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ORIGINAL ARTICLE

Prevalence of fecal contamination within a public drinking water supply in District Korangi, Karachi, Pakistan

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ABSTRACT
The present study was to monitor the presence of pathogenic microorganisms mostly E.coli and status of residual chlorine in drinking water of district Korangi. Drinking water samples were collected from three distinct areas of district Korangi. Presence of coliforms, fecal coliform and Escherichia coli clearly shows that the water is unsafe for drinking purpose and residual chlorine was below the guideline provided by WHO. Analyzed samples yield that out of 35 samples only 11% sample is safe for human consumption and 89% sample is unfit for human consumption as it heavily loaded by microbial growth and residual chlorine is not up to the mark.
Keywords: *Residual Chlorine, Drinking water, Health status, District Korangi*

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INTRODUCTION

Water quality problems are on the top in developing countries which are succeeded by air pollution, solid waste and wastewater disposal. As the time passes the quantity of water become scarce and quality is depreciated due to urbanization, industrialization, deforestation, land degradation, global warming, increasing population etc .In Pakistan it is estimated that 30-40% diseases and death are associated to poor water quality respectively. Water quality is tie to the population density where the population is dense it is pushover to have more pollution [8].

In the world by population, Pakistan is the sixth largest country. The population of Pakistan would augment to 228.8 million and 295 million by the year 2025 and 2050 respectively [9].This increase in population will put the pressure on water sector to meet the domestic, agriculture and industrial needs. Now the Pakistan has become a water deficit country. It is calculated in 2004-2005 that approximately 38.5 million people lack an open arm to safe drinking water source. It is a common fact that provision of the safe drinking water will shorten the prevalence of diarrhea, malaria, trachoma, hepatitis A&B and morbidity levels In Karachi only 10,000 people die every year of renal infection as a result of polluted drinking water [3].In many cases the water is collected from faecally contaminated sources which are stored in an open and unsafe container. Such collected household water usually heavily contaminated with faecal microbes and bearing the high risks of exposure to waterborne pathogens [7]. The most significant health problem associated to drinking water has been the profusion of infectious diseases through contamination with pathogenic microorganisms. In both developed and developing countries the microbial quality of water is still remain the dominant issue. Chlorine has been strongly used for the control of water borne infectious diseases [10].

River Indus is the major river and source of fresh water in the country including Karachi, that flows across the entire country from north to south and ultimately into the Arabian Sea. Karachi is situated approximately 160 kilometers away from the River Indus , which is the last major city harnessing water from the Indus River. Karachi acquires 78% drinking water from Keenjher Lake and 20-25% potable water from Hub dam .Karachi is facing the severe water crisis. The problem of water pollution is posing a serious threat to Karachi. Growing population is responsible for the environmental pollution. Water contamination is one of its element that worsly affect the human life.

At present situation Karachi is facing the shortage of about 180-200MGD. The main source of water in Karachi is Indus River which consists of 425 million gallons from Dhabeji and K2 project, 30 million gallons from Gharo and 100 million gallons from Hub Dam. The bitter truth is that even after having the supply of 100 million gallons from Hub, the shortage of 100 million gallons will remain still there.As Karachi is at the tail-end of the surface water supplies, it receives water which has been used for municipal, agricultural, and industrial purposes, often several times. None of the cities (or other major users) along the Indus River treat the water before discharging it into the river[15].
District Korangi is an administrative district of Karachi Division in Sindh, Pakistan. It is located in the eastern part of Karachi. This district is formed in November 2013 by splitting District Karachi East. It comprises of Korangi, Landhi and Shah Faisal Colony.

MATERIAL AND METHOD

Sample Collection and Preservation

Thirty five (35) drinking water samples were collected from District Korangicomprisesof Korangi, Landhi and Shah Faisal Colony. After collection, the sample bottle was labeled properly assigning a sample code. Samples were collected in duplicate, one bottle used for bacteriological analysis contained few ml of sterile sodium thiosulphate to neutralize the effect of residual chlorine if any, and another sample bottle was retained for determining residual chlorine. After collection of samples the bottles were placed in an ice-box maintained at temperature of 4-8^{o}C and transported to the Institute of Environmental Studies, University of Karachi for analysis. The sampling survey was conducted in September, 2014.

