Bacteriological Assessment of Potable Water Samples from different types of Water Purifiers of Indore city

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Abstract: *The principle risk to human health derives from fecal contamination. Safety of drinking water has become an important aspect for life of human being. The present study was undertaken to evaluate RO & RO + UV treated water quality of various water purifiers & coolers of Indore region. To check the potability of water, various water samples were collected & investigated for presence of indicator organisms such as coliforms. Coliform test was performed for counting of total coliforms. WHO bacteriological guidelines for drinking water recommend zero coliform /100ml. It was concluded from 30 investigated samples, that 40% of RO treated water is highly contaminated and not fit for drinking purpose. In 7% & 3% of RO treated water samples, 21 coliforms /100 ml & 12 coliforms /100 ml were observed respectively which shows that the quality of water sample is unsatisfactory. 2.2 coliforms /100 ml were observed in 10% of water samples, which indicates that water sample is unsatisfactory. Zero coliforms were observed in 40% of RO+UV treated water sample. The RO+UV treated water samples were found to be safest for drinking. A possible follow-up would be necessary to identify the source of contamination & disinfection of water tank before distribution through the water cooler. Water should be treated properly before consumption as water quality has a direct impact on public health.*

Key Words: *RO Water, RO + UV Water, Water Purifier, Coliforms, Water Potability.*

1. INTRODUCTION:

Water is most extremely essential resource found on earth & is equally important for the living world. Most of the diseases spread through water as it is vital source of life. It has been reported that coliform free potable water may not necessarily be free of pathogens (sim *et al*. 1987). Most of our concern about water purity is related to the transmission of diseases. Tasks have been developed to determine the safety of water. Coliforms are indicator organism to check fecal contamination of water because they are constantly present.

Water is most important for living organism. Health of human and other organism directly related with safe water other than anything (Sapkota *et al.* 2012). Nowadays peoples are more concerned about the safety of drinking water and became totally dependent on various forms of water purifiers. High incidence of childhood diarrhea, helminthiasis, trachoma and the overall high mortality rates are associated with poor environmental sanitation (Mengesha *et al*. 2004).

Reverse osmosis (RO) systems can often improve the quality of water. It is becoming more popular in the home market as homeowners are increasingly concerned about contaminants that affect their health, as well as about non-hazardous chemicals that affect the taste, odor, or color of their drinking water. Reverse osmosis treatment reduces the concentration of dissolved solids, including a variety of ions and metals and very fine suspended particles. In the reverse osmosis process a cellophane-like membrane (thin film composite RO) separates purified water from contaminated water. The RO membrane also functions as an ultrafiltration device, RO membranes can remove compounds in the 0.0001 to 0.1 micron size range (thousands of times smaller than a human hair). UV: Double purification totally kills remaining bacteria and viruses and also removes cyst.

World Health Organization (WHO) estimated that about 1.1 billion people globally drink unsafe water and majority of diarrheal diseases in the world (88%) are attributable to unsafe water, sanitation and hygiene that approximately 36% of urban and 65% of rural Indian's were without access to safe drinking water (WHO 2009). In addition, water has been traced to be one of the ways by, which humans could be infected with various kinds of diseases. Some water borne diseases include typhoid fever, cholera, & bacillary dysentery (Sohani *et al*. 2012). In waterborne infections, pathogens are usually spread by water contamination with untreated or poorly treated sewage (Yau 2003).

The present work was undertaken to evaluate RO & RO + UV treated water quality of various purifiers & water coolers of Indore region to check the potability of water.

2. MATERIALS & METHODS:

Sample collection

A total of 30 water samples were collected from various water coolers & purifiers (RO & RO+UV) from different locations of Indore city. Water samples were collected in non-reactive borosilicate glass/ plastic bottles sterilized by autoclaving at 121°C, 30 min and stored in refrigerator for further analysis.

Microbiological analysis of water

Samples were analyzed within 24 hrs for the presence of coliforms (Total coliforms & fecal coliforms) by using standard protocol of American Public Health Association (APHA 2005).

Presumptive test

All samples were analyzed for total coliform count by coliform test or multiple fermentation tube method containing MacConkey's lactose bile broth medium with durham's vial .The fermentation tubes were inoculated with water samples & incubated at 37°C and examined for acid & gas production after 24 to 48 hrs. Acid & gas within 48 hrs was presumptive evidence of coliform bacilli. The most probable number (MPN) of TC/100 ml of water sample was calculated from Macready probability tables.

Confirmed test

Confirmed test was performed using Brilliant green lactose bile broth (BGLBB) medium. A loop full sample of positive tube of presumptive test showing gas was inoculated in BGLBB medium which was incubated at 37°C for 24 hrs. Gas formation in BGLBB medium constituted confirmed test i.e. coliform present and then completed test was carried out. **Completed test**

Tubes (BGLBB) showing gas was sub cultured on MacConkey agar medium plate and incubated at 37°C for 24hrs to observe Typical & Atypical colonies. Suspected colonies were then identified microscopically by Gram Staining Technique. Gram negative non- sporing rods was evidence of coliform bacilli.

