

# MICROBIOLOGICAL ANALYSIS OF DRINKING WATER OF KATHMANDU VALLEY

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**Abstract:** Drinking water quality assessment in Kathmandu valley has always been crucial with reference to public health importance. A study was conducted to evaluate the quality of drinking water of the valley. A total of 132 drinking water samples were randomly collected from 49 tube wells, 57 wells, 17 taps and 9 stone spouts in different places of Kathmandu valley. The samples were analyzed for microbiological parameters. Total plate and coliform count revealed that 82.6% and 92.4% of drinking water samples found to cross the WHO guideline value for drinking water. During the study, 238 isolates of enteric bacteria were identified, of which 26.4% were *Escherichia coli*, 25.6% were *Enterobacter* spp, 23% were *Citrobacter* spp, 6.3% were *Pseudomonas aeruginosa*, 5.4% were *Klebsiella* spp, 4.0% were *Shigella* spp, 3.0% were *Salmonella typhi*, 3.0% were *Proteus vulgaris*, 3.0% were *Serratia* spp and 1.0% were *Vibrio cholerae*.

**Key words:** Drinking water; Public health; Coliform; Bacteria.

## INTRODUCTION

Drinking water is indispensable for human existence. The Kathmandu valley suffers a severe drinking water supply crisis, particularly in the dry seasons of every year. The drinking water supplies in the cities of the valley is intermittent. Nearly all of the surface sources and ground water sources have been exploited. The growing imbalance between supply and demand has led to chronic shortages and competition that have resulted in pollution and environmental degradation. Apart from quantitative shortages, the quality of drinking water in the Kathmandu valley is becoming a serious public health issue for the past few years. The quality of water for drinking has deteriorated because of the inadequacy of treatment plants, direct discharge of untreated sewage into rivers and inefficient management of the piped water distribution system (UNEP, 2001).

Diseases caused by contaminated water are among the ten most prevalent water borne diseases in Nepal (DoHS, 1998). Diarrhoea, which is caused by poor sanitation, hygiene and water quality, is one of the most prevalent water borne disease in Nepal. During 1995/96, the incidence of diarrhoea among children below five years of age was 131 per 1,000 children. The mortality rate due to the diarrhoea was 0.34 per 1000 children under five years of age, while the case of fatality rate was 2.56 per 1,000 (CBS, 2001).

In Nepal, the incidence of diarrhoea is increasing in alarming rate. A report obtained from Teku Hospital in Kathmandu shows that 16.5 % of all deaths were due to water-borne disease (Metcalf, 2000). Probably the most important pathogenic bacteria transmitted by the water route are

*Salmonella typhi*, the organism causing typhoid fever, and *Vibrio cholerae*, the organism causing cholera (Madigan *et al.*, 1997).

Ideally, drinking water should not contain any microorganisms known to be pathogenic or any bacteria indicative of faecal pollution. Detection of faecal indicator bacteria in drinking water provides a very sensitive method of quality assessment and it is not possible to examine water for every possible pathogen that might be present (WHO, 1993).

## MATERIALS AND METHODS

Drinking water samples from different sources in Kathmandu valley were collected and transported by standard methods as mentioned in APHA, 1998. Random sampling was adopted for the study. Microbiological analysis of water samples was conducted in Environmental Laboratory of Nepal Academy of Science and Technology.

### Microbial Examination of Water Sample

The total plate count was conducted by pour plate technique on plate count agar (PCA) and counting the colonies developed after the incubation at 37°C for 24 hours (APHA, 1998). The total coliforms were enumerated by the membrane filtration (MF) technique as described by APHA, 1998. Detection of *Salmonella* and *Shigella* species were done by the enrichment of water samples on Selenite F broth, followed by isolation of the typical organism on selective medium, Xylose Lysine Deoxycholate Agar (XLD). (Collee *et al.*, 1996)

Detection of *Vibrio cholerae* was done by enriching the samples in 1% alkaline peptone water for 6 to 8 hours followed

by isolation on Thiosulphate Citrate Bile salt sucrose (TCBS) agar medium (Collee *et al.*, 1996).

All colonies with different characteristics on M-Endo agar, Xylose Lysine Deoxycholate Agar (XLD) agar and Thiosulphate Citrate Bile salt sucrose Agar (TCBS) were sub cultured onto Nutrient agar (NA) for purification. Enteric bacteria isolated on respective selective or differential media were identified on the basis of their colonial, morphological and Biochemical properties following Bergey's Manual of Determinative Bacteriology, 1994.

## RESULTS

A total of 132 drinking water samples were collected from different places of Kathmandu valley, of which 35 were from tube wells, 21 from wells, 15 from tap waters and 8 from stone spouts of Kathmandu, Lalitpur and Bhaktapur districts. In totality samples from Kathmandu, Lalitpur and Bhaktapur contributed 59.8 %, 32.6% and 7.6% respectively.

Ground water contributed 80.3%, while 19.7 % were collected from municipal drinking water sources and stone spouts.

### Bacteriological Analysis of Water

#### A. Total Plate Count

Total plate count for total bacterial count performed for all water samples showed only 17.4% samples were within the WHO guideline value (<10 cfu/ml). In source wise distribution of samples, 71.1% of tube well, 89.5% of well, 82.4% of tap and 100% of stone spout samples were exceeded the guideline value.

