Bacteriological Analysis of Mineral Water and Drinking Water Supplies, in Mehsana, Gujarat

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Abstract: The bacteriological quality of drinking water supplies was undertaken for a movement towards self-awareness against waterborne diseases, such as diarrhoea and improved water management through increased community participation. The bacteriological quality of municipal water supplies and 10-L bottles of mineral water from water dispensers were comparatively studied. The samples were subjected to the detection of total coliforms, faecal coliforms, Escherichia coli, faecal streptococci, Pseudomonas, Staphylococcus spp. and heterotrophic plate count. The results showed that 35% of the tap water samples from municipal water systems and 25% of the 10-L bottles of mineral water from water dispensers were contaminated by at least one coliform or indicator bacterium and/or at least one pathogenic bacterium. This shows the need for an improved examination system for the bottled water industry. For the municipal water systems, it is recommended to perform the pseudomonas enumeration periodically, in addition to the routine data collected by most systems.

Keywords: bacteriological quality, drinking water, total coliforms, faecal coliforms

1. Introduction

The quality of drinking water is of vital concern to mankind, since it is directly associated with the existence of human life. Faecal pollution of drinking water causes water-borne diseases, which affect entire population of cities (Farah et al., 2002). Drinking water supplies have a long history of being infected by a wide range of microbes (Cairncross S et al., 2010). Therefore, the primary goal of water quality management from health perspective is to ensure that consumers are not exposed to pathogens that cause disease. Protection of water sources and treatment of water supplies have greatly reduced the incidence of these diseases in developed countries (McMichael, 2000).

Therefore, testing the source of water is necessary (Abera S et al., 2011). This is useful as result of the failure of treatment process or as a part of an investigation of serious water-borne disease outbreak (WHO, 2006).

It is well-appreciated that many communities in developing countries face severe public-health problems relating to drinking-water (Opryszko et al., 2009) it include the supply of safe water is important to protect the health of the community people, scarcity and pollution of water both by microbial and chemical contaminants (Legnani et al., 1999) are major problems faced by rural population in several parts of India, lack of sanitation is detrimental to water potability concentrating pathogenic organisms (Fewtrell L. et al., 2005). Diarrhoea is the most common infectious disease worldwide and gastrointestinal infections kill 1.8 million people globally each year, mostly children in developing countries (WHO, 2006). While urban industrial centres in such areas continue to receive water supplies from rural lakes and water sources by virtue of their economic status, rural communities with no traditional base of harvesting and conservation of water are left in the lap of migration and/or hardship (Dufouret et al., 2003) (Lomate et al., 2005).

2. Materials and Methods

2.1 Sample collection

Twenty residences and 20 workplaces were randomly selected from Mehsana town viz. Mh1, Mh2, Mh3 and Mh4. 10-L bottles of mineral water supplied by a recognized company among various bottling companies sampled in this study. The samples for microbiological analyses were collected in 1.0 L sterilized plastic bottles containing sodium thiosulfate (10% w/v) and transported to the laboratory in ice. Analyses were carried out within 6 h of sampling.

2.2 Microbiological analysis

The microbiological parameters determined were total coliforms (TC) and faecal coliforms (FC), faecal streptococci (FS), Escherichia coli, Pseudomonas aeruginosa, Staphylococcus spp. and aerobic and facultative anaerobic heterotrophic bacteria (HPC). TC, FC, FS, E.coli, P. aeruginosa, and Staphylococcus spp. were quantified by membrane filtration. A volume of 100 mL of the samples was filtered through membrane filters with 0.45 mm pores (Millipore, MA, USA). The membranes were placed on solid media employed for each bacteria. The bacteria were enumerated and identified. The heterotrophic plate count (HPC) was determined by the pour plate technique as described by the standard methods (APA, 1998) (Trivedy and Goel, 1998).