Fecal coli test

Tubes showing gas were sub cultured into EC or similar medium and incubated at 44 + 0.2°C for 48 hrs to test for gas production, which indicates fecal coli. Colonies from solid medium are sub cultured to lactose broth and if gas is produced in these they are further sub cultured into EC broth (APHA 2005).

3. RESULTS:

The bacteriological analysis of RO & RO+UV treated water samples, depicted in Table 1& Figure 1, shows >240 coliforms/100 ml contamination in 40% of RO treated water samples, which indicates that water sample is highly contaminated and not fit for drinking purpose. The results are quite alarming which suggests that RO water purifiers are not reliable source for the drinking purpose. In 7% & 3% of RO treated water samples, 21 coliforms /100 ml & 12 coliforms /100 ml were observed respectively which shows that the quality of water sample is unsatisfactory. In 10% of water sample, 2.2 coliforms /100 ml were observed, which indicates that water sample is unsatisfactory because *E.coli* was present & according to WHO guidelines, potable water samples should have a zero count of *E. coli*. Zero coliform were observed in 40% of RO+UV treated water sample since Ultrafiltration & UV double purification totally kills remaining bacteria and viruses and also removes cyst. According to WHO, zero no. of coliform shows excellent quality of potable water. In our study RO+UV treated water shows zero coliform which shows excellent water quality and can be considered as potable water.

Table1. Bacteriological assessment of water samples from different water purifiers of Indore city

Sample No.	Site of sample collection	Type of water Source	Total Coliform count /100ml (MPN)	* Fecal coliforms	Quality
1	College Campus Nasia Road (office)	Water cooler With RO	>240	+	Unsatisfactory
2	College Campus Nasia Road (quadrangle)	Water cooler With RO	>240	+	Unsatisfactory
3	College Campus Nasia Road (comp.dept)	Water Cooler With RO	>240	-	Unsatisfactory
4	Railway Station	Water cooler With RO	>240		Unsatisfactory

				+	
5	Sarvate Bus Stand	Water cooler With RO	>240	-	Unsatisfactory
6	Chawani	Water cooler With RO	>240	-	Unsatisfactory
7	Dawa bazar	Water cooler With RO	>240	-	Unsatisfactory
8	MR -10	Water Cooler With RO	12	+	Unsatisfactory
9	Bapat Square	RO	21	-	Unsatisfactory
10	Sanyogitaganj	Water Cooler With RO	21	+	Unsatisfactory
11	Vijay Nagar	RO+UV	0	-	Excellent
12	Clerk Colony	Water cooler With RO	>240	+	Unsatisfactory
13	Bhandari Hospital (ground floor)	Water Cooler With RO +UV	0	-	Excellent
14	Bhandari Hospital (1st floor)	Water Cooler With RO +UV	0	-	Excellent
15	Pardeshipura	Water Cooler With RO+UV	0	-	Excellent
16	Subhash Nagar	RO	2.2	+	Unsatisfactory
17	Sudama Nagar	RO+UV	0	-	Excellent
18	Palasia	RO+UV	0	-	Excellent
19	Khandwa Road	Water Cooler With RO	2.2	+	Unsatisfactory
20	Dewas Road	Water Cooler With RO+UV	0	-	Excellent
21	Veena Nagar	RO+UV	0	-	Excellent
22	Malwa Mill	RO	>240	+	Unsatisfactory
23	LIG Square	RO+UV	0	-	Excellent
24	Narayan Bag	RO	>240	-	Unsatisfactory
25	MahaLaxmi Nagar	RO	>240	-	Unsatisfactory
26	Abhinandan Nagar	RO+UV	0	-	Excellent
27	Sukhliya	RO+UV	0	-	Excellent
28	Sudama Nagar	RO	>240	+	Unsatisfactory
29	Manglaya	RO+UV	0	-	Excellent
30	Chotigwaltoli	RO	2.2	+	Unsatisfactory

