Assessment of Bacterial Water Load, Through Disinfection Processes, Chlorination and Ultraviolet

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Abstract

The purpose of the research was to evaluate the degree of reduction of the bacterial load of water using as chemical disinfectant chloramine T 1% (ChT1%) and physical disinfection using UV at a wavelength of 253.93 µm, 30 minutes exposure time. The results of the research show a more significant reduction of TNG/ml of water in samples subjected to exposure to UV, but in this case the decrease is affected by the turbidity of the water.

Keywords: *chlorination, TNG, turbidity, ultraviolet, water*

INTRODUCTION.

Chloramine, secondary disinfectants, is recognized as a safe disinfectant and a good alternative to chlorine (<https://www.cdc.gov/>, 2015). Is a weaker disinfectant than free chlorine but, the residual chloramine is more stable and longer lasting so, it provides better protection against bacteria re-growth (Metzger, 2007) and does not produce carcinogenic trihalomethanes or haloacetic acids (Pedraza, 2015). UV treatment provides an excellent disinfection without generating byproducts, no introduction of disinfectant-resistance to bacteria (Song et al., 2016). UV light inactivates microorganisms by modifying their DNA, preventing replication or infection, and a sufficiently large dose may inactivate waterborne enteric pathogens (Oram, 2014). Ultraviolet disinfection is safe, it destroys the germs but the action is also dependent on the turbidity of the water (<https://novascotia.ca/>, 2017).

MATERIALS AND METHODS

The samples were collected from a local source of water permanently contaminated with organic matter (brook) located at latitude 46.747 and longitude 23.524. Water samples (10) taken under sterile conditions, were analyzed by point of view of initial bacterial load by mixing 1 ml of water in Petri dishes to 18 ml of agar which was incubated at 37°C for 24 hours. Afterwards, was analyzed turbidity with portable turbidimeter ISO HI 98713, degree of contamination with organic matter. For water disinfection was used 0.2-0.3 ml chloramine T 1% (ChT 1%) and UV. From the raw water samples exposed to ultraviolet for 30 minutes and from samples in which ChT 1% is the disinfectant, were taken 1 ml of water poured in Petri dish and mixed with 18 ml agar incubated at 37°C for 24 hours. The statistical analysis was performed after a nonparametric test Kruskal-Wallis, the results being represented as mean ± SD, and the differences considered significant if $p \leq 0.05$, using SPSS software.

Table 1. NTG / ml water values for samples subjected to Chloramine T 1% and UV disinfection

n	Parameters	Mean± sd	Min	Max	RW-UV	WChT1%	
					30 min.	0.2 ml	0.3 ml
10	RW	4060.70±3174.30	1251.00	9920.00	***	ns	*
10	RW-UV	104.30±103.89	21.00	334.00	-		ns
10	WChT1% 0.2 ml	1199.50±581.87	588.00	2065.00	-	-	ns
10	WChT1% 0.3 ml	646.40±464.40	263.00	1860.00	-	-	-
Reduction of NTG					38.93 t	3.38t	6.28t

Legend: Min- Minimum;Max - Maximum, min- minutes, RW-raw water, RW-UV- raw water-UV exposure, WChT1% water subjected to disinfection to chloramine T, n- No of samples, *** -P<0.001;

** - P<0.01, * -P<0.05; ns- P>0.05; t-time

RESULTS AND DISCUSSION

The turbidity of the raw water varied between 36 and 111 NTU (69.74 ± 22.26), while, the organic matter: $3.83\text{--}16.22 \text{ mgO}_2/\text{l}$ (8.60 ± 4.59). Dependent on the disinfection method applied without any prior water treatment, it is noted that, the best option is water exposure to UV, the differences being extremely significant as TNG/ml water; reduction between raw sample and this disinfection method. However, disinfection efficiency has been affected by high water turbidity. Suspended particles are a problem because, the microorganisms buried in the particles, are protected and not destroyed (Dreeszen, 2003), and another cause would be that, UV dose was not enough ($1 \log, 3.88 \text{ mJ}/\text{cm}^2$) calculated by formula (Leinberger, <http://www.elaguapotable.com/>). Using ChT1% as a disinfectant, the differences between the raw samples and those with the addition of 0.3 ml of ChT1% are significant as can be seen from the table (1) and insignificant at 0.2 ml. The residual chlorine is $0.5\text{--}0.7 \text{ ml/l}$ for the use of 0.3 ml ChT1% and, $< 0.3 \text{ ml/l}$ at 0.2 % ChT1%. A distinctly significant reduction of TNG/ml water with 91.32%, can be ascertained by using UV (104.3 ± 103.89) versus 0.2 ml of ChT1% (1199.5 ± 581.87). TNG/ml water from the sample with ChT1% 0.2 ml has diminished of 3.38 times, 6.28 times in the samples with ChT1% 0.3 ml and, 38.93 times at exposure of raw water for 30 minutes at UV compared to the average obtained in the initial samples. One of the reasons why

chlorination was not effective can be attributed to the large amount of organic matter, which after Küpper *et al.*, 2009 may have unfavorable influence on the disinfection process.

CONCLUSION

The most effective solution for disinfection without pre-treatment of water is UV, but, turbidity affects the effectiveness of disinfection

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