COMPARATIVE STUDY ON THE MICROBIOLOGICAL QUALITY OF WATER COOLER DISPENSERS AND TAP WATER

— research paper —

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Abstract: The microbiological quality of water from water cooler dispenser and from tap water located in workplaces in Cyprus was comparatively studied. Aerobic heterotrophic bacteria, Total coliforms and two of indicators of fecal pollutions (*Escherichia coli*, and Intestinal enterococci) as well as the pathogenic bacteria *Pseudomonas aeruginosa* commonly associated with stagnant water, were choose for this comparative study and enumerated. The microbiological analysis performed on the water from dispenser and water from the tap there showed that the water samples from the dispenser are more polluted than the water samples from the tap. This highlights the need for frequent cleaning of water dispenser in order to eliminate various contaminants, and therefore lower the possibility of water borne illness.

Keywords: water quality, water cooler dispensers, coliforms, aerobic heterotrophic bacteria, *Escherichia coli*, Intestinal enterococci , *Pseudomonas aeruginosa*

INTRODUCTION

Many places in Cyprus have already experienced the benefits of providing easily accessible water through water coolers dispensers. Water coolers are popular in office buildings and commercial stores and the quality of this source of drinking water has the potential to cause waterborne outbreaks, especially in sensitive and immunocompromised subjects. Access to clean drinking water is a human necessity as well as an important health and environmental issue. Municipal tap water need to follow a strict set of

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guidelines for drinking water quality, according with (EU Council directive 98/83/EC, 1998) on the quality of water intended for human consumption, but the quality of water from individual water coolers is not regulated or controlled once installed on a dispenser. The lack of adequate cleaning of water coolers can lead to decreased water quality or contamination.

The aim of this study was to determine the microbiological quality of water coolers dispensers in comparison with the tap water in workplaces in Cyprus; investigate whether or not water cooler water is actually cleaner, healthier, or safer than tap water, and evaluates the importance of handling factors as cleanliness and disinfection program. The microbiological characteristics of the tap water and water from the dispenser are compared with the drinking water according to the EU Council Directive 98/83/EC.

MATERIALS AND METHODS

For the comparative study samples were taken from 50 different locations all over the Cyprus. The samples from the tap were taken after prior sterilization of the outer surface of the faucets with ethanol 95%. The water samples from the dispenser were collected directly from the 20 liter bottle of spring water (from the bottling companies in the region) after installation on the water dispenser without prior sterilization of the dispenser faucet. Water dispensers studied in this study were with disposable cups, and used to refill bottles. The samples were collected in 500 ml sterile bottle containing thiosulfate. The samples were kept at 4^0C and analyzed within 24 h.

The aerobic heterotrophic bacteria were determined by the pour plate method at 37^oC according with the method ISO 6222:1999 (ISO, 1999). Total coliforms and *Escherichia coli* were quantify by the Colilert method. Briefly, the Colilert method is based on the water sample turning yellow, indicating coliforms with b-galactosidase activity on the substrate ONPG (O-nitrophenyl-ß-D-galactopyranoside) and fluorescence under long-wavelength UV light when the substrate MUG (5-methylumbelliferyl-ß ß D-glucuronide) is metabolised by *E. coli* containing ß-glucuronidase (Stevens et al., 2003).

Pseudomonas aeruginosa was analyzed by membrane filtration procedure, according with the method ISO 16266:2008 (ISO, 2008). For both tap water and water from dispenser, 100 ml sample was used for analyses. After gathering all the data, tap water and the water from dispenser were compared.

Table 1 shows the standards for microbial quality of water according with the Council Directive 98/83/EC of 3 November 1998.

Table 1. European microbiological limits for tap water from municipal supplies

Parameter	Parametric value
Escherichia coli	0/100 ml
Coliforms	-
Intestinal enterococci	0/100 ml
Pseudomonas aeruginosa	0/100 ml
Aerobic heterotrophic bacteria at 37^0C	20/ml

RESULTS AND DISCUSSIONS

The results of the microbiological analysis performed on samples of tap water from municipal supplies, and 20 liter bottles of water from water dispensers appear in Table 2.