**Table 1:** Source wise Quality of Total bacterial Count of Water Samples.

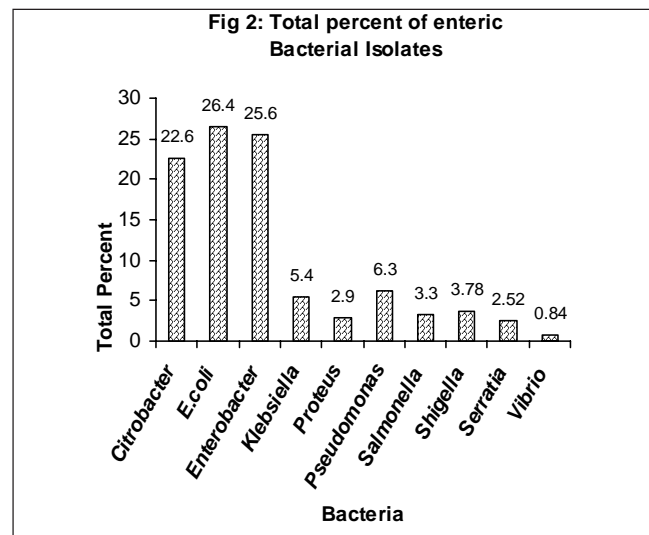
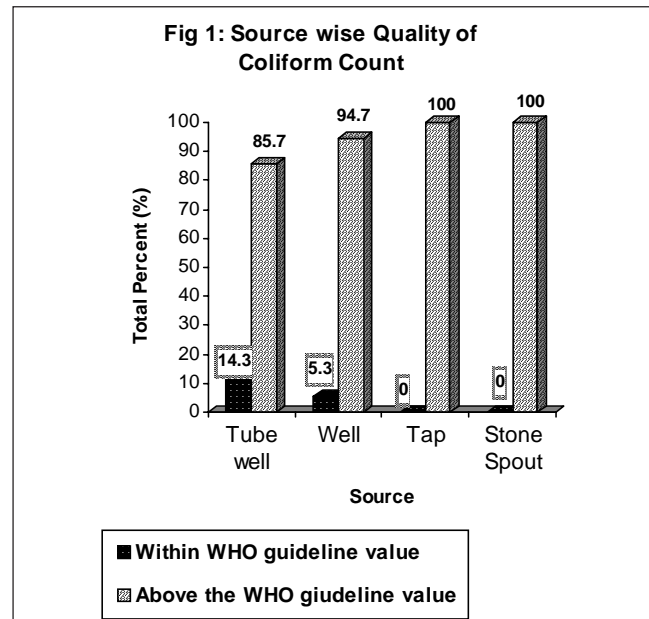
S N	Source	Percentage (%) of Samples compared with WHO guideline Value		Total number of Samples
		Guideline value (<10 cfu/ml)	Excess to Guideline value (>10 cfu/ml)	
1	Tube well	28.9 %	71.1 %	49
2	Well	10.5 %	89.5 %	57
3	Tap water	17.6 %	82.4 %	17
4	Stone Spout	0 %	100 %	9
<b>Total</b>		<b>17.4 %</b>	<b>82.6 %</b>	<b>132</b>

#### B. Coliform count

Source wise distribution of coliform count showed that the 85.7% of tube wells, 94.7% of wells, 100% of taps and 100% of stone spouts crossed WHO guideline value (0 cfu/100ml). (Fig. 1).

#### C. Isolation and Identification of Bacteria

In this study, 238 isolates of enteric bacteria obtained were identified as *Escherichia coli* (26.4%), *Enterobacter* spp (25.6%), *Citrobacter* spp (22.6%), *Pseudomonas aeruginosa* (6.3%), *Klebsiella* spp (5.4%), *Shigella* spp (3.78%), *Salmonella typhi* (3.3%), *Proteus vulgaris* (2.9%), *Serratia* spp (2.52%), and *Vibrio cholerae* (0.84%). (Fig. 2) The results revealed that 31.5%, 43.7%, 16.0% and 8.8% of isolates were



obtained from water samples of tube well, well, tap and stone spout sources.

## DISCUSSION

The main objective of this study was evaluation of quality of water from different sources (tap, stone spout, tube well and well) from Kathmandu valley.

Heterotrophic plate counts and Coliform counts have been used extensively as a basis for regulating the microbial quality of drinking-water. In this study, both regulatory parameters were excessively above the WHO guideline values. Study results clearly indicated that most of the natural water sources are highly contaminated. The detection of pathogenic enteric bacteria in different sources of drinking water in Kathmandu valley also reveals the alarming situation for water borne epidemics in the valley.

Water quality indicates that pollution of the water is increasing alarmingly and that it has created serious threat to human health and environment. Bacteriological pollution of

drinking water supplies may be either due to the failure of the disinfections of the raw water at the treatment plant or to the infiltration of contaminated water (sewage) through cross-connection, leakage points and back siphonage. In piped supplies, discontinuity increase the likelihood of contamination as the risk of back siphonage into the distribution network is increased when pipes are at lower pressure than the surroundings soil, which often contains leaked out effluent from leaking sewers.

The result clearly showed that the quality of the water consumed is critical in controlling infectious diseases and other health problems.

According to the WHO, the lack of safe water supply and of adequate means of sanitation is blamed for as much as 80 % of all diseases in developing countries. In Nepal, morbidity and mortality rates from water borne disease are considered high particularly among children below the age of five.

A regular monitoring the water quality for improvement not only prevents disease and hazards but also checks the water resources from going further polluted (Trivedy and Goel, 1986). The conservation of water sources is very important to provide safe water. As far as possible, water sources must be protected from contamination by human and animal waste, which can contain a variety of bacterial, viral, protozoan and helminthes parasites. The control of drinking water quality in distribution networks remains a major challenge in urban areas. The protection of sources, treatment and distribution management are all-critical strategies in maintaining and improving piped water supplies.

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