Comparative Study of Assessment of Water Qualities Stored in Tamra and Stainless steel Vessels

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Abstract

Background - Environmental pollution is a major threat to community health. Among them water pollution is very important issue because it is a basic cause for major epidemic diseases e.g. Cholera, Typhoid, Diarrhoea, Hepatitis - A etc. Also the safe drinking water is basic need of human being. Current research is concerned especially for rural population, where there is scarcity of other water purification facilities in rural areas and also purified water supply by local Govt. agencies is not available daily and because of this water needs to be stored for minimum 2 to 3 days. So this research project is conducted on Comparative study of assessment of water qualities stored in Tamra& Stainless steel vessels.

Aim - To study the comparison between changes in qualities of raw water stored in Tamra& Stainless Steel vessels.

Study Design – Experimental study

Materials& Methods - The present investigation is based on analysis of water and data is mainly collected from experimental studies. The study was carried out with raw water of river and tube well stored in both Tamra& Stainless Steel Vessels to find out the changes in qualities in terms of physico-chemical & bacteriological parameters like Turbidity, Temperature,Hardness, pH, TDS, TSS and MPN .Storage of water was done up to 48 hrs and observations were taken after 12 hrs, 24 hrs& 48 hrs.This study was carried out in village Kodoli from Kolhapur district. Testing of water was done at Environment Science Department of ShivajiVidyapeeth, Kolhapur.

Results- Assessment of water qualities of sample was done by comparison between water analysis reports of both vessels as well as comparison with Indian Standard Specification for drinking water. Statistical analysis is done on the data generated during this experimental study.

Conclusion-_Tamra_ Vessel is more effective to reduce MPN count of raw water throughout the study period from both the sources viz., River & Tube well in each _rutu.Tamra_ vessel has effect on parameters like Turbidity, Hardness, TSS and TDS up to certain limit. _Tamra_ Vessel may be good choice for storage of purified water for house hold purpose.

Keywords

Water qualities, Physico-chemical & bacteriological parameters, Storage in vessels, Tamra& Stainless steel, Household storage & purification

Greentree Group

INTRODUCTION

Water is a basic need of human beings.For human beings water should be easily accessible, adequate in quantity, free from contamination, safe and readily available throughout the year. Environmental pollution is a major threat to community health. Environmental pollution includes air, soil pollution as well as water pollution. Hence water pollution is a basic cause for major epidemic diseases e.g. Cholera, Typhoid, Diarrhoea, Hepatitis A etc.

In current research project I would like to propose a water treatment method which is based on the reference of *SushrutaSamhita* which will be an economical alternative especially for rural population for household purification & storage of water.

सौवर्णेराजतेताम्रेकांस्येमणिमयेऽपिवा |
पुष्पावतंसंभौमेवासुगन्धिसलिलंपिबेत् ||

सुश्रुतसूत्रस्थान ४५/१३

Water stored in metallic vessels like gold, silver, copper, bronze, precious stone or in earthen pots and made fragrant by putting flowers into it should be used for drinking.

In above *shloka, Sushruta* has mentioned simple water storage procedure in various vessels to make it safe for drinking. In this research project Copper vessel is taken in consideration because these vessels are readily available in rural areas since generations and are comparatively affordable than other metal vessels mentioned in *shloka*.

The present study is carried out with the aim to study the effect of water stored in *Tamra* vessel and Stainless Steel vessel with its changes in qualities.Study is conducted in Village Kodoli , in district Kolhapur. In Kodoli local authority that is grampanchayat supplies purified water to people covered under its jurisdiction, in fact not daily. It is available alternate day or after every two days. This is an attempt to give better choice to above said population where there is need of two to three days storage of water. At the same time this simple storage method is easy to practice and will be useful for mass population especially for rural population & can prevent epidemic diseases.

MATERIALS & METHODS

The present study is carried out with raw water of river and tube well which is stored in both *Tamra*& Stainless Steel Vessels to find out the changes in qualities in terms of physico-chemical & bacteriological parameters like colour, odour, turbidity, temperature ,hardness, pH, TDS, TSS and MPN. Six samples from different sites of each source are collected in every season

(*Rutu*) according to Ayurveda i.e. *Varsha, Sharad, Hemant, Shishir , Vasant & Grishma* in order to evaluate the changes in water qualities. Collected raw water testing is done first, after that storage of water is done up to 48 hrs and observations are taken after 12 hrs, 24 hrs& 48 hrs.

For the river water sample river Warana is present in this area. Six collection points of river are selected randomly. And for tube well total 67 tube wells are present in this research area, out of these six are selected randomly. For this study both the Vessels are of water pot (*kalashi*) shaped with lid having capacity of 5 litre water storage. Collection of water is done at peak time of season &collection of raw water is done at 9.00 to 10.00 am every time.

