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COMPARISON OF WATER QUALITY PARAMETERS FROM DIFFERENT SOURCES AND STORAGE CONTAINER MATERIALS TO ASSESS DRINKING SUITABILITY – A CASE STUDY

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Abstract: Drinking water is vital for survival of all living creatures on the planet. However, the quality of water that we consume largely determines our health and related risks or benefits. Age old Indian tradition suggest the use of copper vessels, earthen pots etc. as utensils for the drinking of water. With modernization, several new products have come up in the market. This study aims at assessing the goodness of drinking water utensils made up of different materials and attempts at concluding which containers or material are most suited for storage and drinking of potable water.

Index Terms - Quality, Potable water, Health risk.

I. INTRODUCTION

Water is an indispensible source of livelihood for mankind. There are three major types of water demands in India; irrigation in agriculture being the major consumption sector for demand of water, followed by power production and last being the domestic demand. Whilst the stakeholders are constantly concerned about the supply of water to meet the requisite demand, a prime concern is also the quality of water being supplied and the one being consumed.

Human activities that involve urbanization, agricultural development, over use of fertilizers, inadequate management of land use and sewage disposal have direct or indirect effect on the quality of water thereby making it unfit for domestic purpose. Therefore now a day, fresh water has become a scare commodity due to over exploitation and pollution. Hence it is necessary to evaluate quality of water of that area in order to assess its suitability for various uses and to evolve the policies for the best use of water resources.

Whether your water causes illness, stains on plumbing, scaly deposits, or a bad taste, a water analysis identifies the problem and enables you to make knowledgeable decisions about water treatment. Water quality of any specific area or specific source can be assessed using physical, chemical and biological parameters.

MATERIALS AND METHODS

The study was carried out in Indore city of Madhya Pradesh State in India. Fig. 1 shows the satellite location map of Indore city.

