

Physical and Microbiological Analysis of Water from Different Sources of Karachi

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ABSTRACT

Objective: A number of diseases are caused by consuming water of poor quality. According to a community health study 30% of all reported cases of illnesses and 40 % of deaths in Pakistan are due to waterborne diseases. The purpose of the study was to i) to determine the physical quality and presence of total coliforms and *Escherichia coli* count and also ii) to compare the coliform and *Escherichia coli* bacteria in drinking water of different towns of Karachi with WHO 's recommended values.

Study Design: Retrospective Study.

Place and Duration of Study: This study was conducted in the Department of Biochemistry in collaboration with Department of Microbiology, Basic Medical Sciences Institute, Jinnah postgraduate Medical Centre Karachi during the period of June 2007 to February 2008.

Materials and Methods: Multiple water sample collected from 18 towns of Karachi by different sources like Piped water, Hand pumps, Mineral bottles and Filter plants. The 250 milliliters sample for microbiological analysis was collected to perform all the required analyses and to provide for any quality control need, split samples or repeat examination. Statistical Package for Social Science (SPSS version 11.0) used for data feeding and analysis. The results was given in the text as number and percentage for qualitative/categorical variables like *E. Coli* and Coliform and mean and standard deviation for quantitative variables like Physical parameters (pH, Temp, DO, Conductivity, TDS).

Results: The pH in tap water samples ranged between 6.8 to 7.6. Temperature recorded at spot ranged between 25-32 °c. The dissolved oxygen varied from 3.6 to 4.8 pm, its permissible limit is 4ppm. In 108 tap water samples MPN of coliform/100 ml water samples were < 10 in 21(19.4%) samples and > 10 in 87(80.6%) samples. Recovery of *E. coli* as indicator organisms of fecal pollution in different water samples were found.

Conclusion: During the drinking water quality assessment a wide range of pollutions were found and generated very useful baseline information on the current pollution status of supplied water to Karachi which indicates that Karachi is receiving highly polluted water.

Keywords: water pollution, physical, microbiological analysis, Karachi

INTRODUCTION

Human health depends on safe water more than any other thing. Basically the life of human is related to safe drinking water. Most of the problems in developing countries are mainly due to the lack of safe drinking water¹. Aquatic pollution in Pakistan is mainly due to increasing anthropogenic and agricultural activities, fast urbanization, rapid industrial development, poor sanitation system and unhygienic practices by general public. According to a community health study 30% of all reported cases of illnesses and 40 % of deaths in Pakistan are due to waterborne diseases. Poor quality of water human consumption may be either due to the presence of harmful bacteria and absence or excessive electrolyte concentration.² The presence of minerals in drinking water can have both good and bad consequence. Several minerals known to be beneficial and essential for human life, while other are toxic even in small amount. ³ Polluted water is a major cause of human diseases, misery and death. According to the World Health Organization (WHO) about 4 million children die every year as a result of diarrhea caused by

waterborne infections. The bacteria most commonly found in polluted water are coliforms excreted by human beings. Improperly designed rural sanitary facilities also contribute to contamination of groundwater.⁴ The scanty hospital's data indicating that a substantial proportion of morbidity in Pakistan is due to use of polluted water. Gastrointestinal infections resulting in diarrhea show high frequency among children as well as adults.⁵ The pathogenic strains have been associated with several diseases including diarrhea, urinary tract infections and meningitis. ⁶ In developing countries, diarrheal diseases are often associated with infant and child deaths (Sobel et al. 2004).⁷ Based on crude presumptive tests, Hunter et al. reported, that *Escherichia coli* is present within many of the drinking pools.⁸ *Escherichia coli* (*E. coli*) is a member of fecal coliforms that contaminate the drinking water from human and animal fecal waste.⁹ Water-washed route in which disease is associated with scarcity of water for personal hygiene are scabies, skin ulcer, and conjunctivitis and water-based route which involves parasites include schistosomiasis.¹⁰

The purpose of the study was to determine the physical quality and presence of total coliforms, sand Escherichia coli count and also to compare the coliform and Escherichia coli bacteria in drinking water of different towns of Karachi with WHO values.