For Physical & Chemical testing of raw water sample is collected in the clean plastic can having 1 liter capacity. Also for storage in vessels raw water from both the sources is collected in plastic can having a 10 lits capacity. Before collecting the sample the can is rinsed three times with boiled water. For Bacteriological testing of raw water sample is collected in clean sterilized bottles made of natural glass, of capacity 200-250 ml.

Tamra vessels are cleaned with tamarind and after that washed with dish washing detergent. And Stainless Steel vessels are washed with dish washing detergent only. Both the vessels are dried by clean cloth then exposed to sunrays for 20 minutes. After this used for water storage. Procedure is done before every storage.

10 lits of sample from each source which is collected in this plastic can immediately poured into both vessels (*Tamra*& Stainless Steel) 5 lits in each. Storage of this water is done for total 48 hrs in each vessel. After 12 hrs 24hrs & 48 hrs adequate water sample is brought from vessels for laboratory testing for above mentioned all parameters. Total 6 samples are taken in each *rutu* from both the sources. Same procedure is done in every season (*Rutu*) according to Ayurveda i.e. *Varsha, Sharad, Hemant, Shishir ,Vasant & Grishma.*

Also the testing of one sample is done with purified water supplied by Grampanchayat in research area as well as analysis of release of copper ion in water & quantity of copper in malachite (basic copper carbonate) is done for *Tamra* vessel.

Assessment is done by following methods – For Parameter

Turbidity : - Digital Nephelometer

Temperature:- By Laboratory Thermometer

Hardness: - EDTA (Ethylene diamine tetra acetic acid) Titration method.

pH :- By pH meter

Total Suspended Solids:- By filtration of water sample through standard glass-fiber filter

Total Dissolved Solids :-By evaporation method

Bacteriological Indicator:-MPN (Most Probable Number) by Multiple Tube Method. This result is known as presumptive coliform count.

Assessment of water qualities of samples are done by comparison between water analysis Laboratorial results from both vessels as well as comparison with Indian Standard Specification for drinking water.

This study is carried in village Kodoli from Kolhapur district. All water testing's are done at Environment Science Department of ShivajiVidyapeeth ,Kolhapur.

RESULTS & DISCUSSION

The results showed very good effect of water stored in copper vessel as compared to stainless steel vessel. Reduction in MPN is found highly significant in water stored in copper vessels than that of stainless steel which is the important parameter for quality of water.

1) Turbidity – We observed significant reduction in turbidity in *Vasant, Greeshma, Varsha, Hemant and Shishirrutu* for both

vessels for river water as well as for tube well water. For *Sharadrutu* reduction is up to certain limit in both the vessels.Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, planktons and other microscopic constituents. Storage for hours settles the impurities in it by gravitational force.

For river as well as tube well source, in each *rutu*, reduction in turbidity for water stored in *Tamra*vessel and Stainless steel vessel is not significantly different.So there is no any influence of vessel regarding turbidity.

2) Temperature – Temperature shows reduction as well as increase for both vessels identically and which is respective to temperature variations in atmosphere.So there is no any influence of vessel regarding temperature.

3) Hardness – We observed significant reduction in Hardness in all *rutus* for both vessels for river water as well as for tube well water. For river as well as tube well water reduction in hardness is more effective in *Tamra* vessel than stain less steel vessel. (Fig. 1)

Cu^{++} ions which are released by copper vessels reacts with dissolved O_2 to form soluble CuO (Copper Oxide) Which

further reacts with bicarbonates present in water to form Malachite/ Basic copper carbonate $(Cu_2(OH_2)CO_3)$ which is turquoise to green colour. Thus when water is stored in copper vessel for long duration we found green colour layer of malachite inside the copper vessel. Removal of bicarbonates from water results in reduction in hardness caused by bicarbonates.

4) pH- We observed slight increase in pH in all *rutu*for both the vessels for river water as well as for tube well water. So there is no any influence of vessel regarding pH.

5) Total Suspended Solids (TSS)-We observed significant reduction in TSS in all *rutu*for both vessels for river water as well as for tube well water.Storage for hours settles the suspended matter in it by gravitational force. For river as well as tube well source, reduction in TSS for water stored in *Tamra* vessel and Stainless steel vessel is not significantly different in every *rutu*. So there is no any influence of vessel regarding TSS.

6) Total Dissolved Solids (TDS) - We observed significant reduction in TDS in all rutus for both vessels for river water as well as for tube well water. For river as well as tube wellwaterreduction in TDS is more effective in *Tamra*vessel than stain less steel vessel.(Fig.2) Hardness reduction results in TDS reduction as these bicarbonates are in dissolved form which are removed by Cu++.

