Bacterial Water Quality in the Personal Water Bottles of Elementary Students

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ABSTRACT

Background: Samples of drinking water were collected directly from the personal water bottles of students at an elementary school in Calgary, Alberta.

Methods: Total and fecal coliforms and heterotrophic bacteria were enumerated using membrane filtration and agar plate count methods respectively.

Results: The Canadian Drinking Water Quality Guidelines (CWQG) criterion was exceeded for total coliform in 13.3% of 75 samples. Fecal coliform and total heterotrophic criteria were exceeded in 8.9% (of 68 samples) and 64.4% (of 76 samples) respectively.

Findings: The use of personal water bottles for students in elementary classrooms is not recommended.

Sampling was conducted to collect representative samples of water that the students were drinking. Any available water present in an individual student’s water bottle was transferred into sterile (autoclaved at 230°C for 20 minutes) polypropylene bottles for lab analysis. Three separate classrooms were sampled over a one-week period. In total, 76 samples were collected directly from student water bottles, with sample volumes ranging from 10 to 500 mL. In addition, source water samples were collected from each of the classroom sinks and two drinking water fountains located in the school hallways. All water samples were stored at 4°C and analyzed within 18 hours of collection.

Heterotrophic bacteria were quantified using Heterotrophic Plate Counts (HPC) on standard HPC plate count media. Coliform bacteria were analyzed using Standard Membrane Filtration (MF) techniques and m-Endo (total coliform) and m-FC (fecal coliform) media.

Significant levels of coliform bacteria were found in water from the students’ personal water bottles (Table I). Of the 76 samples analyzed for total coliforms, 10 (13.3%) contained >10 cfu/100mL. Fecal coliforms were enumerated at >1 cfu/100mL in 6 of 68 samples analyzed (8.9%).

Heterotrophic bacteria concentrations were also elevated. Heterotrophic plate counts are used as an overall indicator of the bacterial quality of water supplies. Drinking water guidelines (>500 cfu/mL) were exceeded in water collected from...
64.4% of the bottles. These high heterotrophic counts may indicate the effect of bacterial regrowth in bottles that have remained at room temperature for an extended period. Significant bacterial regrowth has been shown to occur in treated, chlorinated water, when left at ambient temperature for as little as 8-24 hours.  

Bacterial levels from each of the five source water samples were all under the detection limits for both coliforms (i.e., <1 cfu/100mL) and heterotrophs (<10 cfu/mL).

**DISCUSSION**

The findings suggest that significant bacterial contamination can occur in individual water samples originating from personal water bottles. This study cannot identify the origin of contamination, however the most likely source of enteric bacteria found in the students’ water bottles is the hands of the students themselves. Inadequate and improper hand washing after students have used the bathroom facilities could result in fecal coliforms in the classroom area. A study conducted within a Houston, Texas day-care isolated fecal coliforms from the hands of 17% of staff and children, and 13% of classroom objects during routine monitoring. These rates increased significantly during outbreaks of diarrhea. Although the transmission routes of fecal contamination in day-care centres may vary from those in primary schools, contamination of hands, taps and sinks was shown to be a reliable predictor of diarrhoeal risk. These same sources may potentially be the main vectors of fecal transmission from the environment to the students’ water bottles in this study. A previous study conducted in a primary school in Leeds, England indicated that hygiene training significantly decreased the levels of fecal streptococci isolated from the hands of elementary children. The results obtained from this study suggest there is a need to educate students about proper hygiene practices in order to decrease the spread of coliform bacteria.

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**REFERENCES**


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