Microbiological Assessment

The samples were processed in laminar flow hood using sterilized culture media (the sterility of media was checked prior to use) by Most Probable Number Technique (MPN) as per standard methods described in APHA(2005)[16].Total Coliform,Total Faecal Coliform and Total Faecal Streptococci test were also performed, as per standard methods [16]to check the quality of the water. Moreover, Flouorocult LMX broth was also used for simultaneous enrichment and detection of total coliforms and *E.coli* in water samples.

Chlorine Estimation

Residual chlorine was determined by Merck kits.

Statistical Analysis

The data were statistically analyzed using STATISTICA (99 Edition) software. The descriptive statistics mean, median, minimum, maximum, lower quartile, upper quartile, Quartile range, standard error, standard error and skewness were computed for each variable.

RESULT AND DISCUSSION:

The present investigation was to monitor the presence of pathogenic microbes mostly *E.coli* and residual chlorine status in drinking water of district Korangi. Such information will help us to regulate to what extent supply water is being disinfected. Drinking water quality was figure out on the basis of WHO standard [14].
In the present investigation, out of total 35 samples of district korangi 48.57% samples were positive for *E.coli* and 28.57% shows residual chlorine status as shown in Table 1.4. Residual chlorine concentration in drinking water samples collected from district korangi was below the detection. Reduced level of the residual chlorine resulted in severe microbial contamination. *E.coli* detected in samples is above the guidelines given by the WHO[14].The KWSB operates water treatment plants around the city and claims to supply water that is free of pathogenic microorganisms[15].The coliform presence in water was primarily due to unhygienic condition prevailing in district korangi. These are undeveloped areas with congested streets, open drains, and inefficient water supply system. Most of the water supply pipes were leaked and placed closed to the sewer pipe lines or passing over open sewers that result in cross contamination [2]. Old and rusty sewage pipelines are the major source for the growth of microbes. The leakage of the water supply lines also aspect to contaminate the drinking water with external pollution [6]. The existence of E.coli apparently indicated that water is unfit for human consumption and these microbes led to different diseases [4]. In accordance to WHO guidelines[14] there should be no coliform/100ml of treated water in distribution. *E.coli* presence certainly shows fecal contamination [11] and illustrates a possible contamination of enteric pathogens [5].In order to remove pathogens from drinking water chlorine has been found to be very competent in killing water borne pathogens. . It is well established means of drinking water disinfection. In disinfection process pathogens are very susceptible to chlorine. It kills the microorganism by deactivating their enzymatic activity and also provides residual disinfection and inhibits the re-growth of bacteria in the distribution network. The usage of chlorine as disinfectant for drinking water stops the threats which are present in non-disinfected drinking water.A

major detriment of chlorine is the constitutional formation of possibly toxic or carcinogenic by-products. Therefore under these situation, the disinfecting power of chlorine residual not as high as energy chlorine model but as move to low energy chloramines [13]. These products are produced due to the reaction of chlorine with organic matter. Eliminating these toxic compounds is a difficult and endless process. The health risks from these byproducts at the levels at which they appear in drinking water are excessively small in correlation with the risks associated with inadequate disinfection. Hence, it is important that disinfection not be compromised in pursuing to control such byproducts. Another major disadvantage of chlorine use is that some organisms are resistant to chlorine and will not be weaken and is related to diarrhea diseases. This situation has profound public health implication as the continuity of all classes of microbes under these conditions will be longer. The public health threat comes from sewage encroachment which contains the high concentration of *E.coli* (108-109 per ml) [13]. Drinking water contamination with pathogenic microbes has been responsible for causing serious water borne diseases like diarrhea, typhoid, nausea, dysentery and other related health problems [12].

