

ASSESSMENT OF DRINKING WATER QUALITY SUPPLIED TO QUAID-E-AWAM UNIVERSITY OF ENGINEERING, SCIENCE & TECHNOLOGY (QUEST) NAWABSHAH, A CASE STUDY

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ABSTRACT

A comprehensive descriptive study was carried out in vicinity of Quaid-e-Awam University of Engineering Science & Technology (QUEST) Nawabshah, Sindh, Pakistan with the aim to ascertain the physicochemical quality and the presence or absence of bacterial contamination of drinking water supplied to this University. The areas under study included Boys Hostel, Mosque, department of Civil Engineering, Mechanical Engineering (B-Sector), departments of electrical engineering and Computer Sciences (A-sector), Administration block and civil laboratories (C-sector). The physicochemical data were collected from 08 different locations. Two different forms of chlorine (Total and residual) were measured at each sampling point. The significant analysis from the data available indicated that the pH generally varied from 8.31-8.41, TDS ranged between 1295-1313 mg/l, electrical conductivity was found fluctuated from 2160 – 2190 μ S/cm, turbidity was found within 6.85-9.72 NTU, total hardness as Ca CO₃ was recorded Over Range (>500 mg/l) at each station and all the samples were having no chlorine in both Total and residual free forms. All the samples (100%) were found positive for bacterial contamination.

Key words: Drinking water quality, Chlorination, Disinfection, Distributions System, Nawabshah

1. INTRODUCTION

Drinking water is considered as an integral aspect of life sustainability. Its availability and quality has remained one of the critical issues in the water sector of Pakistan. It is considered that 60% of the population is served with safe drinking water in urban areas but the same is not true for rural areas, as the figure is not more than 45% [1]. For analyzing the quality of the water there is no any regular monitoring program in this country even the Drinking Water Treatment Plants (DWTP) are not included in the monitoring system which allows severe bacteriological contamination to go unobserved at all the levels of the distribution of the drinking water supplied to the end users [2]. It is believed that the distribution system of the drinking water plays an important and vital role for preserving and supplying the safe drinking water to the public [3]. The availability of disinfectant like chlorine in the distribution has remained as an exceptional sign for studying water quality in the distribution network [4].

Many researchers have indicated that the drinking water supplied without having the traces of disinfectant as residual chlorine bacterial growth of many microorganisms can be traced with elevated levels while the availability of residual chlorine reduces the microbial contamination level and its frequency of the occurrences at the tap of the end user [5]. Various viruses such as Hepatitis A Virus, Hepatitis E Virus, Rota Virus and parasites like *Entamoeba histolytica*, *Giardia lamblia* are also to be found in the absence of disinfectant [6-9]. The quality of the drinking water supplied through distribution network in Nawabshah city has always remained questionable and no major research projects are carried out so far strengthening the fact that the water microbiology and physicochemical analysis has remained a neglected subject [10-15]. However the present study is based on both physicochemical analysis and presence or absence of bacterial growth in the drinking water supplied to QUEST Nawabshah which indicates that all the samples (100%) are free from chlorination and

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consequently are positive for bacterial contamination.

2. MATERIALS AND METHODS

Spectrophotometers, Multiparameter Meter were used to analyze the physicochemical parameters. For presence and absence (P/A) of E. Coli in the samples, Broth Ampules method (HACH) kit was used. A total of 80 samples were collected from 08 different locations in such a way to make it representative study of the area taken into consideration. The samples were collected with intensive care in highly sterilized plastic bottles of 200 ml. All the samples were collected, transported and analyzed according to APHA [16]. Sampling locations and sampling frequency are shown in Table 1. In this study pH, TDS, Electrical Conductivity (EC), Temperature, were analyzed by SensIon 59 Multiparameter Meter (HACH), Hardness, Turbidity and Dissolved Oxygen (DO) were analyzed with Digital Spectrophotometer DR 2700 (HACH).

