)	0.0071 ± 0.005	0.01	0.05	0.01
Fe (ppm)	0.255 ± 0.09	-	0.3-1	0.2
Pb (ppm)	0.307± 0.15	0.01	0.05	0.01
E. Coli	0	0	0	0

(Source: World Health Organization; 2011.Guidelines for Drinking-water Quality, 4th Edition.)

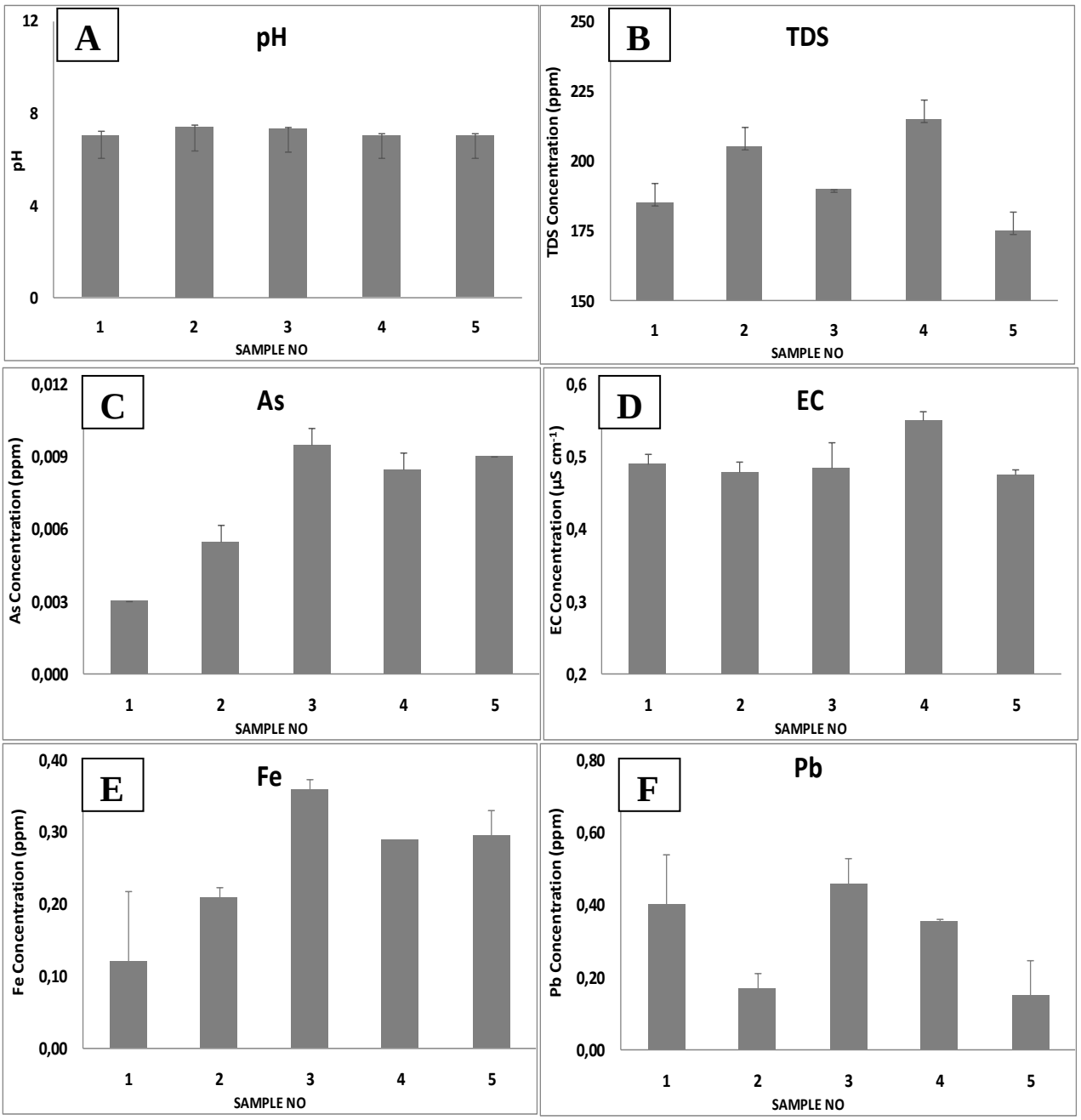

Figure 1: Concentration (mean±standard deviation) of pH, TDS, EC, As, Pb, and Fe at different sampling location.

Conclusion

Generally, it can be concluded that the drinking water of selected academic institutions in Tangail Municipality was suitable for drinking purpose as samples contained acceptable amount of the pH, EC, TDS, As, Fe, and E. coli except Pb and Fe. Additionally, it is observed that station-2 (B.B. Govt. Boys' High school, Tangail) and Station-1 (B.B. Govt. Girls' High school, Tangail) were more suitable and sampling station-3 (Vivekananda school and college, Tangail) was less fit for drinking purpose among other sampling stations. So, further research should be accomplished to understand the possible reason for higher concentration of lead and iron as well as which treatment ought to carried out to remediate those heavy metals.

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