Table#1.1 **BACTERIOLOGICAL & RESIDUAL CHLORINE ANALYSIS OF DRINKINGWATER**

DISTRICT	Sample Code	MPN/100ml			Total Fecal Coliform (*E.coli*) Test	Residual chlorine (mg/l)	RESULT
		TCC	**TFC**	**TFS**			
	K-1	210	210	<3	-	0	UFHC
	K-2	<3	<3	<3	-	0.25	FHC
Korangi	K-3	460	460	<3	-	0.10	UFHC
	K-4	1100	210	<3	+	0	UFHC
	K-5	40	28	<3	-	0	UFHC
	K-6	≥2400	≥2400	7	+	0	UFHC
	K-7	≥2400	≥2400	<3	-	0	UFHC
	K-8	150	93	4	-	0	UFHC
	K-9	1100	1100	3	-	0	UFHC
	K-10	≥2400	≥2400	7	-	0	UFHC
	K-11	1100	1100	4	-	0	UFHC
	K-12	≥2400	≥2400	11	+	0	UFHC
	K-13	1100	64	4	-	0	UFHC
	K-14	≥2400	≥2400	9	+	0	UFHC
	K-15	≥2400	210	<3	+	0	UFHC

Table #1.2 **BACTERIOLOGICAL & RESIDUAL CHLORINE ANALYSIS OF DRINKINGWATER**

DISTRICT	Sample Code	MPN/100ml			Total Fecal Coli form (*E.coli*) Test	Residual chlorine (mg/l)	RESULT
		TCC	**TFC**	**TFS**			
	L-1	≥2400	≥2400	3	+	0	UFHC
	L-2	≥2400	≥2400	<3	+	0	UFHC
Landhi	L-3	≥2400	≥2400	4	+	0	UFHC
	L-4	≥2400	≥2400	3	+	0	UFHC
	L-5	≥2400	≥2400	<3	+	0	UFHC
	L-6	≥2400	≥2400	9	-	0.10	UFHC
	L-7	460	460	<3	-	0.25	UFHC
	L-8	≥2400	210	<3	+	0.15	UFHC
	L-9	40	28	<3	-	0	UFHC
	L-10	1100	210	7	+	0.15	UFHC

Table#1.3**BACTERIOLOGICAL& RESIDUAL CHLORINE ANALYSIS OF DRINKINGWATER**

DISTRICT	Sample Code	MPN/100ml			Total Fecal Coliform (*E.coli*) Test	Chlorination (mg/l)	RESULT
		TCC	**TFC**	**TFS**			
Shah Faisal colony	S-1	≥2400	1100	4	+	0.15	UFHC
	S-2	<3	<3	<3	-	0.25	FHC
	S-3	<3	<3	<3	-	0.25	FHC
	S-4	1100	210	7	+	0	UFHC
	S-5	≥2400	460	<3	-	0	UFHC
	S-6	≥2400	≥2400	11	+	0	UFHC
	S-7	≥2400	460	9	+	0	UFHC
	S-8	≥2400	1100	7	+	0	UFHC
	S-9	<3	<3	<3	-	0.25	FHC
	S-10	1100	210	<3	-	0	UFHC

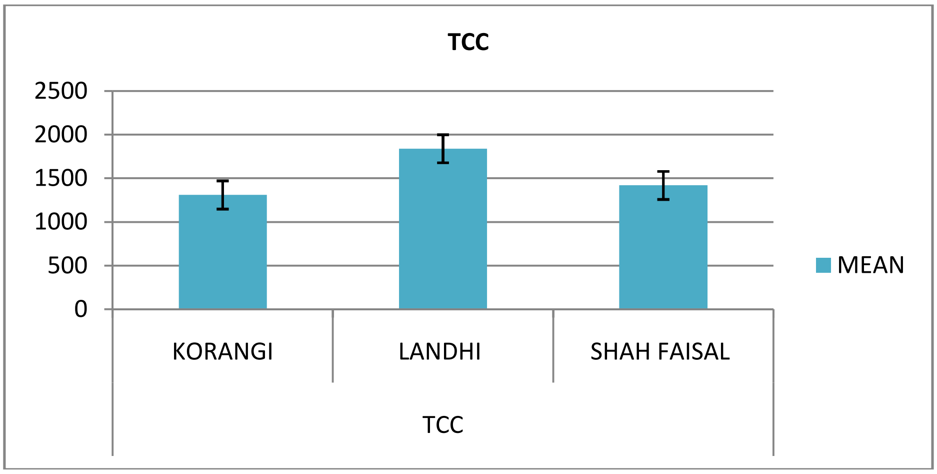
*TCC = Total Coliform Count *TFC = Total fecal coliform count *TFS = Total fecal streptococci *UFHC = Unfit for human consumption *FHC = Fit for human consumption