7) Most Probable Number (MPN)-We observed significant reduction in MPN in all *rutus* for both vessels for river water as well as for tube well water.For River as well as tube well samples, storage of water in *Tamra* vessel is remarkably effective in reduction of MPN than Stainless steel vessel in each *rutu*at every time interval. (Fig.3)From these results we can say that both metals have disinfecting ability but *Tamra* vessel shows highest anti microbial activity.

When water is stored in a copper vessel, in very small quantities cooper gets dissolved in water. This is known as the oligodynamic effect. The oligodynamic effect was

Fig . 1 Reduction in Hardness

Reduction in Hardness

Fig. 2 Reduction in TDS
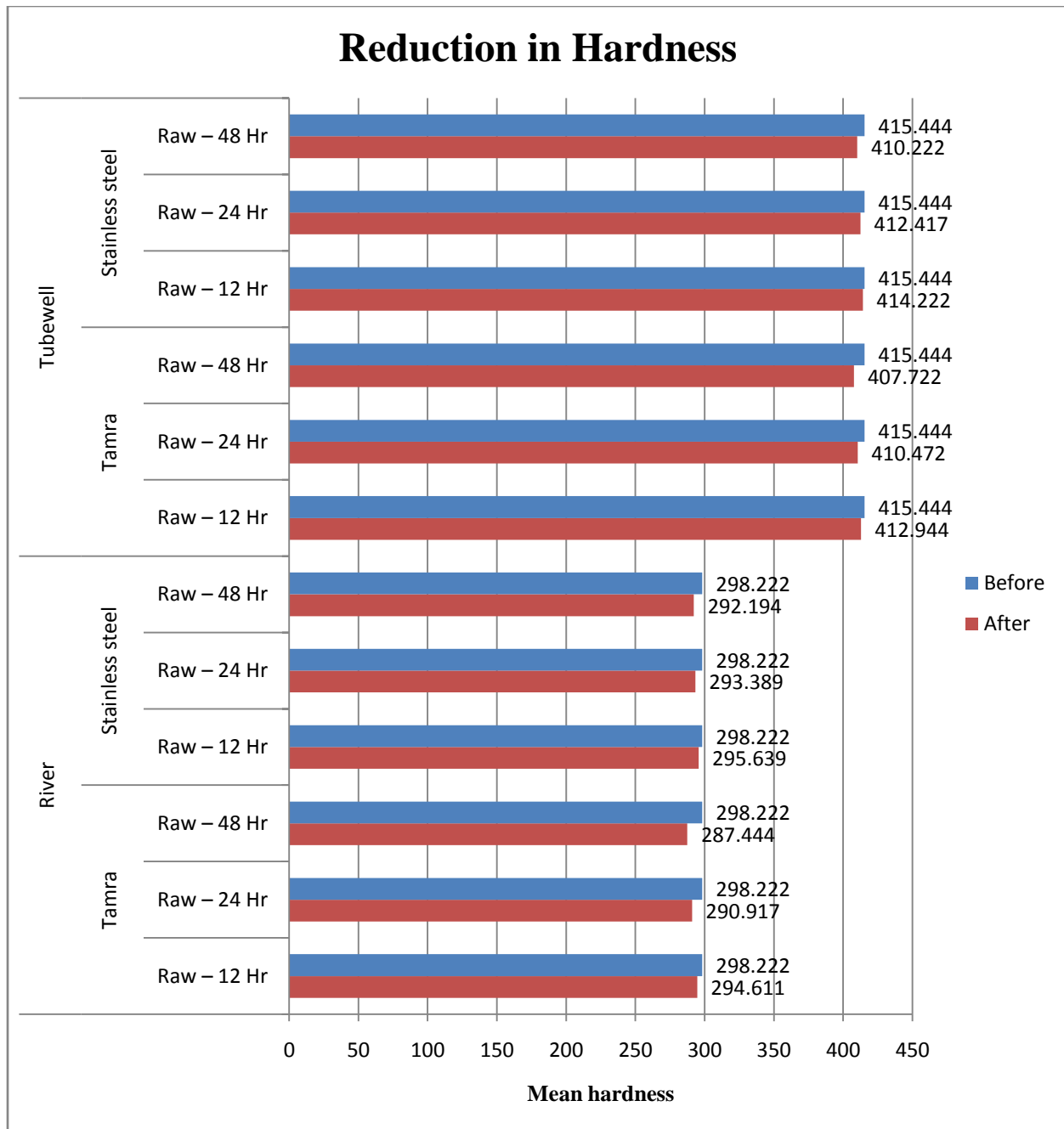
discovered in 1893 by the Swiss KW Nageli. This has the power to destroy a wide range of molds, fungi, algae and harmful microbes due to its toxic effects on living cells.