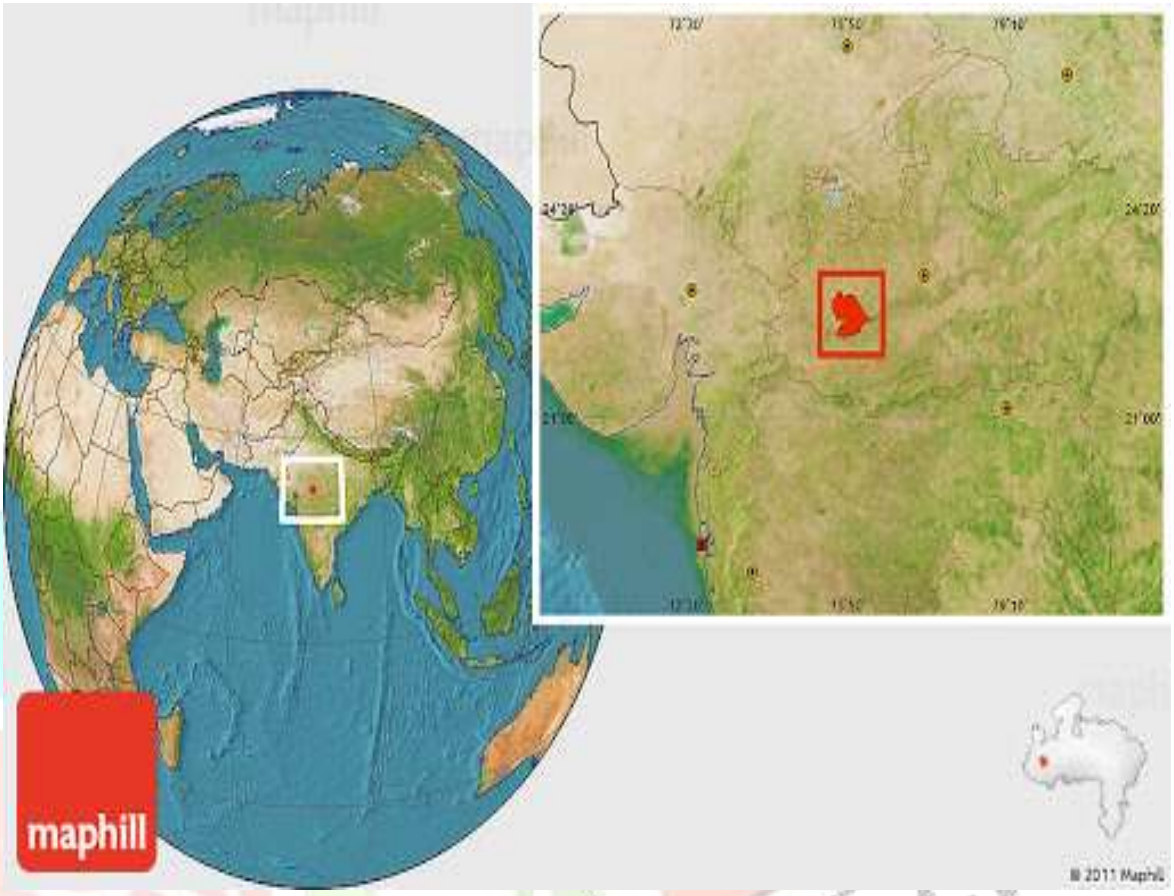

Fig. 1: Location of Indore City

The water samples were collected from two different sources namely:

1) R.O. purified water

3) Underground water or boring water

The water samples that were, collected from each of these sources were stored in containers made of different materials for a period of around 30 hours. The different containers materials were:

1) Earthen Pot or 'Mitti' [E]

2) Glass Bottles [G]

3) Steel Bottles [S]

4) Food Grade Plastic Bottles [P]

5) Copper pot or 'Tamba' [C]

The storage of samples in different container materials is indicated in Fig. 2.

Fig. 2: Storage of Drinking Water in different container materials

General Water Quality Indicators are parameters used to indicate the presence of harmful contaminants. Testing for indicators can eliminate costly tests for specific contaminants. Generally, if the indicator is present, the supply may contain the contaminant as well. For example, turbidity or the lack of clarity in a water sample usually indicates that bacteria may be present. The pH value is also considered a general water quality indicator. High or low pH can indicate how corrosive water is. Corrosive water may further indicate that metals like lead or copper are being dissolved in the water as it passes through distribution pipes.

Table 1 shows some of the common general indicators.

Table 1. General water quality indicators

Indicator	Acceptable Limit	Indication
pH value	6.5 to 8.5	An important overall measure of water quality, pH can alter corrosivity and solubility of contaminants. Low pH will cause pitting of pipes and fixtures or a metallic taste. This may indicate that metals are being dissolved. At high pH, the water will have a slippery feel or a soda taste.
Turbidity	<5 NTU	Clarity of sample can indicate contamination.
Total Dissolved Solids (TDS)	500 mg/l	Dissolved minerals. High TDS also like iron or manganese can indicate hardness (scaly deposits) or cause staining, or a salty, bitter taste.

Nuisance contaminants are a third category of contaminants. While these have no adverse health effects, they may make water unpallatable or reduce the effectiveness of soaps and detergents.

Some nuisance contaminants also cause staining. Nuisance contaminants may include **iron bacteria, hydrogen sulfide, and hardness**. Table 2 shows some typical nuisance contaminants you may see on your water analysis report.

Table 2. Common nuisance contaminants and their effects

Contaminant	Acceptable Limit	Effects
Chlorides	250 mg/l	salty or brackish taste; corrosive; blackens and pits stainless steel
Copper (Cu)	1.3 mg/l	blue-green stains on plumbing fixtures; bitter metallic taste
Iron (Fe)	0.3 mg/l	metallic taste; discolored beverages; yellowish stains, stains laundry
Manganese (Mn)	0.05 mg/l or 5 ppb	black stains on fixtures and laundry; bitter taste
Sulfates (SO_4)	250 mg/l	greasy feel, laxative effect
Iron Bacteria	present	orangish to brownish slime in water

Hardness is one contaminant commonly encountered in Ground Water Sources. Hard water is a purely aesthetic problem that causes soap and scaly deposits in plumbing and decreased cleaning action of soaps and detergents.