Table # 1.4 (summary table)

S.NO	Area	No.of samples	E.coli exist	Residual chlorine	FHC	UFHC
1	Korangi	15	33.33 %	13.33%	6.66%	93.33%
2	Landhi	10	70%	40%	0	100%
3	Shah Faisal Colony	10	50%	40%	30%	70%
4	**Total**	**35**	**48.57%**	**28.57%**	**11.42%**	**88.57%**

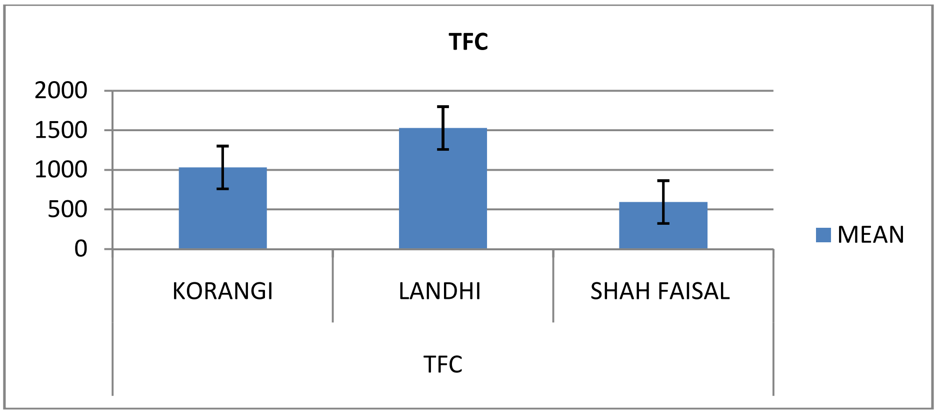
Table# 2.1

PARAMETER	AREA	MEAN	Std error
TCC	KORANGI	1310.8	257.34
	LANDHI	1840	296.03
	SHAH FAISAL	1420.6	350.22



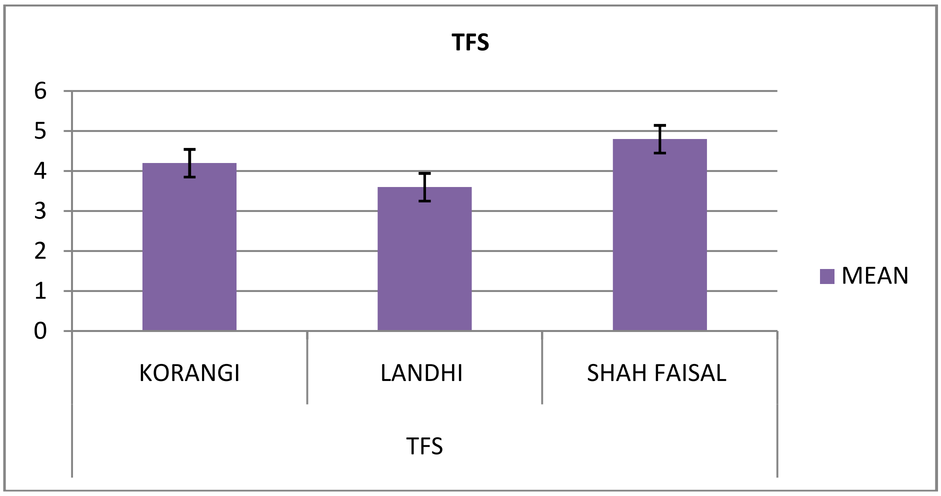
Table#2.2

PARAMETER	AREA	MEAN	Std error
TFC	KORANGI	1031.8	272.63
	LANDHI	1530.8	356.33
	SHAH FAISAL	594.6	246.78



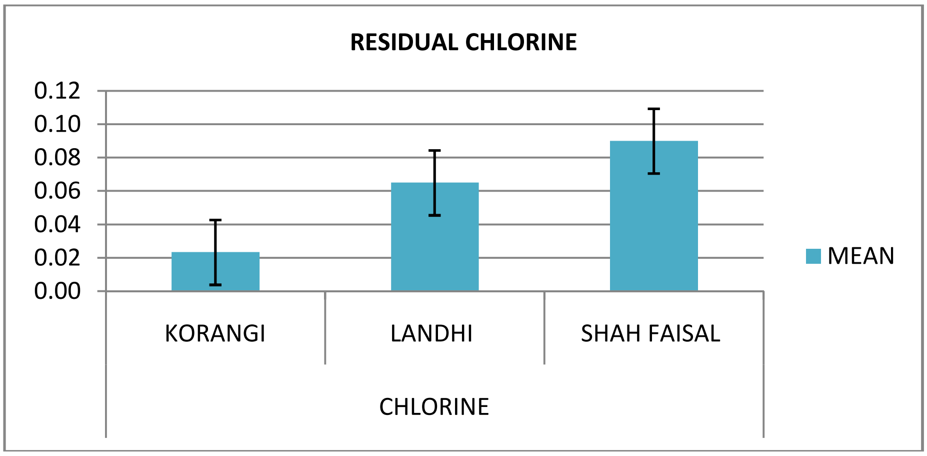
Table#2.3

PARAMETER	AREA	MEAN	Std error
TFS	KORANGI	4.2	0.76
	LANDHI	3.6	0.78
	SHAH FAISAL	4.8	1.08



Tale#2.4

PARAMETER	AREA	MEAN	Std error
RESIDUAL CHLORINE	KORANGI	0.02	0.02
	LANDHI	0.07	0.03
	SHAH FAISAL	0.09	0.04



DESCRIPTIVE STATISTICS OF KORANGI

Parameter	Valid N	Mean	Median	Mini	Max	Lower quartile	Upper quartile	Quartile range	Std.Dev	Std.error	Skewness
TCC	15	1310.80	1100	2	2400	210	2400	2190	996.67	257.34	-0.01
TFC	15	1031.80	460	2	2400	93	2400	2307	1055.88	272.63	0.50
TFS	15	4.20	3	2	11	2	7	5	2.93	0.76	1.28
RESIDUAL CHLORINE	15	0.02	0	0	0.25	0	0	0	0.07	0.02	3.16

DESCRIPTIVE STATISTICS OF LANDHI

Parameter	Valid N	Mean	Median	Mini	Max	Lower quartile	Upper quartile	Quartile range	Std.Dev	Std.error	Skewness
TCC	10	1840	2400	40	2400	1100	2400	1300	936.14	296.03	-1.29
TFC	10	1530.80	2400	28	2400	210	2400	2190	1126.80	356.33	-0.51
