Original Article

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Bacteriological Analysis of Water of Kathmandu Valley

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ABSTRACT

Introduction: Water is indispensible for human existence. Water pollution is the most serious environmental quality issue all over the world, yet the people are less aware and give little emphasis on the vital connection between water and health. Drinking water of most communities and municipalities in Nepal is obtained from surface sources, rivers, streams, ponds and lakes. Most of these sources of water are likely to the polluted with domestic and industrial wastes and many types of microorganisms present in water causes various types of infectious diseases. Therefore, we intend to find the bacteriological water quality of Kathmandu valley.

Methods: A total of 200 water samples collected from different sources (over head tank, well and tube wells, taps, springs through spouts and household filter) from different parts of Kathmandu Valley were subjected for bacteriological analysis by MPN (3 sets 3 tubes) method. Presence of fecal coliform was detected by Eijkman test.

Results: Out of total 200 water samples, 130 (65.0%) were unsatisfactory, 19 (9.5%) were intermediate (suspicious), 30 (15.0%) were satisfactory and remaining 21(10.5%) were excellent. Of the unsatisfactory water samples subjected to Eijkman test, 22.0% of overhead tank, 30.0% of ground water, 30.0% of piped tap water, 40.0% of natural tap (spout) and none of the household filter water showed fecal coliforms. Water contamination rate was higher during summer than in winter season.

Conclusions: It is concluded that most of the water sources of Kathmandu valley are bacteriologically unsatisfactory for drinking.

Keywords: water contamination, MPN, coliform, kathmandu valley.

INTRODUCTION

Although Nepal is one of the richest countries in terms of per individual water availability, it is the poorest country in terms of use of water[1]. Many people collect water from different sources or store water in insanitary conditions in the household. Even water sources are free from contamination, household storage pots, tanks and insanitation around house hold may be sources of contamination if not properly cleaned and maintained[2].

Despite of campaign for safe drinking water, still waterborne infectious diseases significantly contribute in health problems in the world, particularly in the developing countries[3]. Even in developed countries like USA 67.7% of the gastroenteritis is of water borne origin[4]. In Nepal, diarrhoeal disease ranks second in the list of top-ten diseases[5]. A high rate of microbial contamination of drinking water has been reported by previous workers from Nepal[6-12]. This study was conducted through out one complete year (2012 AD) to report the present scenario of water sources of Kathmandu valley and has been well correlated with periodic outbreak of gastroenteritis including cholera, particularly during monsoon (rainy) season every year[13-19].

METHODS

This study was conducted at Nepalese Army Institute of Health Sciences, Sanobharyang, Kathmandu from

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Jan. 2012 to Jan 2013. A total of 200 water samples collected from different sources (over head tank, well and tube wells, piped water taps, springs through spouts and household filter) from different parts of Kathmandu valley were subjected for bacteriological analysis by MPN (3 sets 3 tubes) method. Samples were collected randomly, aseptically in 300 ml sterile screw capped bottles and immediately transported to department of microbiology for processing.

Presence of fecal coliform was detected by Eijkman test [20,21].

RESULTS

A total of 200 water samples collected from different water sources (over head tank = 50, shallow wells and tube wells = 50, piped water taps = 50, springs through spouts = 25 and household filter = 25) in Kathmandu valley during the year 2011/2012 were tested for the presence of coliform bacilli using MPN technique. Of the tested samples, 130 (65.0%) were unsatisfactory, 19 (9.5%) were intermediate (suspicious), 30 (15.0%) were satisfactory and only 21(10.5%) were excellent (Table-1).

Table 1: Quality of water from different sources* (n =200)

Categories	Over head tank	Ground water	Tap water	Natural sources	Household filters	Total
Excellent	11 (22.0%)	0 (0.0)	0 (0.0%)	0 (0.0)	10 (40.0%)	21 (10.5%)
Satisfactory	5 (10.0%)	0 (0.0)	15 (30.0%)	0 (0.0)	10 (40.0%)	30 (15.0%)
Intermediate	5 (10.0%)	5 (10.0%)	4 (8.0%)	0 (0.0)	5 (20.0%)	19 (9.5%)
Unsatisfactory	29 (58.0%)	45 (90.0%)	31 (62.0%)	25 (100.0%)	0 (0.0%)	130 (65.0%)
Total	50	50	50	25	25	200

*Excellent - No coliform and *E. coli* per 100 ml of water

Satisfactory - 1-3 coliforms and no *E. coli* per 100 ml of water

Intermediate - 4-9 coliforms and no *E. coli* per 100 ml of water.

Unsatisfactory - > 10 coliforms or 1 or more *E. coli* per 100 ml of water

All natural tap (spout) were unsatisfactory for drinking where as 90.0% of ground water, 78.0% of overhead tank, 70.0% of piped tap water and 40.0% of household filter water were unsatisfactory (Table-2).