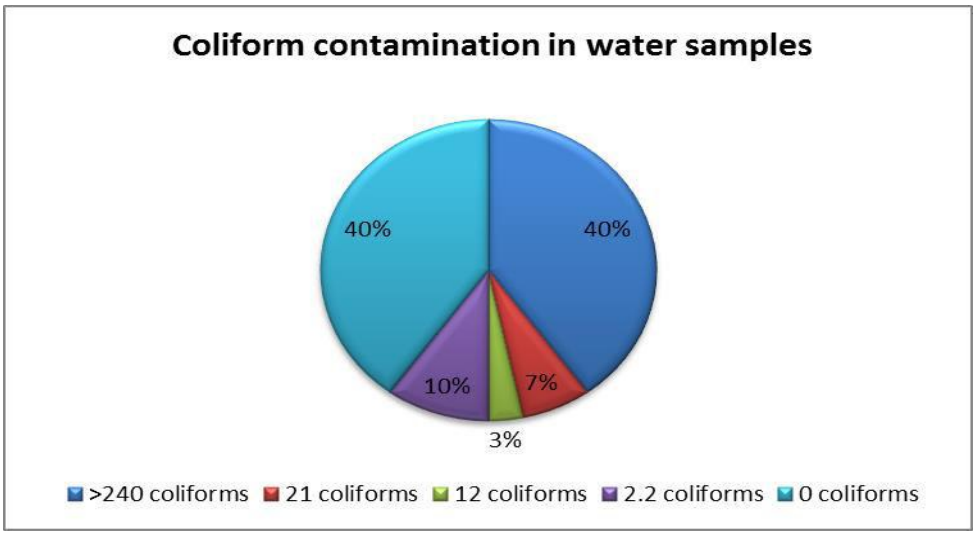

Figure1. Percentage of coliform contamination in water samples

4. DISCUSSION:

Fecal pollution of drinking water introduces a variety of intestinal pathogens (Mengesha *et al*. 2004). It was concluded from 30 investigated samples, that 60% of RO treated water was found to be unsatisfactory for drinking purpose due to the presence of coliforms. In our study it was found that the filter membrane should be changed time to time. Ensuring bacteriological quality of drinking water sources is vital to public health function. Frequent examinations of fecal indicator organisms remain the most sensitive way of assessing the hygienic conditions of water (World Health Organization 2003). Sapkota *et al*. 2012 evaluated the potable water quality of the Dehradun city and reported its contamination with fecal coliforms. Kumar *et al*. 2013 reported 18 samples of water cooler out of 26 samples were found to be unsatisfactory due to the presence of fecal coliforms (90) and not fit for drinking purpose. The survey report also revealed that every year several deaths particularly among children occurred due to water-borne disease (Goel *et al*. 2007)

In 40% of RO+UV treated water sample, Zero coliform were observed which shows excellent water quality and can be considered as potable water. The similar reports was given by Abaza *et al*. 2008 that the highest percentage of acceptable samples was revealed from reverse osmosis (RO) system (90.7%), followed by charcoal filter (83.3%), tap water distribution system (DS) (82.3%), and only 54.7% from tap water tanks. It was concluded from their study that filtered water samples were found to be superior to tap water samples as regards their bacteriological aspects. In addition *P. aeruginosa* was considered as an excellent indicator for the efficiency of the water filters. Nearly a similar result was reported by Payment *et al*. 1991in the United States (93%). A lower percentage was reported by Miles *et al*. 2009 in United States (73%).

In order to ensure that potable water is microbiologically safe to drink, there must be no pathogen in the water at its point of use. Since some pathogens are extremely resistant to certain water treatment processes, the microbiological quality of the raw water is linked to the quality of the treated water; hence both types of water should be monitored. Raw water quality is used to inform treatment process selection, and treated water quality has a direct impact on public health (Burgess *et al*. 2009). Household water treatment is a practical strategy to prevent waterborne diseases (Mintz *et al*. 1995).

RO purification is the latest technology to come up and has gained much popularity. Apart from killing bacteria and viruses, it also removes dissolved impurities like Arsenic, Rust, pesticides, fluorides etc. However while removing dissolved impurities it also removes natural essential minerals from water which are essential to our health. Thus it renders water totally lifeless. Also, within 3-6 months of usage, the pores of RO membrane may get enlarged, allowing bacteria & viruses to easily pass into the purified water and making water unfit for drinking. Thus the membrane of filter device should be changed according to manufacturer's instructions and filter brand of high quality should be selected. The UV lamp brand should also be of high quality and should be changed time to time.

The water cooler revealed the high number of *Pseudomonas sp*. means required the proper maintenance by change the filter and washing the filter time to time as per guidelines (kumar *et al*. 2013).

5. CONCLUSION

It is concluded from the above results that:

- The membrane of filter device should be changed and filter brand of high quality should be selected otherwise the quality of RO treated water is found to be unfit for the drinking purpose as various coliforms were found in the RO treated water since RO only reduces hardness of water but not concerned with the killing of microorganisms.

- Water with RO+UV was found to be fit for consumption as it was found negative MPN Test which refers Zero no. of coliform.

- Although RO purification process removes even dissolved impurities, backup purification by ultrafiltration and UV processes ensure that 100% pure water is available all the time.

- There is different water purification systems, microbial removing process can be based on the micro filtration, UV radiation, chlorination, reverse osmosis. Each of the system has advantages and disadvantages but none of them is absolutely reliable. The microbiological examination is still remaining important way to control purity of the water and it suitably for drinking purpose.

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