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RESEARCH ARTICLE

PHYSIOCHEMICAL AND MICROBIOLOGICAL ANALYSIS OF DRINKING WATER IN EDUCATIONAL INSTITUTES OF HYDERABAD SINDH NEAR INDUS RIVER

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ABSTRACT

Objectives: Evaluation of Physical and Chemical quality of drinking water available in Educational institutes of city Hyderabad of Sindh Pakistan near Indus River.

Background: Drinking water quality is the great public health concern because it is a major risk factor for various viral, bacterial and protozoan diseases, globally. Over 25 million deaths are blamed due to waterborne-diseases. Pakistan has been facing the same problem due to improper water management, bad sanitary condition and poor drinking water quality. Human activities also contribute further more impurities and ultimately it affects the quality of water. If this contaminated water is used for drinking water, it may cause health problem. The educational progress of students depends on health. The water is one of the vital components of human health, because about 60-65% diseases are spread through water.

Study design: Cross sectional study

Study setting: Thirty two Educational Institutes randomly selected in the field practice area of Department of Community Medicine, LUMHS, Water Testing & Surveillance Laboratory, LUMHS, Jamshoro, Sindh.

Material and Methods: The drinking water samples from Thirty two Educational Institutes located in Hyderabad were collected as per standard procedure. Analyzed from various physico-chemical parameters and Microbiological parameters as per PSQCA(Pakistan Standard Quality Control Authority)/ WHO standards. For analysis samples were transported to Water Testing & Surveillance Laboratory, Department of community medicine, LUMHS, Jamshoro, Sindh.

Results: Data revealed that the pH of all samples ranged from 7.7-7.9, conductivity 750 μ S to 879 μ S, Salinity 0.5 %, Total Dissolved Salts 592mg/L to 736mg/L, The Turbidity of sample No: 2, 15,25,26,27,28,29,30,31 & 32 is higher than the permissible limit of WHO i. e; 5 NTU, Arsenic level of all samples shows within the limits of WHO standards, while Total coliform, Total Fecal Coliform and E-Coli were positive in all the samples.

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INTRODUCTION

Surface water sources or the underground aquifers are the only drinking sources in Pakistan. Underground aquifers supplies about 70% of the total drinking water. This ratio is further increasing at present. In many areas of Pakistan the water quality for drinking water is not matching to the WHO/Pakistan criteria. Without proper treatment of disposal of the industrial,

municipal and waste waters, and also because of the saline drainage flow from agricultural areas is deteriorating (Tahir et al., 1998, Chilton, 2001). Various physicochemical parameters for drinking water in Pakistan are not in accordance with the standards of WHO/Pakistan identified by various research studies (Rahman, 1996, Malana et al., 2011, Baig et al., 2012, Farid et al., 2012). Outbreak of diseases is caused by Polluted drinking water. Three districts of southern Sindh Pakistan namely Thar, Badin and Thatta, was found responsible for poor water quality of vomiting, gastroenteritis, diarrhea, skin and kidney problems (Memon et al., 2011). Salt, pathogenic microorganism toxic organic, inorganic

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compounds, and heavy metals, may also be present in water when agricultural and industrial waste is mixed with drinking water. Improper management of human and livestock waste also their disposal and treatment can affect the quality of water (Singhal et al., 2003). The contamination of ground water is caused by Infiltration of effluent from septic tanks. Pesticides residual, industrial effluents Agricultural runoff, also affect the quality of underground water sources (Eicchon et al., 2001). Leakage from sewage gain the entry to distribution system of drinking water is one of the most common sources of drinking water pollution, alter the physiochemical properties of drinking water, spread disease causing microorganism. The most dangerous water pollutants are pathogenic microorganism in terms of human health (Cunningham 2005). Water play vital role in the spreading of various protozoan, bacterial, and viral diseases from the bagging of the recorded history. Wide variety of microorganism contaminates the drinking water by some pathogenic microbes and cause different diseases in human. Dangerous disease like dysentery, typhoid, cholera, hepatitis, and diarrhea can spread by focally polluted drinking water, it is an established fact. The most important one is diarrhean these waterborne diseases. Worldwide 250 million cases of waterborne diseases are reported (Esrey et al., 1985). 25 million deaths are blamed due to waterborne diseases annually (Cunningham 2005). 40% children's under 5 years age are affected by Diarrhea, a waterborne disease. In developing countries, due to prevalence of diarrhea among 1.5 billion cases, 4 million ends with death (Esrey et al., 1985).

