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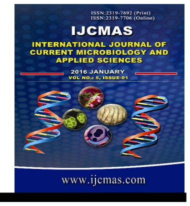

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Effect of Storage Containers on Coliforms in Household Drinking Water

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A B S T R A C T

Safe drinking water is essential to the health and well-being of the human beings. In recent years, the water is being polluted mainly due to human activities. Water pollution affects drinking water sources like ponds, lakes streams leading to shortage of clean microbial safe water for drinking purpose. In rural villages, people use pond water after filtering through a cloth for cooking and drinking purpose. They generally store it in a mud pot and in copper containers, believed to be safe for drinking purpose. The method of storage is essential in maintaining water purity and safety for drinking purposes. Based on the understanding of the literatures, we have taken efforts to study the effect of various storage vessels on the acceptable water quality where there are no bacteria especially, of faecal origin i.e. coliforms. The bore well water was collected and stored at room temperature in 10 different types of containers and evaluated for coliform bacteria at different time intervals from 0 to 25 hrs using MNP method. From the results that there was no significant reduction of coliform bacteria in the water stored in Glass. Plastic, Ceramics, Coconut shell, Aluminum and Stainless Steel container, where as significant level of reduction of coliforms bacteria was observed in the water stored in Mud pot, Brass, Copper and Silver containers suggesting that water can be stored in any one of these containers for house hold purpose free from microbes.

Introduction

Water is essential to all living beings. According to F. Batmanghelidj MD, author of "Your Body's Many Cries for Water", "25% of the human body is made up of solid matter while the remaining 75% is water. Safe drinking water is colourless, odourless, tasteless and free from faecal contamination (Ezeugwunne et al. 2009). Improper sanitation and fecal contamination of drinking water sources is majorly responsible for pollution of water (Opio et al. 2011; Cabral.S.P.J. (2010). Water related diseases continued to be one the major health problems globally (Oladipo et al. 2009; Folarin et al. 2013 and Uwah et al. 2014) and people from both developed and developing countries suffer from diarrhoeal diseases due to consumption of contaminated water (Eileen et al. 2009; UNICEF, 2013; WHO 2002a and WHO 2002b). Estimation by WHO states that about 3 million children below 5 years of age from developing countries die every year due to diarrhoeal diseases by drinking polluted water. Water often gets polluted with human and animal faeces which contain potentially highly pathogenic microorganisms that can cause diseases in human beings (Sobsey et al. 1993;; Leclerc et al. 2002; Theron and Cloete, 2002; Gerba et al. 2005 and Cabral.S.P.J. 2010). The most commonly used fecal indicator microorganisms such as total coli form bacteria, thermo tolerant bacteria and *E. coli* are both found in human and animal feces but do not differentiate between the human and animal fecal pollution (Gerba, et al. 1996; Sinton et al. 1998; Soller et al. 2010 and Odonkor et al. 2013). According to (Sarsan, 2013) coliforms are used as water quality indicators for two main reasons 1. Coliforms are mainly contaminate the drinking water 2.Determination of the coli forms in the drinking water is relatively simple and economic. Coli forms could be easily detected by its ability to ferment the lactose and produce gas within 24 to 48 hrs at 35 to 38° C.

In developing countries, people usually collect drinking water from surface sources like ponds, wells, streams, municipal pipes, stored water from tanks or storage level itself. Water may become contaminated at any point between collection, storage, serving at homes (Nala et al. 2003 and Tambekar et al. 2006 and Rufener et al. 2010). The storage water for hours or even days increases the possibility of fecal contamination of otherwise good quality water inside the household (Valerie Daw Tin Shwe, 2010 and Subbaraman et al. 2013). The Household drinking water storage containers or the point-of-use are importance for the fecal recontamination of water (Subbaraman et al. 2013). Higher levels of microbial contamination is associated with storage vessels having wide openings (e.g., buckets and pots), by introduction of hands, cups and dippers that can carry faecal matter, and lack of a narrow opening for dispensing water (FOS, 1995 and Onigbogi and Ogunyemi, (2014). For improving and protecting the quality of water to these households, effective, affordable, functional and sustainable intervention strategies are required (CDC, 2001; Sobsey, 2002; Krieger et al. 2002; UNICEF, 2008 and Choffnes et al. 2009). The Indian ayurveda describes storing water in a copper vessel overnight and drinking it in the mornings for many health benefits. Storing water in copper and silver pots finds mention in ancient texts of Ayurveda for purification of water (Sharma et al. 2004; Preethi Sudha et al. 2012 and Radha and Susheela, 2015). Copper is known for its antimicrobial effect (Preethi Sudha et al. 2012). Sarsan, 2013 have reported that the water stored in the copper and silver vessels have antimicrobial, anti- inflammatory, antioxidant and anti carcinogenic activities.