Table 1: Sampling locations and frequency

S. No.	Area	Location	Samples
1	Boys Hostel	Hostel Masjid	10
2	Boys Hostel	B Block	10
3	B – Sector	Civil Eng. Dept	10
4	B- Sector	Mech. Eng. Dept	10
5	A-Sector	EE Dept.	10
6	A-Sector	C.S. Department	10
7	C-Sector	Civil Labs	10
8	C- Sector	Admin Block	10

3. RESULTS AND DISCUSSIONS

From the present study it is revealed that the critical parameters of drinking water at various locations of QUEST are not found satisfactory. The pH at all locations is ranging from 8.31-8.41, with a clear indication that the pH of location 8 (Administration block) is very close to 8.5 the maximum contamination level (MCL) for pH by WHO (2007) [17]. The situation of the water supply in other cities of the country is not satisfying but for pH parameter of Rawalpindi drinking water, it has been reported as 7.3. These results are also in accordance with the earlier study conducted by PCRWR- DRIP in 2007, showing that the pH values varied from 7.00–8.30 [18]. The mean values of pH against each location are shown in figure 1.

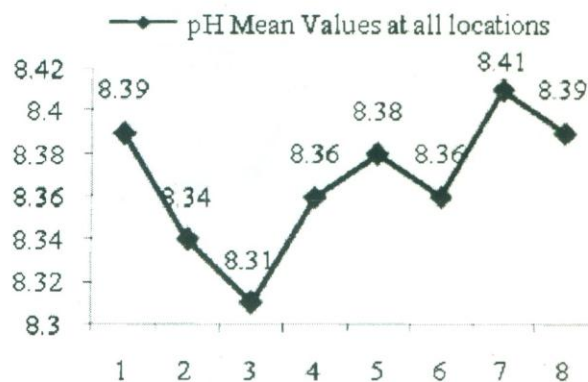


Figure 1: pH Mean values at all locations

Temperature is considered as one of the significant limitations due to the fact that the microbial growth is directly related to it. Temperature observed at the time of collection of water samples ranged from 19.6 to 20.64°C. The minimum value of 18 °C is observed at location #5 (Electrical Engineering Department). However the data has indicated that this parameter exceeds the WHO limit of 12°C. These observed results are in line with the study carried out by [19]. The mean values of this parameter at all locations are presented in figure 2.

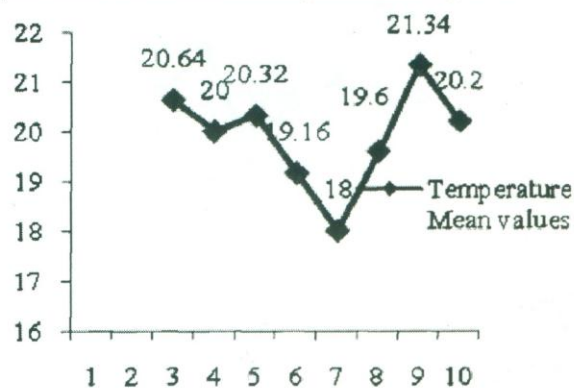


Figure 2: Temperature Mean values at all locations

The total dissolved solids (TDS) values of the samples were found fluctuated from 1295 to 1313 mg/l, these limits exceed the WHO the highest limits for TDS in drinking water of <500 mg/l consequently based on TDS decisive factor all the water samples were found unfit for drinking purposes. These results are not in accordance with [19 & 20]. The observed mean values of TDS are presented in figure 3.

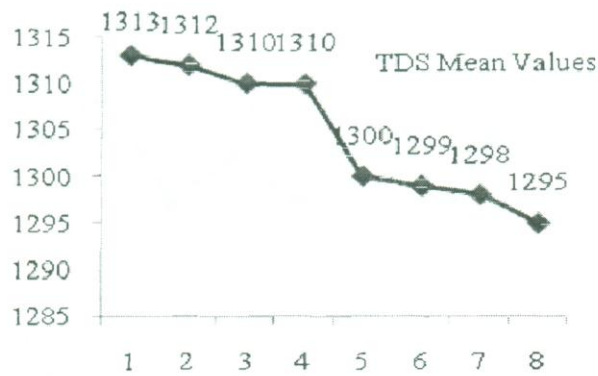


Figure 3: TDS (mg/l) Mean values at all locations

Electrical Conductivity (EC) is one of the important parameters of drinking water. In our study the values of conductivity varied from 2160 to 2190 $\mu\text{S}/\text{cm}$. In a study it is revealed that statistically a close proportionality of TDS and EC remains evident and that the increased temperature increases the conductivity due to increase of termination of ionic variety [21]. The observed mean values of EC of this study are presented in figure 4.