MATERIALS AND METHODS

This study was conducted in the Department of Biochemistry in collaboration with Department of Microbiology, Basic Medical Sciences Institute, Jinnah postgraduate Medical Centre Karachi during the period of June 2007 to February 2008. Multiple Water sample collected from 18 towns of Karachi. 1) Kamari 2) Baldia 3) SITE 4) Lyari 5) Sadar 6) Orangi 7) North-Nazimabad 8) Liaquatabad 9) Jamshed 10) New Karachi 11) Gulberg 12) Gulshan-e- Iqbal 13) Korangi 14) Shah Faisal 15) Landhi 16) Binqasim 17) Malir 18) Gadap.

Water collected by different sources: 1) Piped water. 2) Hand pumps. 3) Mineral bottles. 4) Filter plants.

For Physical Parameters: Drinking water samples were collected from the residential areas of all towns of Karachi region at consumers ends houses, apartments, schools, hospitals, hotels, pumping stations, masjid, private hydrants, bore water etc. One liter polyethylene acid resistant, washed rinsed with deionized water and dried bottles were used. Bottles were completely filled with the water samples and after noting the physical parameters, 5ml of (conc.) HNO_3 were added as preservative to adjust the pH < 2.0. Sample numbers with dates were marked. 250 milliliters sample for microbiological analysis was collected to perform all the required analyses and to provide for any quality control need, split samples or repeat examination.

For Microbiological Parameters: For collection, use heat-sterilized bottles containing a sufficient volume of sodium thiosulphate to neutralize the bactericidal effect

of any chlorine or chloramines in the water. Each bottle of 250ml capacity should contain 0.1ml of a fresh 1.8% (w/v) aqueous solution of sodium thiosulphate. When collecting the sample, exercise extreme care to avoid contaminating it with bacteria from the environment. The water sample collected was cultured on following media: MacConkey broth, Brilliant green lactose bile broth, EMB agar.

Statistical Package for Social Science (SPSS version 11.0) was used for data feeding and analysis. The means and standard deviation of quantitative/ continuous variables according to sources of water was compared by Student's "t-test". In all statistical analysis, only p-values < 0.05 was considered significant.

RESULTS

Table 1 show the comparison of mean values of physical parameters pH, temperature and dissolved oxygen in different sources of water supply in Karachi recommended by WHO. The pH in tap water samples showed neutral characteristics and within the permissible limits of WHO. Temperature recorded at spot ranged between 25-32 °c. The dissolved oxygen was also measured and was in permissible limit of 4ppm. The pH in bore water samples was also within permissible limits of WHO. Temperature ranged between 25-32 °c. The dissolved oxygen varied from 3.6 to 4.6 ppm and was within permissible limits of WHO. In tap water samples the specific conductivity was also measured on spot, its range from 375 to 550 mmho/cm. The conductivity of bore water ranged from 914 to 2387 mmho/cm and was higher as compare to WHO. The TDS concentration of bore water in all towns of Karachi was above 500 ppm and lower than excess limits i.e. 1000 ppm while it was significantly higher in bore water as compared to tap water. (P< 0.05)

Table No.1: Comparison of Physical and Biochemical Parameters in Tap, Bore Sources of Water, Filter Plant and Mineral Water in Karachi