In developing countries 80% of all sickness and diseases due to waterborne pathogens and inadequate sanitation system, reported by WHO. In developed countries 90% have adequate, proper managed and safe disposal, 95% of the population has access to clean and safe drinking water, according to UN report. In developing countries the situation is different. In developing countries at least 2.5 billion populations have no proper managed sanitation system and above half of these people have no access to safe drinking water by UN report (Cunningham 2005). For water distribution, Pakistan is also facing the problem of waterborne diseases due to lack of infrastructure facilities, poor water quality and improper manages sanitary conditions. Drinking water before human consumption must be treated and free from toxic chemicals and pathogenic microbes, recommended by WHO (Pak EPA 2005). But drinking water treatment is rarely done before consumption and no such international standard are perused for physical, chemical and microbiological limits of drinking water. Rural areas of Pakistan consists of 70% population has no proper water supply system. In Pakistan, urbanization also threatens to drinking water quality. Urbanization has increased from 31% to 34% in last few years in Pakistan. Safe drinking water availability reduced from 60% to 40% due to increase in urbanization (WHO 1976 report). Due to use of contaminated water 60% deaths occur in Pakistan (Hussain, 2007). Water filtration before distribution is almost non-existence and furthermore, WHO standards are not followed for physiochemical and bacteriological analysis of drinking water, in Pakistan. This study was conducted for physiochemical and bacteriological analysis of drinking water of Educational Institutes of Hyderabad.

MATERIALS AND METHODS

A cross sectional study was conducted with five rounds between November and December 2012. Water samples were collected from reservoirs of Thirty two educational institutes of Hyderabad city and adjacent areas of Hyderabad like Qasimabad, Hussainabad, and Latifabad. Each source to allowing water to flow for 3-5 minutes then samples were collected in polystyrene bottles, which were rinsed 3 times before collected the water samples, as per standard procedure. These samples were analyzed from various Physico-chemical parameters such as PH, EC, Salinity, TDS, Turbidity Arsenic, Conductivity, by conductivity meter (Model no: sanso-direct con 200). Microbiological parameters such as Total coliform bacteria, Total fecal coliform bacteria and E. coli as per WHO standards. For analysis samples were collected in sterilized bottles and kept in ice box for further process in the Water Testing & Surveillance Laboratory, Department of Community Medicine, LUMHS, Jamshoro. The Educational Institutes are indicated by names in Table 1.

Physicochemical Analysis

EC, Salinity, TDS, was analyzed by conductivity meter (senso direct con 200) and pH was measured by pH meter, Turbidity was also measured on digital turbidity meter (PCCHECKIT, Germany), Arsenic was measured with Merk Arsenic Kit (Yu G Son et al., 2007).

Bacteriological Analysis

Bacteriological analysis of drinking water samples were done by Multi-tube Fermentation Method. The Most Probable Number (MPN) of bacteria present in water sample has been estimated from the specially developed statistical table. Confirmatory test on selective culture medium were also performed.

Coli form

Coli form bacteria analysis of drinking water sample were done by Most Probable Number (MPN) method of diluted samples 1:10. Lauryl Tryptose Broth and Brilliant Bile Broth were used as a growth media.

Fecal coli form

Fecal coli form bacteria were analyzed by inoculation method. *Coli form* positive Lauryl Tryptose Broth tubes were inoculated on EC Broth and incubated for 24 h at 44.5°C.