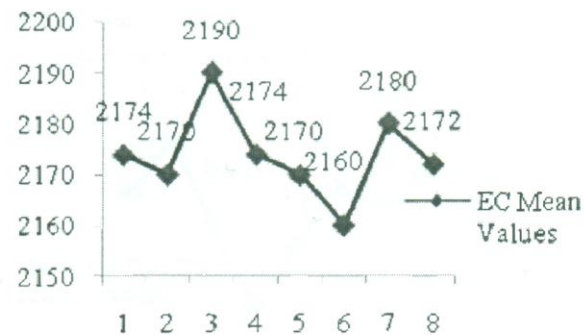


Figure 4: EC Mean values at all locations

Turbidity has a vital role to maintain the quality of drinking water especially when the microbial contamination is taken on priority. The microbiological quality of drinking water can be significantly affected by turbidity since it is dependent variable of source water quality and the basic determinant for various elements of the treatment plants as well [22]. The maximum contamination level (MCL) allowed by WHO for this parameter is 5 NTU, whereas in this study we are not within allowed MCL. The values varied from 6.85 to 9.72 NTU. Location # 8 (Civil Labs) is the critical location where the maximum turbidity 9.72 NTU is observed.

Based on turbidity, the drinking water quality at all locations cannot be considered as safe for drinking. The mean values of turbidity are shown in figure 5.

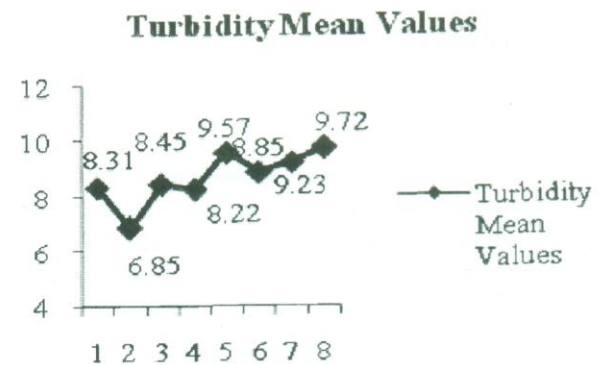


Figure 5: Mean Values of Turbidity at all locations

Chlorine in both forms as Total chlorine and free residual chlorine was not found in all the samples at all locations. Non-availability of chlorine indicates that there is potential microbiological presence of many species which may cause serious health problems for the end users. The same situation can be realized in other cities of the country as confirmed in a study [23], endorsing that the free residual chlorine was not found in drinking water samples collected from the distribution line of sukkur.

Hardness as CaCO_3 at all locations were found over range of (>500 mg/l) when measured on spectrophotometer. The Hardness MCL allowed by WHO is not more than 500 mg/l, therefore exceeded limits of hardness in all the samples reveals that the quality of drinking water is deteriorated. No previous study is available yet for these locations except PCRWR (2004) reporting 370 mg/l for the water supplied in Hyderabad city.

An effort was made to analyze the bacteriological contamination by performing the Broth Ampules Kit (HACH) method to confirm the presence and absence of these E.Coli. According to WHO there should be 00 / 100 ml coliform in the drinking water. The observations exposed that 100% of the samples were found positive (presence) of E.Coli.

4. CONCLUSIONS

After comprehensive critical analysis of the samples of the drinking water supplied through WASA Nawabshah

from the original source of Rohri Canal and Gajra Wah, supplied by distribution lines to the different locations of QUEST, taken in this study it is concluded that:

- pH values are within normal ranges (8.31-8.41) with a note that these values are very close to the standard values (6.5-8.5) therefore proper monitoring of this parameter is required essentially.
- TDS are also higher than the specified limits of 500 mg/l in each sample indicating the deteriorated quality of the water supplied.
- Conductivity is out of range of the standards available from WHO.
- Turbidity of all the samples is more than 5 NTU which is an indicator to preserve the bacterial growth.
- Hardness as CaCO₃ is found "over range" in all samples which may have some potential health problems for the end user.
- Temperature is more than 12°C the WHO standard.
- Bacterial presence was found in all the samples at all locations.

Based upon the research carried out in this study it is finally concluded that the drinking water supplied to the users of the vicinity of QUEST cannot be considered "SAFE" for drinking. Therefore it is recommended that a critical monitoring of disinfectant like chlorine must be carried out on regular basis to prevent the potential health risks to the end consumers. The recommended dose of free residual chlorine 0.2-0.5 mg/l must be ensured to be found in the distribution line.

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