Microbial Quality of Drinking Water in Shahrekord (Iran)

H. Moshtaghi and M. Boniadian
Department of Food Hygiene, Faculty of Veterinary Medicine,
Shahrekord University, Shahrekord, Iran

Abstract: Occurrence and distribution of coliform bacteria in drinking water of Shahrekord city (Iran) investigated. Water samples (190), collected from tap waters (160) and bottled mineral water (90), were microbiologically examined for total bacterial count and total coliforms and recovery of Escherichia coli using a multiple tube test. Total bacterial mean count for tap water was 1.3×10⁶ CFU mL⁻¹, respectively and for bottled mineral water was 2.5×10⁴ CFU mL⁻¹, respectively. Coliform sp. formed 14% for tap water samples and no coliform bacteria isolated from bottled mineral water.

Key words: Drinking water, microbial quality, public health

INTRODUCTION

Drinking water-related outbreaks of pathogenic Escherichia coli have been reported as early as 1965 (in Sweden) and 1971 (in the United States) (Rice, 1999). Since then, drinking water-related outbreaks of pathogenic microorganisms have occurred throughout the world (Swidrow et al., 1992, Levy et al., 1998, Barwick et al., 2000; Olsen et al., 2002) the United Kingdom (Heuvelink et al., 1998, Chalmers et al., 2000), the Caribbean (Daniels, 2000), the Canary Islands (Pebody et al., 1999) and Norway (Robertson et al., 2006). Verotoxigenic Escherichia coli (VTEC) have been implicated in nine of these outbreaks: Seven outbreaks involved serotype O157:H7 (Pebody et al., 1999; Barwick et al., 2000), one outbreak involved serotype O111:H8 (Olsen et al., 2002) and one involved verotoxin producing E. coli serogroup O157 (Heuvelink et al., 1998). Three outbreaks of enterotoxigenic E. coli (ETEC) on cruise ships in the Caribbean involved multiple serotypes including O169:H41, O148:H28 and O8:H9 (Daniels, 2000). Contamination of different sources of drinking water in many countries have studied previously (Ermayat et al., 1988, Pathak et al., 1994; Levesque et al., 1994; Erginkaya and Var, 1997). The objective of this study was to determine the incidence of Coliform sp. in drinking water in Shahrekord city (Iran), to assess health risks for consumers.

MATERIALS AND METHODS

This study was conducted from February to September, 2005 in Shahrekord City (Iran). In this investigation 190 samples of water (tap water, 100 and bottled mineral water, 90) aseptically collected in sterilized bottles from different areas and 90 bottled mineral water of different brands purchased from market in Shahrekord city (Iran). Samples transferred immediately to dark storage conditions and kept at temperatures between 2-8°C for transport to the laboratory and analyzed as soon as practicable on the day of collection.

Corresponding Author: H. Moshtaghi, Department of Food Hygiene, Faculty of Veterinary Medicine, Shahrekord University, Shahrekord, Iran Tel: +98 913 181 2815 Fax: +98 381 442-4427

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The 5-tube MPN method used for water examinations (American Public Health Association, 1998). Inoculated tubes incubated at 35±0.5°C. After 24±2 h for heavy growth, gas and acidic reaction and, if no gas or acidic growth was formed, re-incubated and re-examined at the end of 48±3 h. Production of gas or acidic growth in the tubes within 48±3 h constituted a positive presumptive reaction. Tubes with a positive presumptive reaction submitted to the confirmed phase. The absence of acidic growth or gas formation at the end of 48±3 h of incubation constituted a negative test. For positive tests brilliant green lactose bile broth fermentation tubes used for the confirmed phase.

RESULTS AND DISCUSSION

Occurrence and distribution of coliform bacteria in drinking water, tap water samples (100) and bottled mineral water (90) in Shahrekord city (Iran), were microbiologically investigated.

The quality of many source waters will depend upon geology, soil type, natural vegetation, climate, run-off characteristics, treatment and distribution systems. Disruption of natural geology and heavy rainfall can dramatically affect water quality. Wild animals and birds can also be natural sources of zoonotic pathogens. The discharge of industrial effluents, particularly from abattoirs and cattle markets, may also contain large numbers of pathogenic micro-organisms which increase the risk of contamination.

The mean total bacterial count in tap water was $1.3\times10^6$ CFU mL$^{-1}$ and for bottled mineral water was $2.5\times10^6$ CFU mL$^{-1}$. Out of 100 samples of tap water, Coliform sp. isolated from 14 samples. In biochemical tests 7 samples showed the presence of E. coli; 3 samples, Klebsiella and 4 samples showed the presence of Citrobacter. No coliform isolated from bottled mineral water samples (Table 1).

In a study on quality of drinking water of Kalama region in Egypt 30% of samples from public tap waters were contaminated with coliform bacteria (Ennayat et al., 1988). Another study in India showed that 41-67% of water samples from open water sources contained coliform and/or faecal coliform bacteria (Pathak et al., 1994). In an investigation for the quality of tap drinking water and spring water in the Quebec city of Canada 36 and 28% of water samples were contaminated by at least 1 coliform or indicator bacterium and/or at least 1 pathogenic bacteria (Levesque et al., 1994). Ergínkaya and Var (1997) in a study on microbial quality of bottled spring water in Turkey stated that coliform bacteria found in 12 of the 130 bottles of spring water. Concentrations of fecal coliforms, Escherichia coli, enterococci, coliphage and enteroviruses in the untreated wastewater, water column and sediments of the impacted area and drinking water treatment facility and distribution system at McMurdo Station were determined. All drinking water samples were negative for indicators except for a single total coliform-positive sample. Total coliforms were present in water column samples at higher concentrations than other indicators (Lisle et al., 2004).

E. coli can survive in drinking water for four to twelve weeks depending on environmental conditions. E. coli O157:H7 may actually survive better in municipal water versus surface water and may enter a viable but non-culturable state in both municipal and environmental water (Wang and Doyle, 1998).

<table>
<thead>
<tr>
<th>Source</th>
<th>No. of samples</th>
<th>Mean total bac count mL$^{-1}$</th>
<th>Coliform sp. (%)</th>
<th>E. coli (%)</th>
<th>Klebsiella (%)</th>
<th>Citrobacter (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap water</td>
<td>100</td>
<td>$1.3\times10^6$</td>
<td>14.00</td>
<td>50.00</td>
<td>21.40</td>
<td>28.6</td>
</tr>
<tr>
<td>Bottled mineral water</td>
<td>90</td>
<td>$2.5\times10^6$</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>190</td>
<td>-</td>
<td>7.36</td>
<td>3.68</td>
<td>1.57</td>
<td>2.1</td>
</tr>
</tbody>
</table>
CONCLUSIONS

Drinking tap water of Shahrekord city is contaminated with pathogenic bacteria and chlorination is the only system that is used for treatment of water, thus it is suggested that emphasis be put on catchment management to limit contamination of raw water and to ensure that the number of E. coli in the source water remain low.

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REFERENCES