Table 2. Microbiological quality of tap water and water from dispenser

Indicator bacterium or pathogen	Number (%) of samples positive	
	Water dispenser bottles (n=50)	Tap water (n=50)
Total coliforms	6 (12)	7 (14)
Escherichia coli	0 (0)	0 (0)
Intestinal enterococci	0 (0)	0 (0)
Pseudomonas aeruginosa	34 (68)	15 (30)
Aerobic heterotrophic bacteria(CFU ml^{-1}) >20	43 (86)	15 (30)

It should be noted that *Enterococcus* spp. and *Escherichia coli* were not detected in any of the water samples. In 15 out of 50 (30 %) of the samples of tap water, and in 43 out of 50 (86 %) of the samples of water from dispenser after incubation at 37°C the number of aerobic bacteria was higher than the stated drinking water limits < 20 CFU/ml. The range of results for the water from the dispenser were between 0 cfu/ml to 1.8×10^3 cfu/ ml, and for the water samples from the tap were between 0 cfu/ ml and 5.9×10^2 cfu/ml. As we can see the contamination was higher for the samples collected from the water dispenser. The obtain results for Heterotrophic aerobic counts are showed in Figure 1.
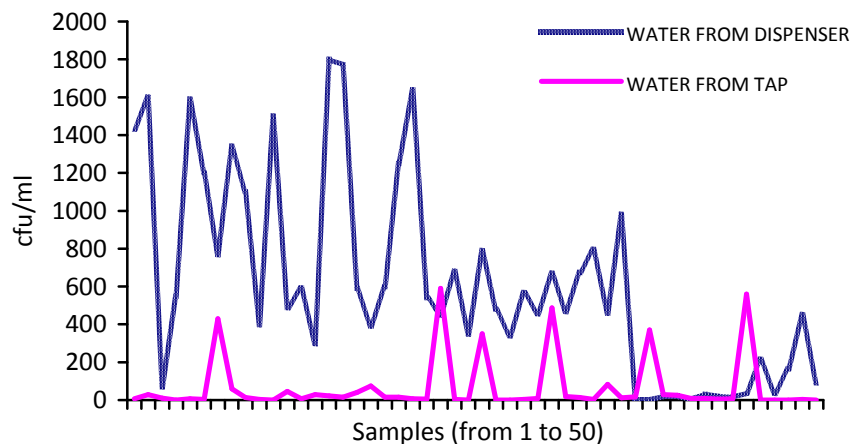
Figure 1. Results for Aerobic heterotrophic bacteria analysis

Pseudomonas aeruginosa was found in the samples collected from the tap in 15 out of 50 (30%) of the samples and in 34 out of 50 (68%) of water samples collected from water dispenser. The range of results for the water from dispenser were found between 0 cfu/100 ml and 3.5×10^2 cfu/100 ml, and from the water collected from tap the range of results found was between 0 cfu/ 100 ml and 3.1×10^2 cfu/ ml. The obtain results for *Pseudomonas aeruginosa* are showed in Figure 2.
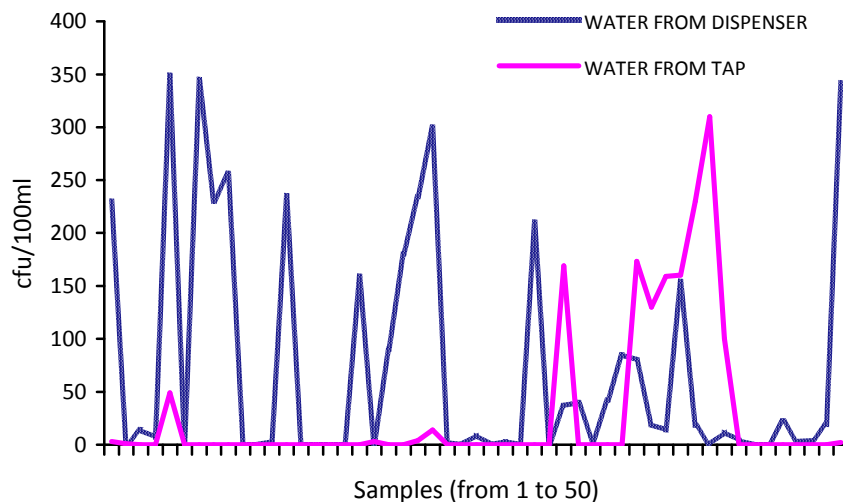

