BACTERIOLOGICAL QUALITY OF DRINKING WATER IN LAHORE

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ABSTRACT

Introduction: *It is well established that a large number of infectious diseases are transmitted primarily through water supplies contaminated with human and animal excreta particularly faeces.[1]* ***Objective:*** *The purpose of the study was to assess bacteriological quality of drinking water in Lahore-Pakistan. It is a cross sectional descriptive study performing the Lahore city during the months of April and May 2008.* ***Materials and Methods:*** *A total of 530 water samples were collected from different localities of whole of the Lahore city. These represented areas with different socio-economic conditions. The samples were collected in sterilized containers and brought to the laboratory within two hours of collection. All the samples were tested for contamination with bacteria using multiple tube method to determine most probable number of total coliforms and faecal coliforms using standard procedure.* ***Results:*** *Among 530 water samples, 197 samples (37.2%) were positive for bacterial contamination. It was observed that bacterial contamination was maximum in areas with low SEC (43.6%), followed by intermediate SEC (36.5%) and high SEC (22.9%). The difference was found to be statistically significant (p<0.15) between areas with High and Low SEC while it was non-significant (p>0.5) between areas with Low and Intermediate SEC.* ***Conclusion:*** *Bacterial contamination is significant problem in Lahore. Regular monitoring and chlorination/establishment of water filtration plants can improve this situation.*

Keywords: *Drinking water; Bacterial contamination; Multiple tube method; Lahore.*

INTRODUCTION

It is well established that a large number of infectious diseases are transmitted primarily through water supplies contaminated with human and animal excreta particularly faeces.[1] Outbreaks of water borne diseases continue to occur throughout the world but especially serious in developing countries.[1-3] The human pathogens that present serious risk of disease whenever present in drinking water include Salmonella species, Shigella species, Yersinia enterocolitica, Campylobacter species, various viruses such as Hepatitis A Virus, Hepatitis E Virus, Rota Virus and parasites like Entamaeba histolytica, Giardia lamblia and so on.[1,4,5]

Keeping in view the importance of safe drinking water, drinking water is routinely examined to ensure safety for drinking in developed countries. It is not practicable to monitor drinking water for every possible pathogen. Therefore, normal intestinal organisms are used as indicator of faecal pollution.[6-8] These include coliform group of organisms.[9] They are considered as suitable indicators because they are easy to detect and enumerate in water.[10] Multiple Tube Method for estimation of total coliforms and faecal coliforms, is a standard test used as indicator of sewage contamination of water supplies.[1]

In Pakistan, water microbiology is a neglected subject. A few studies have been carried out in different parts of Pakistan.[11-16] These studies show that bacterial contamination of water is quite high. Present study was carried out to determine the current status of bacteriological quality of drinking water in different areas of Lahore city.

MATERIALS AND METHODS

Lahore is the second largest city of Pakistan. Its residents are served with water through a piped water supply system. In the present study, water samples from piped water supply of Lahore were tested during the months of April and May 2008. A total of 530 water samples were tested from different localities of Lahore.

These localities belonged to areas with high Socio-economic conditions (SEC), Intermediate SEC and Low SEC. High SEC areas included Johar Town, Wapda Town, Defense Housing Authority, Garden Town, New Garden Town, Model Town and Faisal Town. Intermediate SEC areas included Shad Bagh, China Scheme, Taj Bagh, Walled City of Laho-

re, Saeed Park, Raj Garh, Sham Nagar, Dholanwal, Samanabad, Islamia Park, Icchra, Sanda, Bilal Ganj, Allama Iqbal Town and Mansoora. Low SEC areas included Shah Fareed Colony, Colonies outside Band Road, Colonies inside Band Road, Multan Road Chungi areas, Colonies in Shahdra, Barki, Hadyara, Darooghawala, Bhatta Chowk, R A Bazar and Chungi Amar Sadhu.

Water samples were collected in 200 ml capacity sterilized containers from the household water taps using standard water collection techniques.[17] These water samples were transported to microbiology lab within two hours of collection.

In the laboratory, all the samples were subjected to Multiple Tube Test for determination of most probable number (MPN) of coliforms and faecal coliforms. The test was performed according to standard procedure.[18] The water samples were considered as having doubtful quality. Aseptically, one 50 ml volume and five 10 ml volume water was added to bottles and tubes containing 50 ml and 10 ml each of double strength MacConkey Broth Medium (Oxoid). Additionally five 1 ml volume of water sample was added to tubes containing 5 ml of single strength MacConkey Broth Medium. All the bottles and tubes contained inverted Durham tubes and were pre-sterilized in autoclave.

