Public perception about drinking jar water and its bacteriological analysis

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ABSTRACT

The consumption of jar water has been increasing consistently in these days. To improve such water quality and supply, information is needed to assess water contamination in a variety of community, including those that rely primarily on unimproved distributed sources of drinking water. This study was done to assess the public perception on drinking jar water and assessment of drinking jar water distributed in Kathmandu Valley which was conducted in the Department of Microbiology, Amrit Science Campus, Thamel, Kathmandu during the period of Aug 2009 to Dec 2009. A total 57 water samples of different drinking jar water having different brand names were proceed using standard protocols and analyzed for the presence of total coliforms and fecal coliforms. All identified fecal coliforms isolates from different water samples were subjected to in-vitro antimicrobial susceptibility test by Kirby-Bauer disc diffusion method. In order to know the perception of people in drinking jar water, semi structured questionnaires were made and purposively selected for the study in 525 populations who were using jar water for drinking purpose. Most population rated their drinking jar water good but found to be highly concerned with the quality. Among total water samples, 91.2% (n=52) were found contaminated with total coliforms and 59.6% were with fecal coliforms. During the study, 117 isolates of enteric bacteria were isolated, of which 33.3% (n=39) were *Escherichia coli* followed by other gram negative bacteria. Similarly, out of 58 fecal coliforms isolates, 43.1%, 39.6%, 12.2% were *E. coli*, *Klebsiella spp*, and *Enterobacter aerogens*. Of those fecal coliforms, all were sensitive to antibiotic ciprofloxacin and resistant to ampicilin. The finding indicates that jar water is not safe for drinking purpose without treatment.

Keywords: Drinking water, fecal coliforms, jar water, isolates.

INTRODUCTION

High quality of water sources may be required for drinking purposes, while the quality of water for other domestic uses can be quite variable. Therefore, water polluted to only a certain extent cannot be considered pure for drinking purposes.[1]

The Kathmandu Valley suffers a severe drinking water supply crisis, particularly in the dry seasons of every year. The drinking water supply in the cities of the Valley is intermittent. Similarly, in urban areas in particular, supplies are often rarely 24 hours a day. For example, in Delhi, only 1.0% of those people with water supply connections enjoy 24-hour service availability. In Karachi, Dhaka, and Kathmandu, the figure is less than 1.0%.[2]

Bottled water, however, is being widely consumed in because it contains fewer impurities. Therefore, it can also be beneficial to detect deterioration in the quality of water resources and to facilitate appropriate and timely corrective actions with a minimal negative impact on public health.[3]

Bacterial contamination cannot be detected by sight, smell and taste. The only one reliable way to determine if the water supplies contain bacteria is to have it tested. Even, a single coliform indicates possible contamination of sewage and consumption of such water cause water borne diseases like typhoid, dysentery, and hepatitis. So, water is unfit for drinking if there is presence of single coliform.[4]

Worldwide, 1.1 billion people still did not have access to safe drinking water in 2002.[5] Every day > 6,500 children die from diarrheal illness.[6] Diseases caused by contaminated waters are among the ten most prevalent water borne diseases in Nepal.[7] So the reported data from Nepal have showed high rate of drinking water contamination.[8-11] This has resulted into the endemicity and /or frequent outbreak of various waterborne diseases in the country.

During 1995/96, the incidence of diarrhea among children below five years of age was 131 per 1,000 children. The mortality rate due to the diarrhea was 0.34 per 1000 children under five years of age, while the case of fatality rate was 2.56 per 1,000.[12]