Efforts were made to study the effect of storage of water in 10 different vessels on the storage of water by comparing the total population of coliform present in the water before and after storage for different periods. This study gives an idea about the container in water can be stored.

Materials and Methods

Sample Collection and Storage

The water sample was collected at Madippakam, Chennai, from a bore well situated nearby which is sewage water was stagnated. The water was collected in a sterilized poly propylene bottle and brought to the laboratory and stored in the refrigerator until use. Different storage containers viz, glass, plastic, ceramics, stainless steel, aluminum, mud pot, coconut shell, brass, copper and silver containers were used in this study. The different containers were wiped with alcohol dipped cotton and then rinsed with sterile water before transferring water to it. One hundred mL of the bore well water was transferred to each container and kept the water filled containers at room temperature 32° C for 24 hrs. The water samples were analyzed for the presence of coliforms before and after storage at different time intervals from 0 to 24 hrs and physico chemical parameters.

Physiochemical Parameters

The physiochemical parameters, viz., pH, Electrical Conductivity (EC) and Total Dissolved Solid (TDS) of the water sample were analyzed using Hanan instrument portable waterproof tester (pH, EC and TDS).

Microbiological Studies of the Water Samples

Most Probable Number (MPN) technique was used for analysis of total coliform and fecal coli form bacteria in the collected water sample and the water stored in 10 different types of containers for different time periods. 3 tubes MPN method was routinely followed for the analysis of coli forms in the water.

Presumptive Test

The water samples were analyzed for the presence of coliforms in lauryl tryptose broth (gL: Lactose, 20; Sodium chloride, 5; Dipotassium phosphate, 2.75; Mono Potassium phosphate, 2.75; Sodium Lauryl Sulphate, 0.10; pH at 25˚c 6.8 ± 0.2. by using presumptive test specific for coli forms (Salle,1974). Ten mL of either single strength or double strength Lauryl Tryptose Broth were made in test tubes containing an inverted Durham's tube and sterilized at 121 °C, for 15 min. The broth was aseptically inoculated with 0.1 ml of bore well water to 10 mL to double strength and 1ml, 10ml of bore well water to single strength Lauryl Tryptose broth and incubated at 35° C. The results were recorded after 24 hrs. The formation of gas indicated by a bubble in Durham's tube were recorded as positive indicating the presence of coli forms and those without bubble were regarded as negative for coli forms. The negative tubes are further incubated for another 24 hrs. Tubes which exhibit positive result after 48 hr are also taken for subsequent analysis.

Confirmatory Test

Confirmatory test for the positive water samples were done in brilliant green 2% bile broth (gms/L: peptic digest of animal tissue, 10; Lactose, 10; Ox gall, 20; Brilliant green, 0.0133; pH (at 25 °C) 7.8 ± 0.2. One loop full of the inoculums from positive tubes of Llauryl Tryptose broth was inoculated into the sterile brilliant green 2% bile broth tubes and incubated at 37 °C for 24hrs. After the incubation period, the tubes were examined for the gas production. The numbers of positive tubes were counted and the value of MPN/100 mL as computed by referring the standard MPN table (Aneja, 2003).