Parameters	WHO VALUES	Sources of Water in Karachi				Filter plant (n=12)		Mineral Water (n=12)		P-Value
		Tap water (n=108)		Bore water (n=108)						
		Mean	±SEM	Mean	±SEM	Mean	±SEM	Mean	±SEM	
PH	6.5 - 8.5	7.33	±0.038	7.34	±0.038	7.42	±0.047	7.59	±0.055	0.151
Temperature	Not mentioned	30.95	±0.339	31.44	±0.215	29.20	±1.290	30.90	±0.450	0.102
DO	4 ppm	4.40	±0.075	4.24	±0.054	6.20	±0.280	5.71	±0.401	0.001
Conductivity	500μ mols	474	±6.2	1656	±77.5	561	±348.5	391	±43.1	0.001
TDS	500 mg/l	291	±3.6	1085	±87.9	348	±43.4	262	±22.3	0.001

Table 2 show the degree of bacterial pollution in different water samples. In 108 tap water samples MPN of coliform/100 ml water samples were < 10 in 21(19.4%) samples and > 10 in 87(80.6%) samples. In 108 bore water samples MPN of coliform /100 ml water samples were < 10 in 32(29.6%) samples and > 10 in 76 (70.4%) samples. In 12 mineral water samples MPN of coliform/100 ml water samples were < 10 in 08 (66.7%) samples and > 10 in 05 (33.3%) samples. In 12 filter plants water samples MPN of coliform /100 ml water samples were < 10 in 07 (58.3%) and > 10 in 05 (41.6%) samples.

Table No. 2 Recovery of Bacterial Pollution in different Water samples of Karachi

Water samples	MPN of Coliform per 100 ml of water	
	<10	>10
Tap Water (n = 108)	21 (19.4%)	87 (80.6%)
Bore Water (n = 108)	32 (29.6%)	76 (70.4%)
Filter Plant (n = 12)	07 (58.3%)	05 (41.6%)
Mineral Water (n = 12)	08 (66.7%)	04 (33.3%)

Table 3 shows recovery of E. coli as indicator organisms of fecal pollution in different water samples. In 108 tap water samples MPN/100 ml were found 29 (26.9%) positive samples. In 108 bore water samples MPN/100 ml were found 25 (23.1 %) positive samples. In 12 filter plants water samples MPN/100 ml were found 04 (33.3%) positive samples. In 12 mineral water samples MPN/100 ml were found 03 (25%) positive samples

Table No. 3: Comparative Distribution of E-Coli in Different Sources of Water Samples in Karachi

Sources of water	Positive No.	%
Tap water (n=108)	29	26.9
Bore water (n=108)	25	23.1
Filter Plant (n=12)	4	33.3
Mineral Bottle (n=12)	3	25.0

DISCUSSION

This study was designed to determine the physical and biochemical parameters along with total coliform and E.coli in potable water from different sources of Karachi. Although no health based guideline is

proposed for pH, eyes irritation and other skin disorders are associated with values of pH greater than 11.

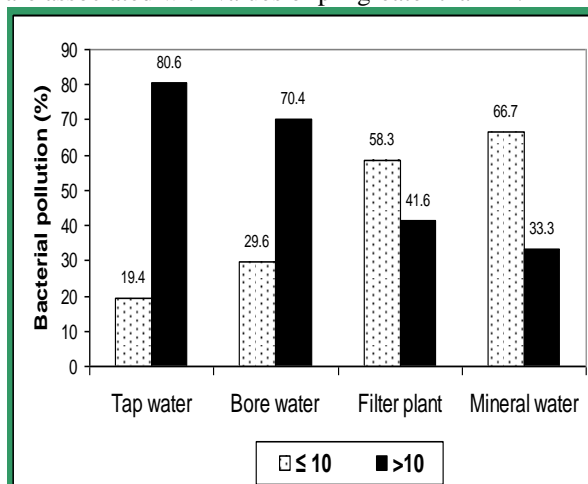


Figure No. 1: Recovery of Bacterial Pollution in different Water samples of Karachi

