ASSESMENT OF THE QUALITY OF DRINKING WATER USED BY THE COMMUNITY OF RAJARATA UNIVERSITY OF SRI LANKA

KWT Chethana and WMGCK Mannapperuma*

Department of Biological Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka.

chamilak@yahoo.com

Keywords: drinking water, fecal coliforms, heterotrophic plate count, total coliforms, water quality

INTRODUCTION

Access to safe drinking water is a vital requirement for all living organisms. In Sri Lanka, only 67% of people have access to safe drinking water (Bandara *et al.*, 2008). In North Central Province of Sri Lanka, contaminated water has become the third leading cause of death (Weeraratna, 2011). This study was designed to assess the selected physicochemical and the microbiological parameters of the bottled and tap water, available at the Rajarata University of Sri Lanka (RUSL) and to determine whether the above parameters are within the permitted levels and to ascertain the safety of drinking water. Also the study was aimed to determine the variation of the contamination levels of bottled water samples with the storage time.

METHODOLOGY

The study was conducted at the Faculty of Applied Sciences, RUSL. Bottled water of volume 20, 5 and 1 liters and the tap water samples were collected according to the SLS specifications for bottled water (SLS 894 2003) and tap water (SLS 614 1983) respectively. Physico-chemical parameters such as pH, BOD, DO, conductivity, colour, odour and chlorine concentration were analyzed as mentioned in the SLS specifications. Heterotrophic bacteria (HPC) were determined by the pour plate method using Nutrient agar at 37 °C for 24 hours. Total and fecal coliform bacteria were determined by membrane filtration followed by incubation of total coliforms on absorbent pads saturated with m-Endo broth (at 37 °C) and fecal coliforms on m-FC saturated pads (at 44.5 °C) for 24-48 hours. Samples were also analyzed for the presence of fungi by incubating spread plates of Potato Dextrose Agar at room temperature for 4-5 days. Identification was done by microscopic observations with the aid of reference material. Microbiological parameters were continuously assessed for five months. Sterilized distilled water and water inoculated with *Escherichia coli* were used as negative and positive controls respectively, in all analysis. Data were statistically analyzed by using Anova single factor analysis in SAS 9.0

software and Microsoft office Excel 2007 software. The differences between the counts were evaluated statistically significant in cases when p-value<0.05. Mean comparisons between different sources were evaluated statistically significant in cases when F>F Critical, by F test.

RESULTS AND DISCUSSION

Heterotrophic and total coliform bacteria were observed in all the tested water samples. HPC was highest in the 20 L bottles (Figure I), possibly due to the improper sterilization of bottles during refilling. Tap water showed the lowest HPC level due to re-chlorination at RUSL. HPC counts increased significantly (F>F Crit) in 20 L and 5 L bottles, while the HPC increase was not significant (F<F Crit) in 1 L bottled water and tap water based on mean comparisons. This increase of HPC could be due to the growth of pre - contaminated bacteria in the tested bottled water samples. The difference of the HPC between the [5 L and 1 L] bottled water and between [5 L bottled water and tap water] samples were significantly different (p<0.05). Therefore, more concern should be made when consuming 20 L and 5 L bottled water. A similar study conducted by Abayasekara *et al.*, (2007) has found that 50% of the tested bottled water was exceeding the permissible level.

During this study, the total coliform counts in all bottled water samples increased exceeding the permissible level given in the specification with storage time (Figure II). It can lead to health problems in immuno-compromised and other susceptible personnel too. Although, 15% of the bottled water tested has been positive for fecal coliforms in a study conducted by Abayasekara *et al.* (2007), none of the bottled water and tap water samples were positive for fecal coliforms in the current study. Similar results have been obtained by Khaniki *et al.* (2010). Current results do not indicate that the water samples tested are negative with fecal coliforms. This may be due to the low sensitivity of the m-FC media used in the method adopted in the current study which is based on lactose fermentation ability of the coliform group. Therefore, other enzymatic methods with higher sensitivity might be able to detect them (Mannapperuma *et al.*, 2010). Some fungi such as *Penicillium* spp. and *Mucor* spp. were observed on the PDA plates of 20 L and 5 L bottled water. In a similar study conducted by Abayasekara *et al.* (2007) in Sri Lanka, *Trichoderma* sp., *Aspergillus* sp., Yeast sp., *Alternaria* sp., *Penicillium* sp. and *Mucor* sp. have been identified in most samples of the bottled water tested. It has also been found that these species produce mycotoxins which can cause health risks for susceptible people (DEFRA 2011).

All the physical parameters tested in this study were below the permissible level as defined by the SLS standards. Although the chlorine level of the tap water (0.05 mg/L) was within the permissible level, it was lower than the minimum level (3.5 mg/L) specified by the Sri Lanka Standards. This may be due to the distance between the treatment centre at Anuradhapura and the University. Even though it has been recommended to rechlorinate the water received by the RUSL regularly, it was not done up to the standard.