Completed Test

The test is aimed for the identification of coli forms through various biochemical means. Streak one loop full of the positive confirmed culture was sterile EMB agar plate and incubated at 37 °C for 24 hrs. Nucleated colonies with or without metallic sheen colonies were marked as typical colonies and transfer to sterile Lauryl Tryptose Broth and nutrient agar slants. Observe gas production on LT broth. Gas production on LT broth indicates completed test.

Results and Discussion

Sample Collection

The site of the bore well from which water was collected for the study is represented in Fig.1. The bore well is situated near to a sewage water stagnation site. We have collected water from this well to study its physico-chemical and microbiological parameters and the effect of storage containers on the microbial safety of water also analyzed.

Physico-Chemical Parameter

The physico-chemical parameters of water before and after storage in ten different storage containers were shown in Table 1. There were no significant change in physico-chemical parameters viz., pH, EC and TDS of the sample before and after storage in different containers. A slight increase in the pH but not significant, was observed in the water stored for 25 hrs. The results were presented in the Table 1. The pH of the water stored in different containers (before and after 25 hrs storage) is as follows: mud pot (7.71 &7.78); aluminum (7.40 &7.65); brass (7.54 &7.69); copper (7.55 & 7.89) and silver (7.67 & 8.02). This slight increase in pH after 25 hrs of storage might be due to some electron fluctuations as it was reported by Saran, 2011 that long period of water storage in aluminum and copper containers metals might get dissolved in water to become ionic (electrolyte) as can be ascertained by its pH measurement. The same trend was observed in EC and TDS. There was slight change in EC and TDS in stored water when compared to fresh water.

The results of microbial analysis of water stored in ten different containers, showed very clearly the decrease in coliform bacterial population by 3 hrs of storage itself and complete removal of coliform bacteria leading to microbial free safe water within 24 hrs, in water stored in brass, copper and silver containers. The number of coli forms has significantly reduced from 1100 to 3 MPN after 2 hrs of storage. In the case of mud pots, the coli form bacteria was detected in water stored until 5 hrs and was not declined later on the storage. However, the water stored in other remaining containers viz., glass, and plastic containers A & B, ceramics, coconut shell show the presence of coliform bacteria even in the water stored for 25 hrs. The results were tabulated in tables (2-11) and Fig. (2).

The results clearly show that household water storage containers were capable of improving quality of the microbial contaminated water. The quality improvements of water by storing them in different containers were already reported and our results are in accordance to those results. (Thompson et al. 2003; Clasen et al. 2007; WHO, 2007 and Jain et al. 2008). The physico-chemical and microbial qualities of some of the bore well water show that there were frequent pollution of groundwater by household waste and sewage. The high levels of bacterial counts of water observed in this work show that most of the bore well water is not safe for human consumption (Uhuo et al. 2014; Okereke et al. 2014 and Amenu et al. 2014). The pH of water is an important factor in its quality with wide fluctuations in optimum pH ranges leading to an increase or decrease in the toxicity of poisons in water bodies (Ali, 1991; Atlas, 1995 and Okonko et al. 2008).

Table.1 Physico-Chemical Parameters of Water Before and after Storage in Different Containers

Sl.No	Name of the Containers	pH		EC (mS/cm^2)		TDS (ppt)	
		Before	**After**	**Before**	**After**	**Before**	**After**
1	Glass	7.67	7.68	1.29	1.27	0.75	1.5
2	Plastic (A)	7.44	7.42	1.49	1.51	0.55	0.56
3	Plastic (B)	7.41	7.38	1.66	1.69	1.00	1.1
4	Ceramics	8.00	8.06	1.72	1.74	1.00	1.1
5	Mud pot	7.71	7.78	1.82	1.86	1.50	1.43
6	Coconut shell	7.66	7.71	1.51	1.53	1.23	1.21
7	Aluminum	7.40	7.65	1.71	1.76	0.86	0.84
8	Stainless steel	8.01	8.05	1.74	1.75	0.91	0.89
9	Brass	7.54	7.69	1.81	1.89	1.28	1.25
10	Copper	7.55	7.89	1.82	1.91	1.34	1.30
11	Silver	7.67	8.02	1.65	2.06	1.32	1.28