Hard water can also cause scale build up in hot water heaters and reduce their effective lifetime. Hardness can be expressed by either mg/l or a grain per gallon (gpg). A gpg is used exclusively as a hardness unit and equals approximately 17 mg/l or ppm.

Most people object to water falling in the "hard" or "very hard" categories in Table 3. However, as with all water treatment, you should carefully consider the advantages and disadvantages to softening before making a purchasing a water softener.

Table 3. Hardness classifications

Concentration of hardness minerals in grains per gallon (GPG)	Hardness Level
below 1.0	soft
1.0 to 3.5	slightly hard
3.5 to 7.5	moderately hard
7.5 ti 10.5*	hard
10.5 and above	very hard

* level at which most people find hardness objectionable.

Thus following tests were carried out on the drinking water samples:

- PH-VALUE TEST
- CONDUCTIVING TEST
- CHLORIDE TEST
- HARDNESS TEST
- ALKANITY TEST
- CALCIUM HARDNESS

Fig. 3 below shows the testing of samples in accredited laboratory, with calibrated equipments.

Fig. 3: Testing of water samples in laboratory

RESULTS AND DISCUSSIONS

After performing tests as indicated in section above, the results have been summarised in Table 4 and Table 5.

A sample of 25 mL was taken for each type of testing.

Table 4 : Observation Table for R.O. Water Testing

S.No.	Containers	pH (5-7pH)	Conductivity (50-100µS/cm)	Total Hardness (mg/l)	Alkality (mg/l)	Chloride (ppm)	Calcium Hardness (ppm)
1	Mitti	7.52	198.74	2.2	2.3	1.7	0.8
2	Glass	7.47	110.21	2.1	1.5	1	0.5
3	Steel	7.52	101.27	1	1.3	1.2	0.5
4	Plastic	7.33	100.32	2	1.3	0.8	0.4
5	Copper	7.18	101.84	1.5	1.4	0.9	0.7

Table 5 : Observation Table for Boring Water Testing

S.No	Containers	pH	Conductivity (µS/cm)	Total Hardness (mg/l)	Alkalinity (mg/l)	Chloride (ppm)	Calcium Hardness (ppm)
1	Mitti	7.821	1009.3	14.6	7.93	8.9	10.5
2	Glass	7.687	1072.3	12	8	8.6	8.9
3	Steel	7.637	1078.8	12.6	7.5	8.1	7.6
4	Plastic	7.536	1072.6	11.5	7.6	7.4	2.9
5	Copper	7.755	1095.9	18.3	7.5	8	1.4

The graphical representation of some of the results is given in Figures 4,5,and 6.