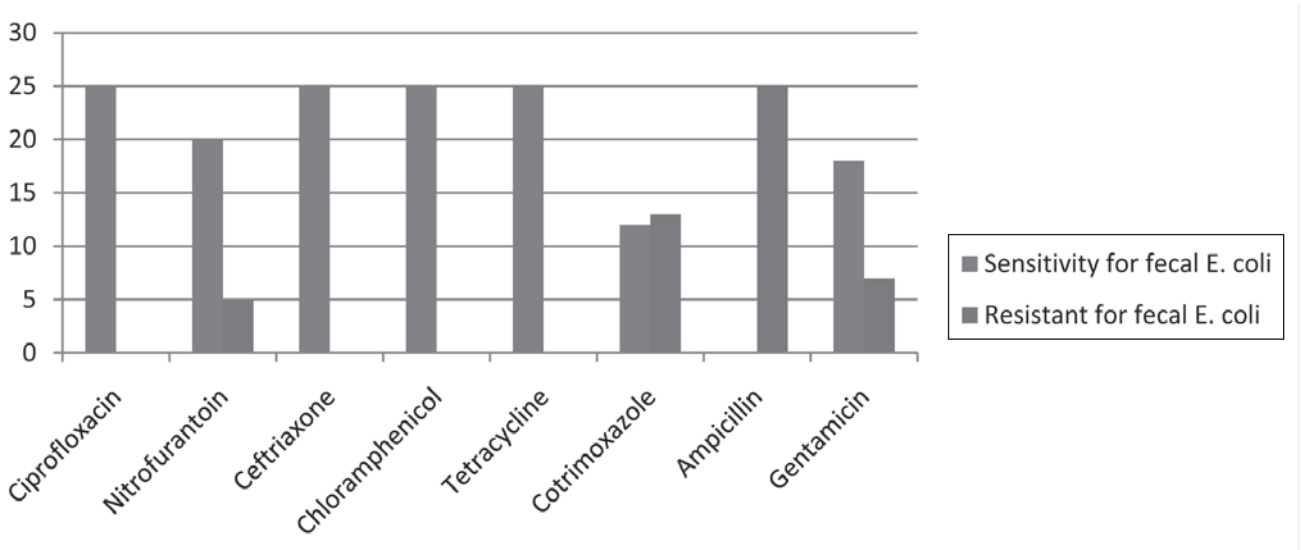

Fig. 1. Antibiotics sensitivity and resistant pattern of fecal *E. coli*

If we are to move toward the millennium development goals of halving the number of people without access to safe water by 2015, a variety of different interventions may be necessary, because water quality and water use patterns depend on environmental, social, economic, and cultural characteristics of a given area.[5] This study aimed to explore the public perception on jar water and its bacteriological drinking quality supplied in Kathmandu Valley.

MATERIALS AND METHODS

Study sit: The study was carried out in Kathmandu Valley inside the ring road, comprised of thirty five wards.

Study population: Each new jar company was searched in these wards and altogether 57 different jar bottles were found in whole wards. The selection of individual jar was random from new jar company.

Sampling method and Sampling size: A field based study was employed for collecting samples, representing all the wards of Kathmandu Valley. Similarly semi structured questionnaire was made and purposively selected to the 525 population from these wards who were using jar water for drinking purpose. Verbal consent was made to know the perception of their drinking jar water. Qualitative data were collected through in-depth interview.

Sample processing: Samples were collected and transported by standard methods as mentioned in APHA.[13] Microbiological analysis of water samples was conducted in Microbiological Laboratory of Amrit Science Campus Thamel.

Sample reliable: To minimize the error in results, samples were collected two times from same company in the random period of intervals. So, total samples were two times the total number (2x57) =114. This was done to prevent the accidental results that might arise by any cause. No duplicate method was done for the isolation and antibiotics sensitivity test except Most Probable Number (MPN) test.

Microbial examination of water sample: Microbial examination of water samples were done by MPN