Table.2 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Collection Container Itself at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Control		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.3 Result of the Analysis of Coliform in the well Water Sample Stored in Glass Container at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
Glass	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.4 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in the Plastic Container A at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
Plastic A	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

+: gas production;-: No gas production: MPN index for 100ml

Table.5 Result of the Analysis of Coliform in the Collected well Water Sample Stored in Plastic Container B at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN

Plastic B	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.6 Result of the Analysis of Coliform in well Water Sample Stored in Ceramic Container at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Ceramics		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.7 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Mud Pot at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Mud pot		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10 ml	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3
	1ml	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3
	0.1ml	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3

+: gas production;-: No gas production: MPN index for 100ml

Table.8 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Coconut Shell at Different Time Interval

Name of Vessels	Vol. of Water sampl	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Coconut		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN

shell	e (ml)	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.9 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Aluminium Container at Different Time Interval

Name of Vessels	Vol. of Water sampl e (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Aluminium		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

Table.10 Result of the Analysis of Coliform in the Collected well Water Sample Stored in Stainless Steel Container at Different Time Interval

Name of Vessels	Vol. of Water sampl e (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Stainless steel		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100	+	+	+	1100

+: gas production;-: No gas production: MPN index for 100ml

Table.11 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Brass Container at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Brass		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	+	+	+	3	-	-	-	3	-	-	-	3	-	-	-	3
	1.0	+	+	+	1100	+	+	+	1100	+	+	+	3	-	-	-	3	-	-	-	3	-	-	-	3
	0.1	+	+	+	1100	+	+	+	1100	+	+	+	3	-	-	-	3	-	-	-	3	-	-	-	3

Table.12 Water Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Copper Container at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Copper		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3
	1.0	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3
	0.1	+	+	+	1100	+	+	+	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3

Table.13 Result of the Analysis of Coliform in the Collected Well Water Sample Stored in Silver Container at Different Time Interval

Name of Vessels	Vol. of Water sample (ml)	**Hours**																							
		1				**5**				**10**				**15**				**20**				**25**			
Silver		1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN	1	2	3	MPN
	10	+	+	+	1100	-	-	-	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3
	1.0	+	+	+	1100	-	-	-	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3

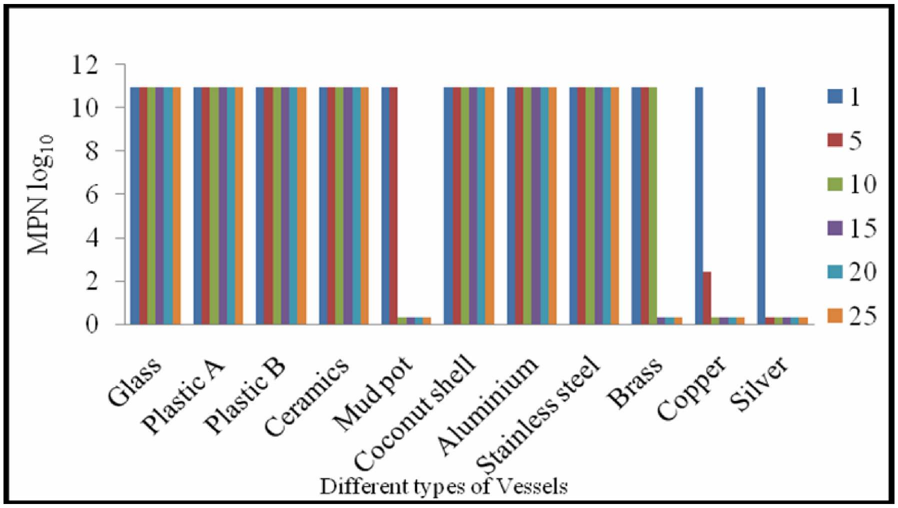
	0.1	+	+	+	1100	-	-	-	1100	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3