Table 2: Presence of total and fecal coliforms in different water samples

Sample	Total (n)	Coliform +ve (%)	Fecal coliform +ve (%)
Over head tank	50	39 (78.0)	11 (18.0)
Ground water	50	45 (90.0)	15 (30.0)
Tap water	50	35 (70.0)	15 (30.0)
Natural source	25	25 (100.0)	20 (80.0)
Household filter	25	10 (40.0)	0 (0.0)
Total	200	164 (82.0%)	61 (30.5%)

Of the unsatisfactory water samples subjected to Eijkman test, 22.0% of overhead tank, 30.0% of ground water, 30.0% of piped tap water, 40.0% of natural tap (spout) and none of the household filter water showed fecal coliforms (Table-2). Water contamination rate was higher during summer than in winter season (Table-3).

Table 3: MPN values in cfu/100 ml of different water samples tested (positive samples)

Sample	n (%)		MPN value (cfu/100 ml)	
	summer	winter	summer	winter
Over head tank	25/30 (83.0.0)	11/20 (35.0)	150-460	23-75
Ground water	29/30 (93.3)	20/20 (100.0)	*TMTC	1100
Tap water	26/30 (70.0)	11/20 (25.0)	150-460	28-120

Natural source	15/15 (100.0)	10/10 (100.0)	1100	460
Household filter	5/15 (80.0)	1/10 (30.0)	3-28	3

*TMTC- Too many to count in all positive samples (>1100 cfu/100ml.)

DISCUSSION

In the present study, almost two-third of the samples tested showed presence of coliform bacilli. This is slightly higher than the contamination rate reported by Ghimire *et al* (74.9%) 2006[7] and *Rawal et al in* 1994 (78.8%)[8] and slightly lower than that found by Rijal *et al.*(95.0%) in 2006[9] and Adhikari *et al* (88.0%) in 1986[10]. However, it was higher than the findings of Atreya *et al* (61.0%) in 2006 from Terai region of Nepal[11], ENPHO 1999[12] and ENPHO and JICA 2005[13], Baveja *et al* (70.0%) from India in 1989[14] and Luksamijarulkul *et al* (68.8%) from Thailand in 1994[15] and *Ise T et al* 1996[16]. These findings indicated that the rate of contamination is decreasing in Kathmandu valley. However, present finding is still alarming when the WHO guidelines for drinking water is considered[3]. This is therefore, can be well correlated with the diarrhoeal diseases ranking second in the top-ten diseases of Nepal[5] and periodic out break of gastroenteritis including cholera particularly in summer season [11,14, 17, 18,19]. This was also reflected by recent outbreak of infective viral hepatitis among police personnel in the barracks including in the Prime Minister quarter (newspaper reports, 2007) and *Escherichia coli* outbreaks in Germany (Newspaper reports, 2011).

In the present study, only 10.5% of water samples tested were excellent. This was due to inclusion of household filtered water. If filtered water was not considered, the percentage of excellent water comes to be 5.5 % which was consistent with the finding reported twenty five years ago. This indicated that the drinking water quality has not been improved well during last twenty five years period despite of various efforts put. This could be due to the population growth, unplanned urbanization, poverty and others. Still, it was very interesting to see that the household filter was also unsatisfactory for drinking. However, all of them were negative for fecal coliforms. These findings indicated that the level of awareness about hygienic handling of filter among house wives needs to be improved.

Present study also resulted that 30.5% of water was recently contaminated with faecal materials of human origin. This was however, much less than reported in twenty five years ago (57.0%) and indicated that the level of awareness about use of toilets is being improved, yet not satisfactorily[10]. Higher rate of contamination during summer season was attributed to rain water contamination.

In the present study, none of the natural tap water samples were satisfactory for drinking. This appears to be contamination with human and animal excreta. This indicates of open defecation, and needs to make the people aware of using toilet.

In general, the higher rate of fecal contamination that exist in Kathmandu valley is attributed to source contamination, ineffective treatment of water, and contamination after treatment during distribution (due to the rusting of water distribution pipe and occasional supply of water and nearby leakage from sewerage pipe that has always positive pressure). With regards to the ground water, contamination appears to occur through seepage of wastewater from sewage or other likely sources [22-26]. In many places, wells have been made without fulfilling the criteria (source of ground water should be located not less than 50 feet from likely sources of contamination) laid by WHO[3]. Keeping in view of these findings, an immediate action with regard to the preventing drinking water sources from contamination and proper treatment at the water treatment plant is strongly suggested. Though, it is not easy to do, an overhauling of water distribution system by replacing the old pipes is also essential. These actions are needed as to prevent the water-borne health problems and related morbidity and mortalities in future.

CONCLUSIONS

Most of the water sources of Kathmandu valley are bacteriologically unsatisfactory for drinking. An immediate action to prevent drinking water contamination is required.

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