All the bottles and tubes were incubated at 37°C for 48 hours. The bottles or tubes which showed acid and gas production were considered positive for coliforms. From the distribution of these positive bottles and tubes Most Probable Number (MPN) of Total Coliforms was determined by referring to standard probability table for estimation of Total Coliforms.[18] All the bottles and tubes positive for Total Coliforms were subcultured into 10 ml of single strength MacConkey Broth with inverted Durham tubes and 5 ml of Peptone water to determine presence of faecal coliforms. These tubes were incubated at 44°C for 24 hours. The tubes showing acid and gas and indole production were taken as positive for Faecal Coliforms. (Ejikman Test Positive). From the number of these positive tubes, MPN of Faecal Coliforms was calculated by referring to the table as for Total Coliforms.

Tha samples with MPN of one or more were considered as contaminated while samples with zero MPN were considered free from bacterial contamination according to UK standard for drinking water in the piped water supplies[18]. Statistical analysis of the results was done by application of chi square test.

RESULTS

A total of 530 water samples were tested from piped water supply system of Lahore in the present study. These were taken from different localities of Lahore

including areas with high, intermediate and low SEC. Out of 530 samples, 197 (37.2%) water samples were positive for bacterial contamination.

Bacterial contamination was maximum in areas with Low SEC (43.6%), followed by 36.5% in Intermediate SEC and 22.9% in areas with High SEC as shown in Table 1. The difference was statistically significant between areas with Low SEC and High SEC (p<0.01) and non significant between areas with Low SEC and Intermediate SEC (p>0.05).

Table 1: *Bacterial contamination among water samples collected from areas with different socio-economic conditions (SEC) of Lahore.*

Areas	No of Samples	Bacterial Contamination	
		Present	**Percentage**
High SEC	96	22	22.9
Intermediate SEC	200	73 *	36.5
Low SEC	234	102 **	43.6
Total	530	197	37.2

*   p>0.05 (No significant difference between areas with Low SEC and Intermediate SEC)

**   p<0.01 (Significantly higher contamination in areas with Low SEC as compared with High SEC)

DISCUSSION

Population wise, Lahore is the second largest city of Pakistan with estimated population of over 10 million. In the present study an effort was made to assess the bacteriological quality of drinking water in Lahore. According to WHO[6] there should be no coliform bacteria/100 ml of treated water in distribution as tested by multiple tube test.

The present study 37.2 percent water samples were positive for bacterial contamination (unfit for human consumption). This figure is lower than those of 42.85 percent[19] and 60.8 percent[20] observed in previous studies carried out in Lahore in 1999 and in 1995 respectively. This shows that there is an improvement in the bacteriological quality of drinking water in Lahore over the past years; though not satisfactory at all. Both of these studies were carried out in summer months of the year. Present study was carried out in the month of April and May. However, the figure of 37.2 percent in the present study is much higher than that of 18.7% in the months of March to May in a previous study carried out in Lahore in 2000-2001 on water samples in distribution.[16] Positivity of water samples collected all the year around was 20.64 percent in this study. These findings indicate that over last couple of years there

appears to be deterioration in the water supply system in Lahore.

It is also observed that there is progressive increase in the frequency of contaminated water samples from areas with High SEC to Low SEC. Therefore, level of sanitary conditions in the community appears to have inverse relationship with the contamination of water supplies. This finding is in agreement with that observed in a previous study at Lahore.[16]

Water in distribution is contaminated during its passage in water pipes. This contamination can occur due to defective joints, back siphonage, rusted pipelines crossing over the sewage pipes and low/high pressure in the pipelines. Proximity of water pipes to the main sewer pipelines also leads to contamination of water in distribution.[21,22]

Situation of water supply in other parts of Pakistan and neighboring countries is also not good. In India, 68.9% of samples[23] while in Indonesia 45.7% samples were found to be unfit for drinking[24]. In a study carried out in Iran, it was observed that 30.2% of water samples from rural areas were contaminated with bacteria.[25] In Pakistan, 38 to 56.2 percent of water samples in Rawalpindi/ Islamabad have been reported to be bacteriologically contaminated in different studies.[13,6,27] These figures are higher when compared to that in the present study. In Karachi, much higher contamination (87%) of tap water samples have been reported.[21] Similarly high percentage of samples of water were found to be contaminated with fecal E coli in Sukkur city and different districts of Khairpur, Sindh (82% and 100% respectively).[28,29] All this data indicates that bacteriological contamination of drinking water is a significant problem not only in Pakistan but also in other developing countries. Bacteriological contamination of drinking water is a significant problem in other parts of the world also like Sudan (45.2%)[30] and Makkah al-Mokaarama (31.2-37.5%).[31]

Keeping in view the high level of contamination of drinking water in our country, it is essential that water be examined regularly and frequently throughout the year as contamination may be intermittent.[8,32] At the same time there is need for making the water supplies safe for human use by regular chlorination and taking immediate appropriate remedial measures whenever contamination is observed. It may also be pointed out that even drinking water from water dispensers has also been observed to be contaminated with bacteria.[33] As water coolers are popular in office buildings and commercial stores nowadays, the quality of this source of drinking water also has the potential to cause water borne outbreaks. Therefore, there is a need for adopting appropriate routine monitoring system to prevent or to diminish the chances of contamination of this water source.

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