Figure 2. Results for *Pseudomonas aeruginosa* analysis

For Total Coliforms were contaminated 6 out of 50(12%) of water samples collected from the dispenser and 7 out of 50 (14 %) of water samples collected from the tap. The range of results for the water from dispenser were found between <1 MPN/100 ml and 2.6×10^2 MPN//100 ml, and from the water collected from tap the range of results found was between <1 MPN/ 100 ml and 18 MPN/ ml. The obtain results for Total Coliforms are showed in Figure 3.
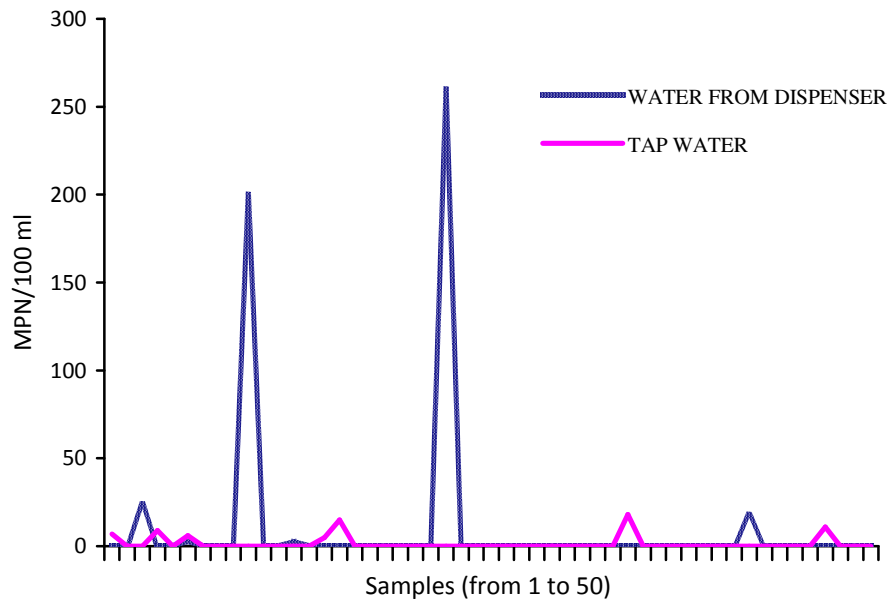

Figure 3. Results for Total Coliform analysis

The absence of *Enterococcus spp.* and *E. coli*, considered to represent an indicator of faecal contamination, renders the water satisfactory and safe with no health implications for both tap water and water from dispenser.

The Council Directive 98/83/EC don't use coliforms as indicators of drinking water quality, but according with WHO guidelines for drinking water the recommend indicators of fecal contamination (*Escherichia coli* or coliforms bacteria) should not be detectable in any 100 ml sample of any water intended for drinking (Guidelines for drinking water quality, 1996). Their presence in drinking water must at least be considered as a possible threat or indicative of microbiological water quality deterioration. The positive total coliform samples found inthis study for both water from tap (7

out of 50 analyzed samples) and dispenser (6 out of 50 analyzed samples) may indicate treatment ineffectiveness, loss of disinfectant, breakthrough (McFeters et al., 1986) and intrusion of contaminated water into the potable water supply (Geldreich et al., 1992) or regrowth problems (LeChevallier, 1990) in the distribution system or water from dispenser.

Heterotrophic aerobic counts measurements are used to indicate the effectiveness of water treatment processes, thus as an indirect indication of pathogen removal and as a measure of numbers of regrowth organisms that may or may not have sanitary significance. The principal determinants of regrowth are temperature, availability of nutrients and lack of residual disinfectants (LeChevallier, 2003). The number of Heterotrophic aerobic counts was higher for the water from dispenser (43 out of 50 analyzed samples, with the higher number of 1.8×10^3 cfu/ ml) than from the tap water (15 out of 50 analyzed samples with the higher value found of 5.9×10^2 cfu/ml). This can be due to poor disinfection of the dispenser machines or due to poor hygiene while refilling the dispenser bottles.

Pseudomonas aeruginosa has not been shown to cause any health effects following ingestion. It is more likely to cause problems with the taste and odour of drinking water. However, the biofilms that *Ps. aeruginosa* could harbor more dangerous bacteria. Contamination of water dispensers by *Pseudomonas aeruginosa* results from the bacteria either being introduced via the mains supply or through poor cleaning or installation practices. Due to the often sporadic or low flow rates in these types of units, the bacteria can attach to the internal pipework surfaces and form a biofilm to protect themselves and then start to multiply (Mena and Gerba, 2009). *Pseudomonas aeruginosa* is very difficult to get rid of once established in water dispensers, because of the inaccessibility of many of the mechanical components.

CONCLUSIONS

On the basis of the results obtained the bacteriological quality of municipal tap water is superior to the quality of the water dispensed by water coolers. The contamination of the tap water may be derived from the plumbing of the building.

The results show differences in quality and quantity of the microbiological parameters between the water coolers samples and the tap water samples. Indeed, the aerobic plate counts were higher in the coolers compared with the tap water and *Pseudomonas aeruginosa* was more frequently detected in water coolers samples than in those of tap water. Also Total coliforms were

detected in higher number especially in the water from dispensers. The contamination of the water cooler dispenser may be derived from the poor sanitation, low level of hygiene, the regular refilling of the bottles and uncontrolled parameters. Therefore, a periodic adequate disinfection of water dispensers had to be indicated in order to keep the level of microbiological contamination under control.

To avoid problems with cross-contamination of machines or devices, it is extremely important to ensure that the staff responsible for the cleaning and sanitizing of water dispensers are correctly trained and are aware of the potential for contamination during the cleaning process**.**

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