3. Results and Discussion

A total of 120 drinking water samples 100 from taps were collected from the selected areas of Mehsana. 33.3% water samples were found to have MPN more than 3. However some of the tap water samples were found contaminated when the sampling was repeated again from the same source. The distribution of contaminated samples was almost similar during the years 2007-08 and 2008-09. (Figure 1)
Incidence of bacteriological contamination of water from all sources was to the extent of 39.3% in Mh1 sites and 38.7% in Mh3 sites, the extent of contamination varies in the water samples collected from Mh2 sites was 56.9% and further it was found to be 25.7% at Mh4 sites (Figure 3).

\[\text{Figure 2: Distribution of bacteria in drinking water supply (Mh1 sites).}\]

\[\text{Figure 3: Distribution of bacteria in drinking water supply (Mh2 sites).}\]

**E coli** was detected in 28% samples and MPN count varied from 0 to 350 per 100ml of sample (Figure 2) in Mh1 sites. Here **Ecoli** was detected in 28% samples and MPN count varied from 0 to 250 per 100 ml of sample. 14% **pseudomonas**, 11% **Enterobacter**, 5% **Streptococcus** spp., 34% **Bacillus** spp., 5% **Staphylococcus** spp. (Figure 3) in Mh2 sites.

\[\text{Figure 4: Distribution of bacteria in drinking water supply (Mh3 sites).}\]

\[\text{Figure 5: Distribution of bacteria in drinking water supply (Mh4 sites).}\]

The occurrence of **Ecoli** was in 29% samples and MPN count varied from 0 to 130 per 100ml of sample. 14% **pseudomonas**, 11% **Enterobacter**, 5% **Streptococcus** spp., 36% **Bacillus** spp., 5% **Staphylococcus** spp. (Figure 4) in Mh3 sites.

The bacterium **Ecoli** was detected in 34% samples and MPN count varied from 0 to 110 per 100ml of sample. 13% **pseudomonas**, 16% **Enterobacter**, 4% **Streptococcus** spp., 23% **Bacillus** spp., 4% **Staphylococcus** spp. (Figure 5) in Mh4 sites. (Figure 2 to 5)

The bacteriological examination of water is one of the important pollution indices of drinking water. Plate count is a supplementary test and gives indication about type of contamination in the present study it ranged from 0 to 500 cfu/ml this indicated bacterial contamination with fecal matter and vegetation (Thakur et al., 2001) and (Victoria et al., 2001).
About 4% samples from 10-L bottles were contaminated with *Escherichia coli*. The finding that 31/77 or more than 1/3 of the bottled water contains coliform organisms suggests the need for an improved surveillance system for the bottled water industry (Kohnen et al., 2005). Similar results were observed in new 10-L bottles; 5/22 or almost 1/4 bottles of water were positive for coliforms. Hence, *Pseudomonas aeruginosa* contamination was evident in 43% of the samples, over 2/3 (58.4%) of the 10-L bottles were contaminated, which was higher than the 10-L bottles (50%) and tap water samples from municipal supplies (Table no.1).

<table>
<thead>
<tr>
<th>Indicator bacteria or pathogen</th>
<th>Tap water (n=80)</th>
<th>Number (%) of samples positive</th>
<th>10-L bottle (n=20)</th>
<th>New a10-L bottle (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total coliforms</td>
<td>5</td>
<td>42</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Fecal coliforms</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Fecal <em>staphylococci</em></td>
<td>0</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>3</td>
<td>45</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><em>Staphylococcus spp.</em></td>
<td>6</td>
<td>28</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HFC (CFU/ml-1)</td>
<td>&lt;1</td>
<td>50</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1-500</td>
<td>48</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>&gt;500</td>
<td>3</td>
<td>38</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

* Bottled mineral water before installation of the bottles on water dispensers

4. Conclusion

The bacteriological quality of municipal tap water is better as compared with the 10-L bottles of mineral water collected from water dispensers and samples collected from new 10-L bottles of mineral water before installation in the dispensers. This highlights the need for an improved surveillance system for the bottled water industry. Obviously, better efforts are necessary to eliminate opportunistic pathogens like *P. aeruginosa*. Moreover, frequent cleaning of water dispensers would help eliminate various contaminants from the water and therefore lower the possibility of waterborne illness. For the municipal water systems, the enumeration for *Pseudomonas* should be performed periodically.

References


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