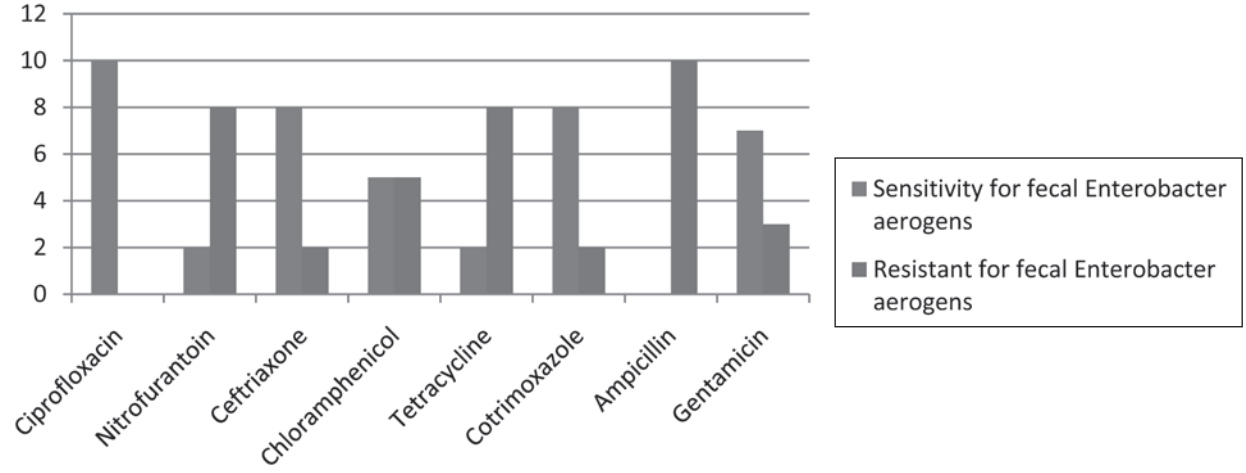

Fig. 2. Antibiotics sensitivity and resistant pattern of fecal *Klebsiella* spp.

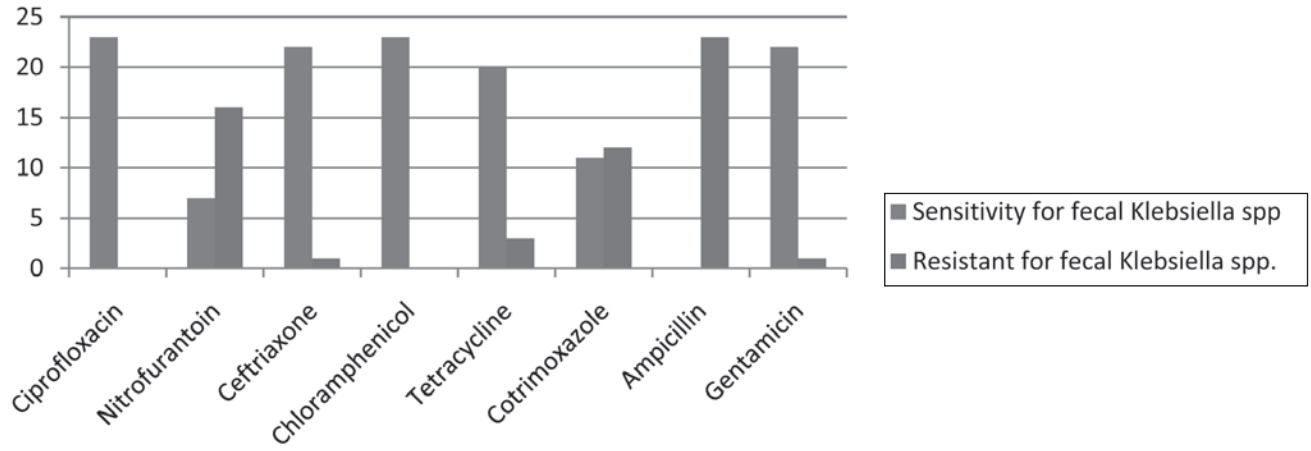

Fig. 3. Antibiotics sensitivity and resistant pattern of fecal *E. coli*

method as described by APHA.[13] 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).

Antibiotic sensitive test: The identified isolates form water samples were subjected to in-vitro sensitive test by modified Kirby-Bauer disc diffusion method. The antibiotics used in the study were ciprofloxacin (5mcg), nitrofurantion (300mcg), ceftriaxone (30mcg), chloramphenicol (30mcg), tetracycline (30mcg), cotrimoxazole (23.7mcg), ampicillin (10mcg) and gentamicin (10mcg).

Data analysis: Data entry was done using Microsoft Office Excel 2007 and data analysis was done using statistical package for Social Sciences (SPSS) version 11.5. Student independent T test (P= >0.05) was considered that there is no significant different between the result of two consecutive water samples by MPN test.

RESULTS

Out of 525 respondents, using jar water as a source of drinking water, majority told that water is good for drinking purpose. Similarly, highest numbers of people were keen to check the quality of water, despite the assurance of quality by companies (Table-1 and 2).

Table-1: People's perception about the quality of jar water

Perception	n (%)
Very good	97 (18.4%)
Good	324 (61.7%)
Satisfactory	69 (13.1%)
Poor	30 (5.7%)
Very poor	5 (0.9%)
	Total n of respondent=525

Of the total 57 numbers of jar bottles tested 91.2% (52/57) were found having contaminated with total coliforms and 59.6% (34/57) were found having contaminated with fecal coliforms. There was no significant difference between the results having coliforms positive by MPN in two consecutive samples which was tested in the random period of time. Statistical analysis was done by student independent T test. Student independent T test was 0.361 (P= >0.05).