E. coli

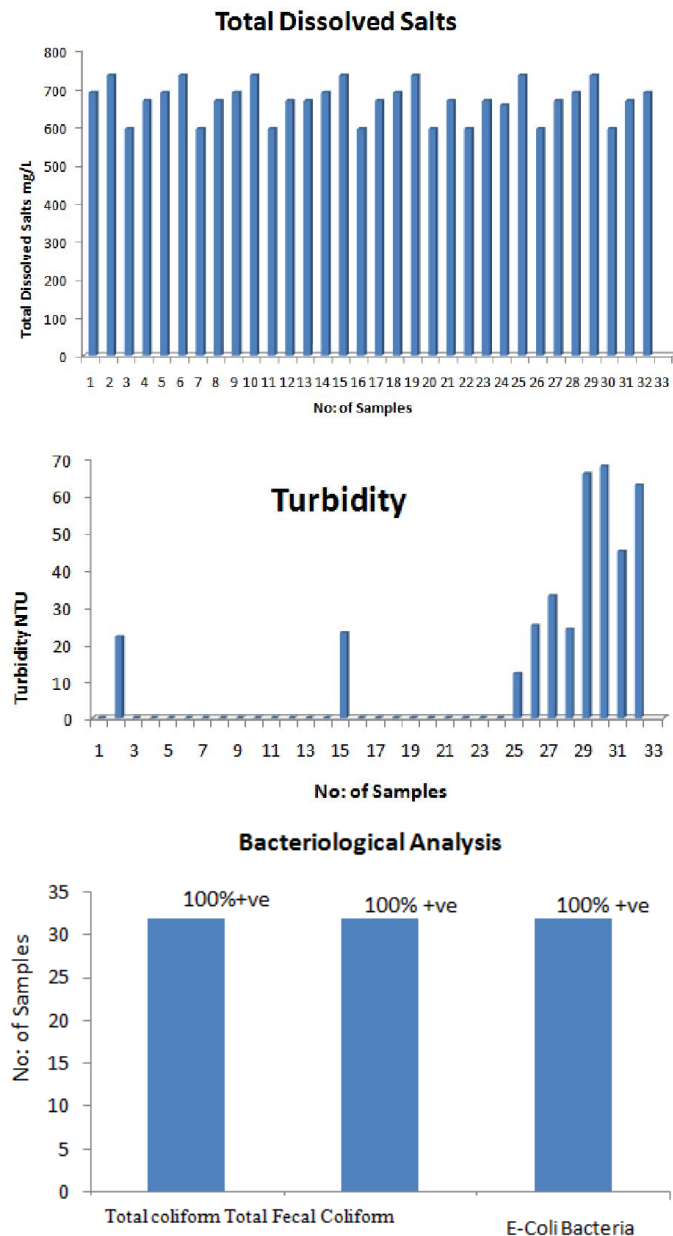
E. coli was analyzed by streaking method. Streak inoculums loop from positive EC Broth tube on Eosin Methylene Blue Agar plates and incubated for 24 to 48 h at 35°C. *E. coli* colonies were confirmed by iodole test. The examination coli form, fecal coli form and E-coli studies were followed by multi tube fermentation method MPN method.

Table 1. Physicochemical and Microbiological Analysis of Drinking Water of Educational Institutes of Hyderabad