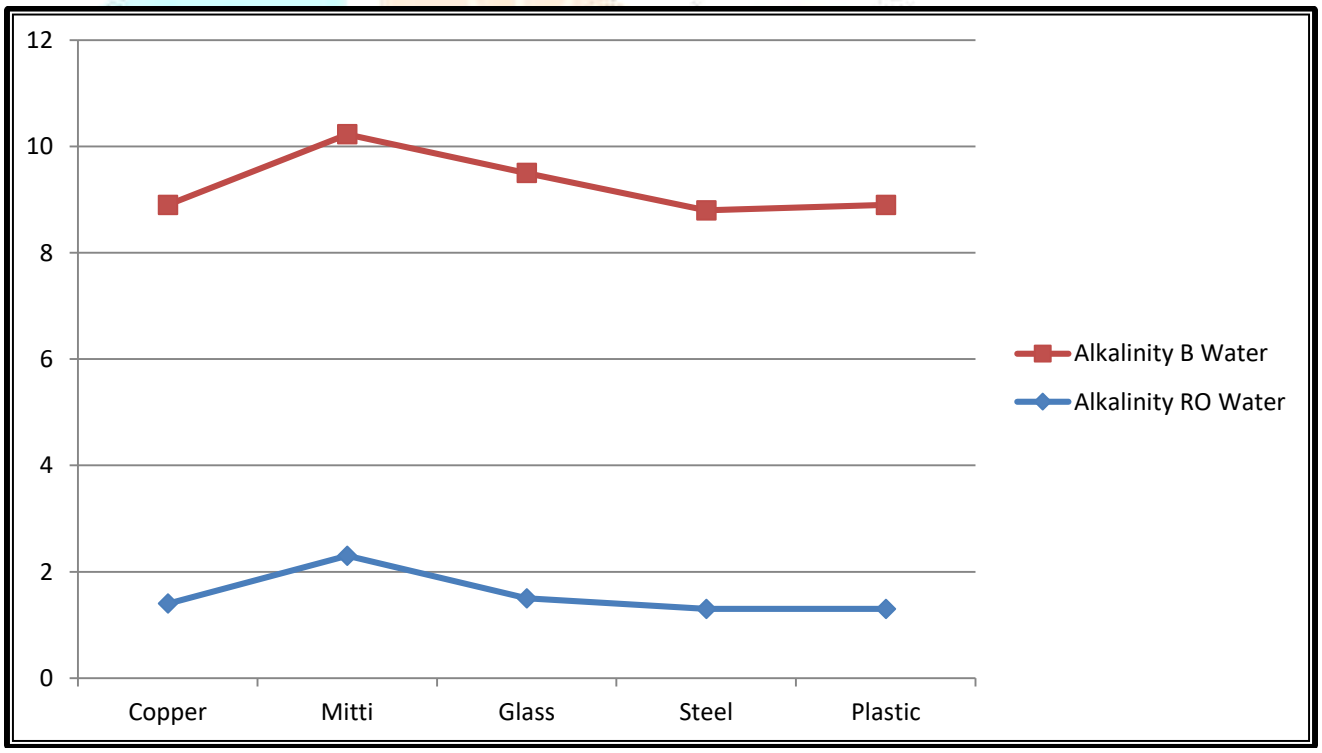

Fig. 4 : Results of Alkalinity test on water samples

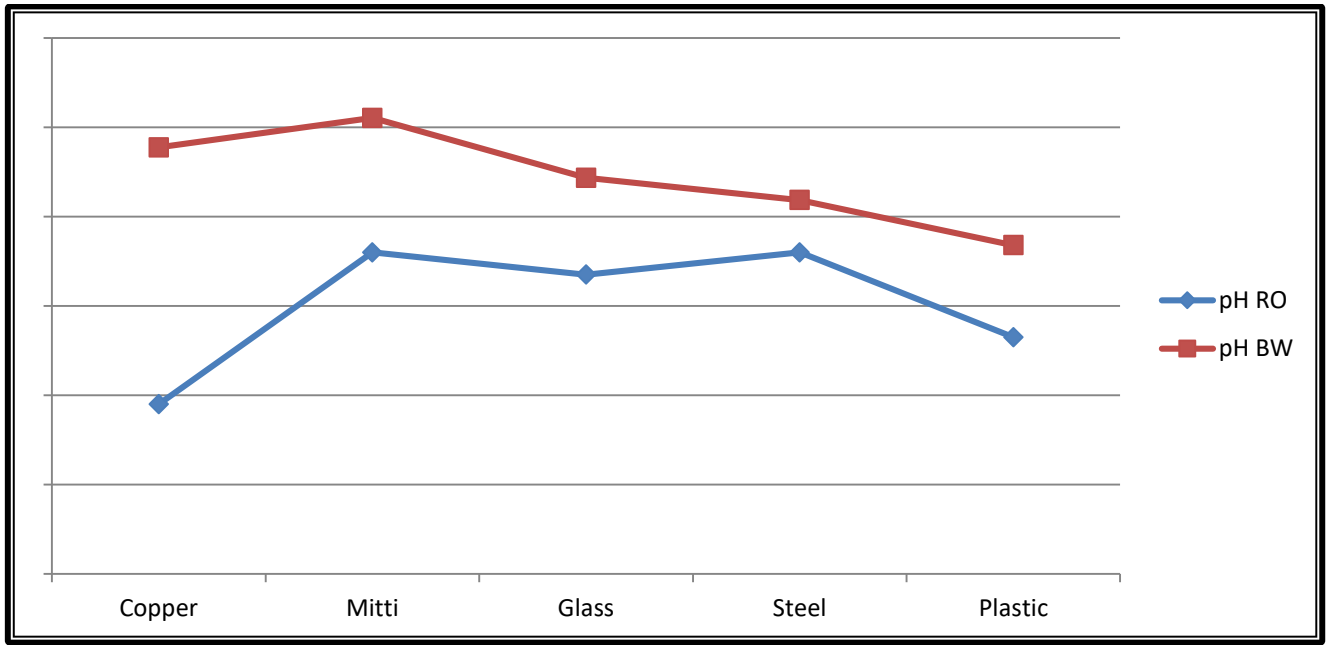

Fig. 5: Results of pH test on water samples

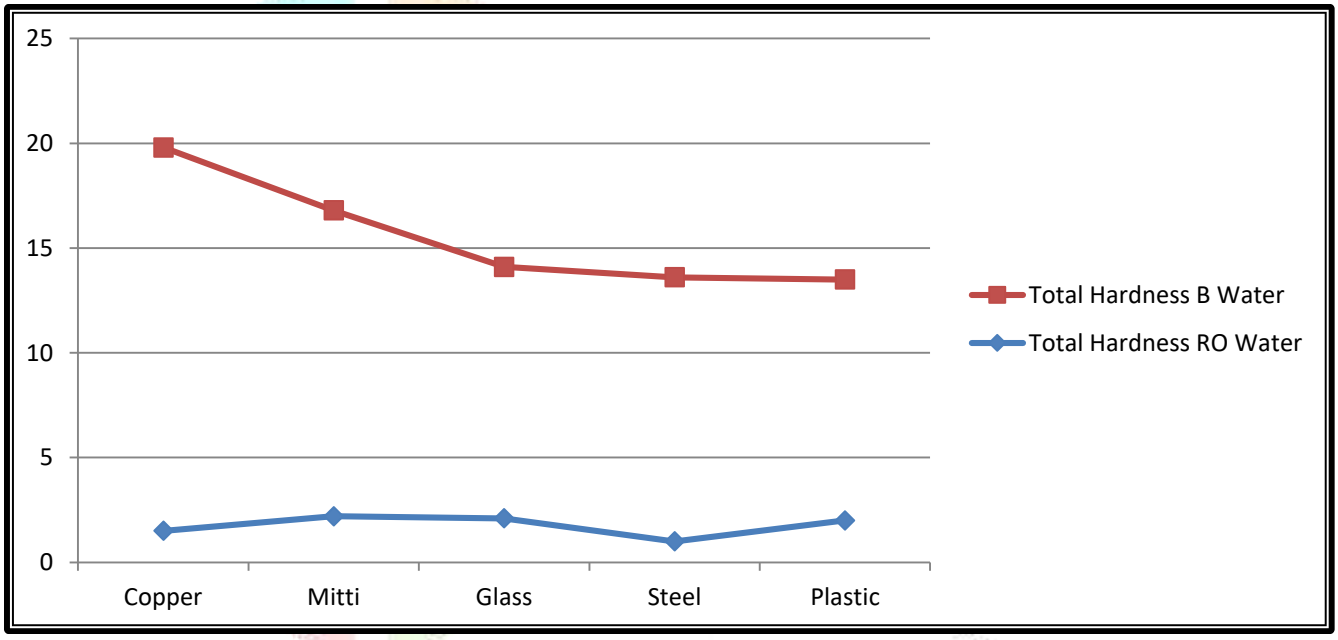

Fig. 6: Results of Total Hardenss test on water samples

CONCLUSIONS

Based on the study as conducted above, following were the findings:

- Alkalinity in mitti was highest and plastic was lowest. No disease can survive in an alkaline environment and thus mitti container is most ideal.
- Also pH of steel sample was highest but the same of all samples, including steel samples was in the acceptable range.
- Hardness in Boring Water was much higher than R.O. Water. For C, G and E, the hardness was unacceptable for drinking purposes.
- For R.O. water all types of containers are fit for drinking as used in the case study. However for boring water steel containers should be given preference above glass, copper, mitti and plastic.

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