Out of 117 isolates the majority was *E. coli* followed by other coliforms. Similarly, 58 were fecal coliforms where the majority was fecal *E. coli.* (Table-4 and 5).

Of eight antibiotics used in vitro sensitivity test, fecal *E. coli* and fecal *Klebsiella* spp showed following pattern of antibiotics sensitivity (Fig. 1 and 2).

Similarly, ciprofloxacin was the most effective antibiotic and ampicillin was the most resistant antibiotic to the fecal *Enterobacter aerogens* (Fig. 3).

DISCUSSION

Most respondents rated the quality of their jar water supplies is good and 18.4% were convinced that it was very safe for consumption. The reason might be either due to attractive jar or the assurance by different

Table-2: People's concern about the quality of jar water

People's concern	n(%)
Very concern (very important to check)	412 (78.4%)
Concern (important to check)	80 (15.2%)
Satisfactory (check will know)	28 (5.0%)
Less concern (less concern to check)	5 (0.9%)
No concern	0
	Total n of respondent=525

Table-4: Pattern of different species of bacteria isolated from water samples.

Organisms	n(%)
E. coli	39 (33.3%)
Klebsiella spp	28 (23.9%)
Proteus spp	12 (10.2%)
Streptococcus spp	7 (5.9%)
Citrobacter spp	5 (4.3%)
Pseudomonas spp	6 (5.1%)
Enterobacter spp	20 (17.0%)
Total isolates	117 (100%)

companies. However, 78.4% of respondents reported having very concerns with the quality of their water; they were suspicious with company's claim. Even, those persons who were convinced in jar water also had concerned for the test of the jar water. The result was found similar in the research carried in the City of Hamilton, Ontario (Canada) where most respondents rated the quality of their private water supplies is good and 60.0% were sure it was safe for consumption. However, 80.0% of respondents reported having at least some concerns with the quality of their water.[14,15] Although, the study in same area had shown chemical and microbial contamination of private water supplies was in excess of government standard.[16]

Only 2.0% of respondents suspected that they or their family members had become ill as a result of a private jar water supply (data not shown). This shows unless there is no direct evidence of illness or negative effects from their water, people may believe it safe for consumption. Similar type of response was found in one study.[14] The participants emphasized the importance of a good quality water supply and the effect of water that can have impact on health. Similarly, 100.0% of respondents said that the quality of drinking water affects their health.

Convenience was a major or motivating factor for buying Jar water. Although, questionnaire design did not include convenience as a category it seems obvious that people who would normally drink tap water would be motivated to buy jar water when tap water is unavailable, for example in a shopping centre, office, college, or at the cinema. Convenience, cost and taste were influential factors when making decisions as to whether to buy bottled water; health beliefs were unimportant motivating factors.[17]

Table-5: Pattern of different fecal coliforms bacteria isolated from water samples

Fecal coliforms	n (%)
E. coli	25 (43.1%)
Klebsiella spp	23 (39.6%)
Enterobacter spp	10 (17.2%)

In present study, 90.0% of the sealed jar water bottles were found to be contaminated with total coliforms and 60.0% of the samples were contaminated with fecal coliforms. By inquiry, it was found that most of the jar companies get their source of water either from periphery area of valley or near Mountain. Several studies have shown that high rate of drinking water contamination has observed in Kathmandu Valley and other Mountain regions.[18-20] Distribution of such contaminated water without proper treatment potentially threat to public health. Despite the assurance on good water quality by different companies by different treatment methods such as coagulation, flocculation, sedimentation, filteration, ozonolysis, reverse osmosis, jar water might be good source for the transmission of different water borne diseases.

E. coli was found to predominant organism in total coliforms and in most of contaminated drinking water.[18,20] This indicates a great risk for the outbreak of water borne diseases like diarrheal disease, typhoid fever and others at any point of time. 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 and a yearly minimum death of 30,000 and morbidity of 3.3 episodes per child has been estimated due to diarrhea alone.[21]

The antibiotics sensitivity patterns of fecal coliforms were variable. Ciprofloxacin and ofloxacin were 100% sensitive for isolates. Similarly, ampicillin was found highly resistant towards isolates.

Present finding indicates the alarming situation of the quality of jar water. The reason behind this is whether private water companies are not supplying properly treated water or the jar bottles that are used for filling water are not properly cleaned.

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