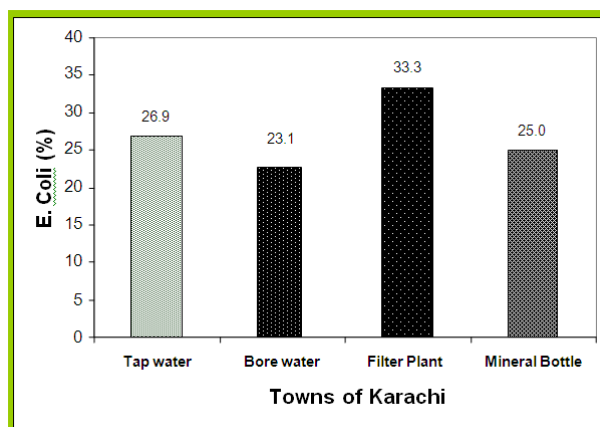


Figure No.- 2: Comparative distribution of e-coli in different sources of water samples in Karachi

The lower values of pH will also lead to the similar effect¹¹. In this study pH of both Tap and Bore water ranged from 6.8 to 7.6 were within the range of WHO (6.5-8.5) recommendations¹². The dissolve oxygen (DO) value is an index of pollution mainly due to organic matter. Usually ground water lacks dissolved oxygen so very low concentrations and support the growth of anaerobic microorganism¹³. Our study showed that dissolve oxygen were in the limit of 5 ppm from both sources. TDS in drinking water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process and the nature of hardware used to convey water. In this study the conductivity in tap water of Orangi, Liyari, North-Nazimabad and Baldia towns were reported above 500 mmohs/cm and show disagreement, however the conductivity in other towns were within limit and showed agreement with WHO¹² recommended values. The water with a TDS level of less than 500 mg/l is consider to be good. The TDS test provides a measure

of the amount of dissolved ions but does not tell us about the nature of ions.⁴ In this study the TDS of tap water was in accordance with the limit of 500 ppm, but the bore water concentration of TDS was not comparable and contained higher value than WHO¹² and were comparable with the results of Beg et al¹⁴, Jaleel¹⁵ and Mumtaz et al¹⁶. Agreement of our study were also found by Rehman et al who reported only 18% of total bore water samples contain TDS within permissible¹⁷

The absence of total coliforms, when used in conjunction with a source-to-tap multi-barrier approach, is used as part of the verification that the drinking water system is producing water that is microbiologically acceptable. Microbiological portability standards for drinking water in most developed countries rely on detection of total coliform and E- coli as marker of the human pathogen. The presence of coliform indicates that there is a high probability of other pathogenic organism. The poor bacterial quality of tap water in big cities has made bottled water popular in Pakistan. However the quality of most of the bottled water manufactured and sold in Pakistan is unsatisfactory both in chemically and bacteriologically¹⁸. In this study we examined 240 water samples obtained from different sources. A total of 180(75%) samples were positive for presumptive test and showed complete agreement with Iqbal's study done in 1999 In BMSI, JPMC, Karachi who showed 75% water samples positive presumption test for total coliform. Another study carried out in Uganda by Haruna et al¹⁹ was in accordance with our study showed total coliform counts in 90% of the samples exceeded by WHO values. Our results showed disagreement with the Drinking Water Inspectorate of England and Wales that included in its regulations a mandatory value of zero coliforms per 100 mL in water leaving treatment works, a mandatory value of zero coliforms per 100 mL in 95% of samples for water in service reservoirs, and a non-mandatory value of zero coliforms per 100 mL at the consumer's tap. Analytical data showed that the drinking water in all over the 18 towns were very poor, and due to this reason many patients are visiting the hospitals daily, which were facing water born diseases.

CONCLUSION

Karachi receives water from Indus river and all major cities and industrial area also situated near the banks of Indus river, they are using water from Indus and discharge the waste water back into river without any treatment. The people of Karachi also using bore water because the shortage of municipal tap water. During the drinking water quality assessment water samples were collected and tested for wide range of pollution and generated very useful baseline information on the current pollution status of supplied water to

Karachi. Our study concluded that Karachi is receiving highly polluted water.

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