+: gas production;-: No gas production: MPN index for 100 mL

Fig.1

Fig.2

Fig.3 Total Coliform Bacteria in Water Samples Stored in Different Containers



In this research, the results showed not much change in pH, EC and TDS in all the water samples stored in different containers. Among the ten different storage containers, viz. glass, plastic A&B, coconut shell, ceramic, aluminum, stainless steel doesn't have the ability to kill the coliform bacteria as evidenced by the presence of coli form bacteria in the stored water. But there is a significant reduction in the coli forms level in water stored in mud pot, brass, copper and silver where it reduced from >1100 to <3. Mud pot gradually increased the cooling effects to the stored water and also reduced the microbial population. Because of the temperature decrease below 30 °C, which is not suitable for *E.coli* growth and it needs 30-35 °C in aerobic condition. For water kept in the earthern vessel for 12 hrs the results showed no substantial decrease compared to the initial inoculums. (Tandon et al. 2005).

It can be inferred from the published literatures that copper metal is the most effective metal in killing the coliforms (Shrestha et al. 2009; Delgado et al. 2011; Grass et al. 2011; Sarsan et al. 2012; Gorman and Humphreys, 2012; Samanovic et al.,2012; Stevenson et al. 2013; Zaman et al., 2014 and Radha and Susheela, 2015). The reduction in population of total bacteria as the day of storage increased in similar to the observation by Payment et al. (1985) and Eniola et al. (2007). The result of this study corroborates with the study of (Sarsan, 2013 and Radha and Susheela, 2015). Many researches indicate that the copper and brass is a low cost microbial safety drinking water storage container (Mehta et al. 2004; Faundez, 2004; Brick et al. 2004; Sudha et al. 2009, 2012 and Sharan et al. 2010; 2011). Brass is an alloy consisting mainly of copper (over 50%) and zinc with smaller amounts of other elements (Saran, 2011). Takes place the short-term storage of *E. coli* and *E. faecalis* for up to 48 hrs in a brass water storage vessel caused sub-lethal injury to the bacteria (Tandon et al. 2005)

Copper has proven to kill bacteria due to what is called the oligodynamic effect, even in relatively low concentrations (Nageli, 1983). This antimicrobial effect is shown by ions of copper as well as mercury, silver, iron, lead, zinc, bismuth gold and aluminum. Copper is known to be far more poisonous to bacteria than others metals such as stainless steel or aluminum (Sarsan, 2013).

At the same time the silver has most antibacterial activity when compare to copper as evaluated by the antibacterial effects of Ag and Cu on gram-positive and gram-negative bacteria, which are resistant to nosocomial infections (Hundakova et al. 2013; Zanzen et al. 2013; Losasso et al. 2014; Paredes et al. 2014; Ben-Knaz Wakshlak et al. 2015; Franci et al. 2015 and Dugal et al. 2015). When all the containers were compared, silver and copper containers were good for storage of drinking water, having antibacterial activities within 24 hrs against *E.coli*. (Shrestha et al. 2009; Grass et al. 2011 and Saran, 2011). Effects of silver ions on normal mammalian cells are minimal (Berger et al. 1976).

Studies have shown that improving the microbiological quality of household water by on-site or point-of-use treatment and safe storage in proper containers reduces diarrhoeal and other waterborne diseases in communities and households of developing and developed countries (Thompson et al. 2003). The traditional Indian practice of storing drinking water in a copper vessel overnight is the simplest way to obtain the health benefits of copper (Radha and Susheela, 2015). The antibacterial potential of copper and brass vessels against common waterborne pathogens such as *Escherichia coli*, *Enterococcus faecalis* (Tandon et al.

2005 and 2007), *Salmonella* sp. and *Vibrio cholera* (Sudha et al. 2009) has been studied.

In conclusion, traditionally certain metal containers/pots/vessels were used to store drinking water in order to ensure safety. A study was conducted with the aim of evaluating the effect of metals such as copper, silver and brass against enteric gram negative bacteria in drinking water. Complete reduction of the tested organism was recorded within 0 to 25 hrs of holding time. This study suggested the promotion of use of water storage containers/vessels made of oligodynamic metals such as copper and brass to control the gram negative *E.coli* in drinking water as silver being expensive. Future studies need to elaborate the mechanism of interaction between Silver, Copper and Brass containers.

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