TFS	10	3.6	2.5	2	9	2	4	2	2.46	0.78	1.64
RESIDUAL CHLORINE	10	0.07	0	0	0.25	0	0.15	0.15	0.09	0.03	1.08

DESCRIPTIVE STATISTICS OF SHAH FAISAL COLONY

Parameter	Valid N	Mean	Median	Mini	Max	Lower quartile	Upper quartile	Quartile range	Std.Dev	Std.error	Skewness
TCC	10	1420.6	1750	2	2400	2	2400	2398	1107.50	350.22	-0.40
TFC	10	594.6	335	2	2400	2	1100	1098	756.89	239.35	1.73
TFS	10	4.8	3	2	11	2	7	5	3.43	1.08	0.77
RESIDUAL CHLORINE	10	0.09	0	0	0.25	0	0.25	0.25	0.12	0.04	0.66

CONCLUSION

The study reveals that the water quality in district Korangi does not meet the WHO guide lines. In the interest of public health, supplies should be examined regularly to confirm that they are free from the pathogenic microbes. Moreover, much emphasis should be given on monitoring the chlorine in water supplies upto the consumer level. It is believed that the filtration plant and reservoirs are chlorinating water adequately, and while chlorine levels were, in most cases, adequate throughout the distribution network, they fell during storage in the underground and overhead tanks of the consumers. This may be simply due to excessive storage time or an excess of organic material in the tanks, which are seldom if at all cleaned by the consumers. It was also observed during the study that some time the level of chlorine exceed to the maximum permissible limit which changes the organoleptic properties of water.

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