CONCLUSIONS

Results showed that only the HPC of the tap water meets the Sri Lanka standards, while total coliform counts were exceeding the standards in both bottled and tap water used by the RUSL. Therefore, consumers should be aware of this problem. These high coliform levels may be due to low chlorine levels in the water as revealed in this study. Although re chlorination process is done at RUSL, it does not meet the standard level. Therefore, re-chlorination should be properly monitored at the RUSL. Further, the increase of HPC and the total coliform counts in bottled water samples with time indicates a direct relationship with microbiological quality and the storage time period. Therefore, it is advisable not to consume 20 L and 5 L bottled water stored for more than a month since they exceed the maximum permissible level after a month. Further, a proper surveillance system should be maintained to test the bottled water at different time intervals during the shelf life. The high bacteriological contaminations in the 20 L bottled water may be due to the improper sterilization of 20 L bottles during refilling and due to the contaminated sources used in the bottled water industry. Therefore, regulations should be imposed on the quality of source waters used in the bottled water industry in Sri Lanka. The current study also revealed that the tap water is bacteriologically more reliable for drinking purposes than the bottled water available at the RUSL. However, the scope of current study does not address about the inorganic ions, levels of toxic metals, radioactive compounds, cyanobacterial toxins and the viruses in the drinking water. Therefore, these contaminants should also be considered during future studies in this regard.

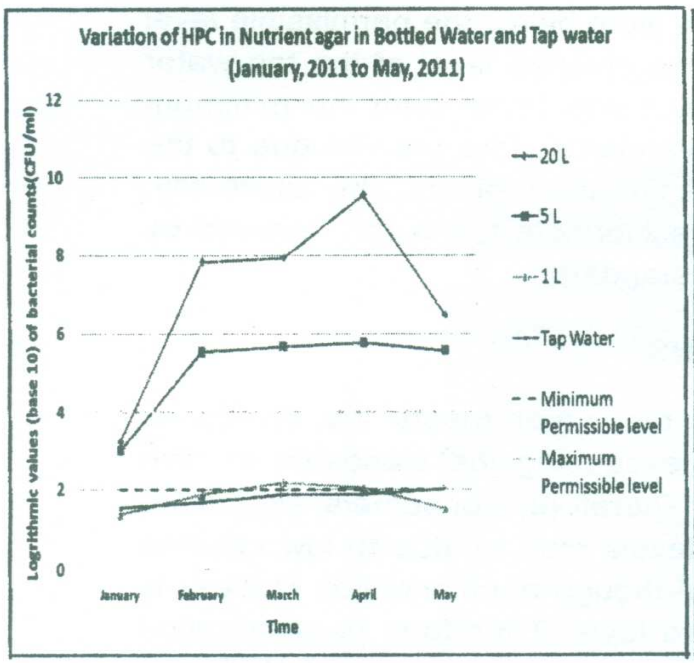

Figure 1- Variations in the HPC Counts in drinking water samples

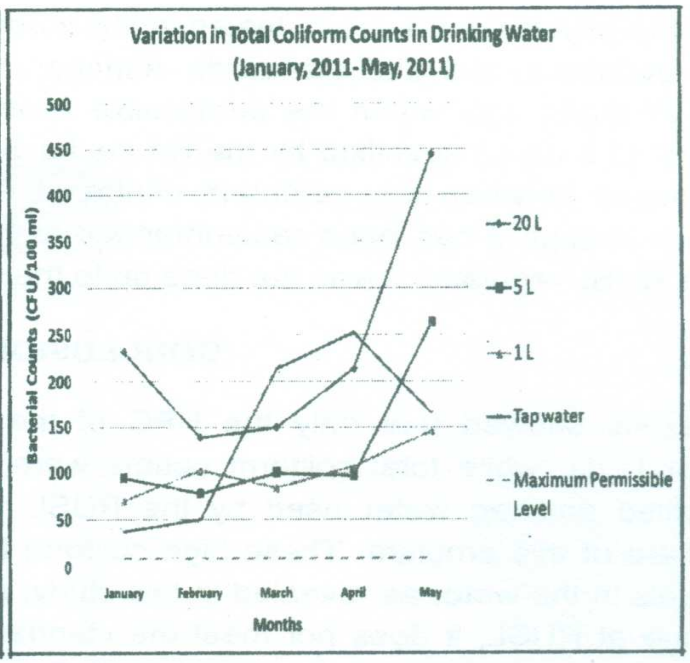

Figure 2 - Variations in the Total Coliform Counts in drinking water samples

REFERENCES

Abayasekara, CL, Herath, WHMAT., Adikaram, NKB, Chandrajith, R, Illepperuma, SC, Sirisena, AD and Rajapura, SG 2007, Microbial quality of bottled water in Sri Lanka: A preliminary Survey. Peradeniya University Research Sessions, Sri Lanka, 12 (1), pp. 49 -50.

Bandara, JMRS, Senevirathna, DMAN, Dasanayake, DMRSB., Herath, V, Bandara, JMRP, Abeysekara, T and Rajapaksha, KH 2008, Chronic renal failure among farm families in cascade irrigation systems in Sri Lanka associated with elevated dietary cadmium levels in rice and freshwater fish (Tilapia). In: *Environmental Geochemistry and Health*, 30, pp. 465 - 478.

Khaniki, GRJ, Zarei, A, Kamkar A, Fazlzadehavil, M, Ghaderpoori, M and Zaei, A. 2010, Bacteriological Evaluation in Bottled Water from Domestic Brands in Tehran Markets, Iran. In: *World Applied Sciences Journal*, 8, pp.3.

Mannapperuma, WMGCK., Abayasekara, CL, Herath, GBB and Werellagama, DRIB 2011, 'Comparison of Sri Lanka Standard –Multiple Tube Fermentation method with alternative bacteriological methods to detect indicator bacteria in water' in *Symposium Proceedings of the Water Professionals' Day: Water Resources Research in Sri Lanka,* The Crossing Boundarise Project-