S. #:	Name of School/ Sampling Area	pH	EC μS	Salinity %	TDS mg/L	Turbidity NTU	Arsenic mg/L	Total Coliform Bacteria MPN / ml	Total Fecal Coliform Bacteria MPN / ml	E-Coli Bacteria
1	Arshi Public School Hussainabad, Hyderabad.	7.8	873	0.5	690	0.00	0.00	+ve	+ve	+ve
2	Govt: Girls High School, Hussainabad, Hyderabad.	7.8	829	0.5	735	22	0.00	+ve	+ve	+ve
3	Qutub Shah Govt: Primary School, Hussainabad, Hyderabad.	7.7	752	0.5	594	0.00	0.00	+ve	+ve	+ve
4	Al-Hafiz Islamia Middle School, Hussainabad, Hyderabad.	7.7	847	0.5	668	0.00	0.00	+ve	+ve	+ve
5	The Faheem's Academy, Latifabad # 02, Hyderabad.	7.8	875	0.5	691	0.00	0.00	+ve	+ve	+ve
6	Public School, Latifabad # 03, Hyderabad.	7.8	825	0.5	733	0.00	0.00	+ve	+ve	+ve
7	The Educators, Latifabad # 03, Hyderabad.	7.7	756	0.5	592	0.00	0.00	+ve	+ve	+ve
8	Chamber Public School, Latifabad # 05, Hyderabad.	7.7	844	0.5	667	0.00	0.00	+ve	+ve	+ve
9	Excellence Girls College, Latifabad # 06, Hyderabad.	7.8	879	0.5	695	0.00	0.00	+ve	+ve	+ve
10	Bride Kids Academy, Latifabad # 06, Hyderabad.	7.8	822	0.5	732	0.00	0.00	+ve	+ve	+ve
11	New Sadia Cambridge High School, Latifabad # 07, Hyderabad.	7.7	758	0.5	593	0.00	0.00	+ve	+ve	+ve
12	The Innocent Public High School, Latifabad # 08, Hyderabad.	7.7	841	0.5	665	0.00	0.00	+ve	+ve	+ve
13	Brilliance Academy, Latifabad # 09, Hyderabad.	7.7	845	0.5	666	0.00	0.00	+ve	+ve	+ve
14	Early Learning School System, Latifabad # 09, Hyderabad.	7.9	870	0.5	690	0.00	0.00	+ve	+ve	+ve
15	Govt: Girls High School System, Latifabad # 10, Hyderabad.	7.8	820	0.5	736	23	0.00	+ve	+ve	+ve
16	Iqra Public High School, Latifabad # 10, Hyderabad.	7.7	753	0.5	594	0.00	0.00	+ve	+ve	+ve
17	Foundation Public School, Auto Bhan Road, Latifabad, Hyderabad.	7.7	840	0.5	668	0.00	0.00	+ve	+ve	+ve
18	Tiny Tots School Tilik Chari, Hyderabad.	7.8	877	0.5	690	0.00	0.00	+ve	+ve	+ve
19	Govt: Primary School, Pathan Colony, Hyderabad.	7.8	839	0.5	735	0.00	0.00	+ve	+ve	+ve
20	Dawn Future School, Heerabad, Hyderabad.	7.7	750	0.5	594	0.00	0.00	+ve	+ve	+ve
21	Govt: High School, Society # 02, Hyderabad.	7.7	848	0.5	668	0.00	0.00	+ve	+ve	+ve
22	Doctor N.A Balouch, Model School, Haider Chowk, Hyderabad.	7.7	753	0.5	594	0.00	0.00	+ve	+ve	+ve
23	Bradford Public High School, Masoom Shah Colony, Hyderabad.	7.7	847	0.5	668	0.00	0.00	+ve	+ve	+ve
24	Islamic Public Service High School, Risala Road, Hyderabad.	7.8	833	0.5	657	0.00	0.00	+ve	+ve	+ve
25	Nanat Rai High School, Gol Building, Hyderabad.	7.8	829	0.5	735	12	0.00	+ve	+ve	+ve
26	Govt: Kali Mori College, Hyderabad.	7.7	752	0.5	594	25	0.00	+ve	+ve	+ve
27	Govt: Sachal Commerce College, Faqir Jo Pir, Hyderabad.	7.7	846	0.5	668	33	0.00	+ve	+ve	+ve
28	Technical College, Wehdat Colony, Hyderabad.	7.8	877	0.5	690	24	0.00	+ve	+ve	+ve
29	Govt: Muslim Science College, Hyderabad.	7.8	820	0.5	731	66	0.00	+ve	+ve	+ve
30	Govt: Noor Muhammad High School, Hyderabad.	7.7	752	0.5	594	68	0.00	+ve	+ve	+ve
31	Govt: Mirza Qaleech Baig Higher Secondary School, Hyderabad.	7.7	853	0.5	668	45	0.00	+ve	+ve	+ve
32	Govt: Haji Manak Bhatti (National) High School, Hyderabad.	7.8	871	0.5	690	63	0.00	+ve	+ve	+ve

RESULTS AND DISCUSSION

The water analysis report shows that the pH of all samples between the range of 7.7-7.9, conductivity 750 μ S to 879 μ S, Salinity 0.5 %. Total Dissolved Salts ranged from 592mg/L to 736mg/L, which is slightly exceeds the permissible limit (WHO i.e 500 mg/L). The Turbidity of sample No: 2, 15,25,26,27,28,29,30,31 & 32 is higher than the permissible limit of WHO i. e; 5 NTU, Arsenic level of all samples shows within the limits of WHO.



All samples contain unacceptable (Total coliform, Total Fecal Coliform and E-Coli), hence water available in all institutions is not potable and unfit for human consumption. The disinfection of water is required to carry out before distribution in Educational Institutions.

Conclusion

The physicochemical parameters of water samples of Educational Institutions exceeding permissible limit as laid

down for drinking water by PSQCA(Pakistan Standard Quality Control Authority) / WHO specification are not suitable for drinking purpose and hence proper treatment is required for distribution of water before use. The bacteriological parameters of water samples of Educational Institutions exceeding permissible limit by PSQCA (Pakistan Standard Quality Control Authority)/ WHO specification are not suitable for drinking purpose and hence before distribution of water, disinfection is required.

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