This antimicrobial effect is shown by ions of:mercury, silver, copper, iron, lead, zinc, bismuth, gold, aluminum and other metals. When copper dissolves in water, water becomes ionic (electrolyte). The production of copper ions kills the algae and bacteria. Electrically charged copper ions $(Cu^{+}2)$ in the water search for particles of

Reduction in TDS

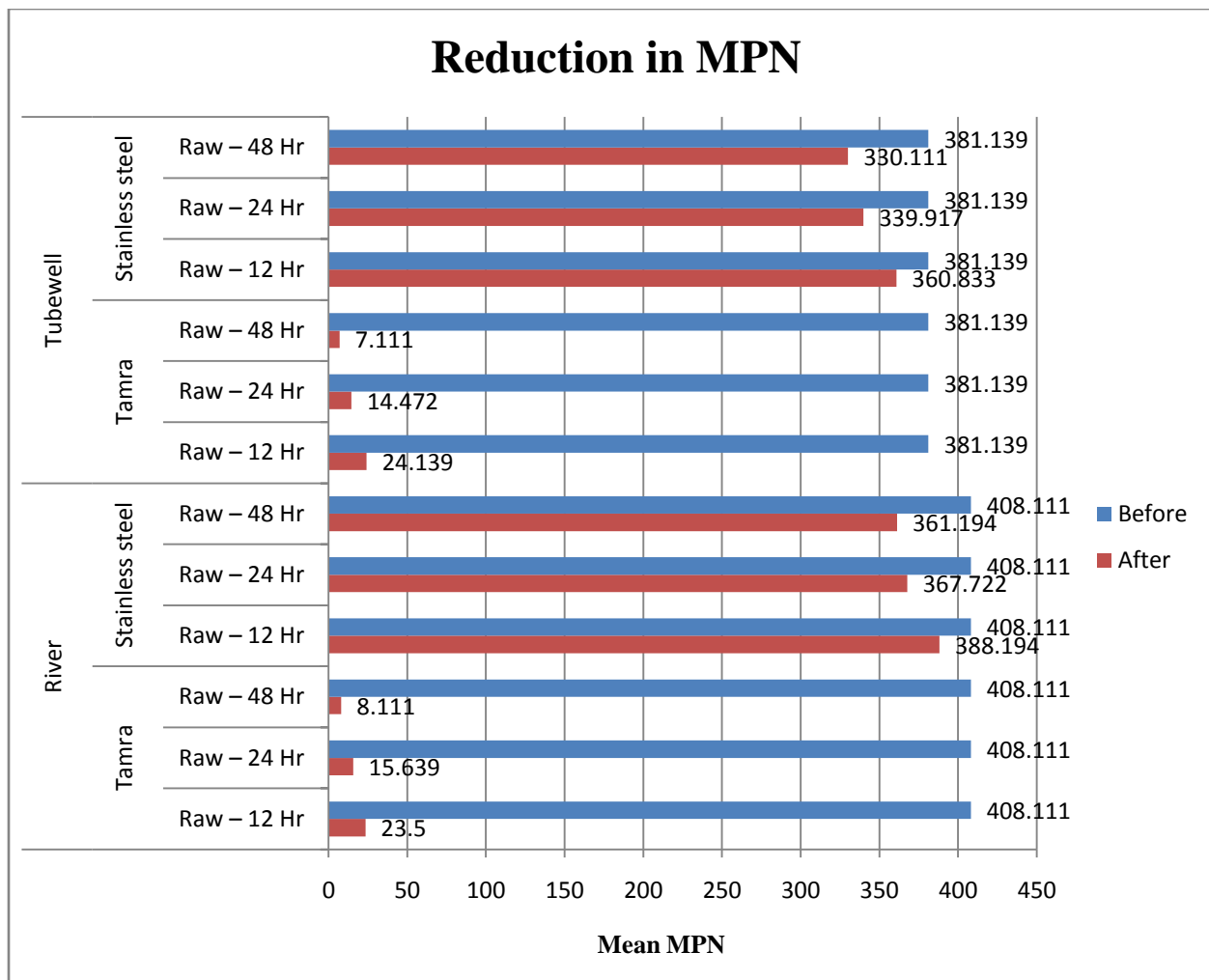|			Before	After
Tubewell	Stainless steel	Raw – 48 Hr	350.806	340.194
		Raw – 24 Hr	350.806	343.472
		Raw – 12 Hr	350.806	347.222
	Tamra	Raw – 48 Hr	350.806	308.639
		Raw – 24 Hr	350.806	317.667
		Raw – 12 Hr	350.806	334.222
River	Stainless steel	Raw – 48 Hr	233.389	223.833
		Raw – 24 Hr	233.389	226.528
		Raw – 12 Hr	233.389	230.028
	Tamra	Raw – 48 Hr	233.389	185.583
		Raw – 24 Hr	233.389	198.556
		Raw – 12 Hr	233.389	215.556

Mean TDS
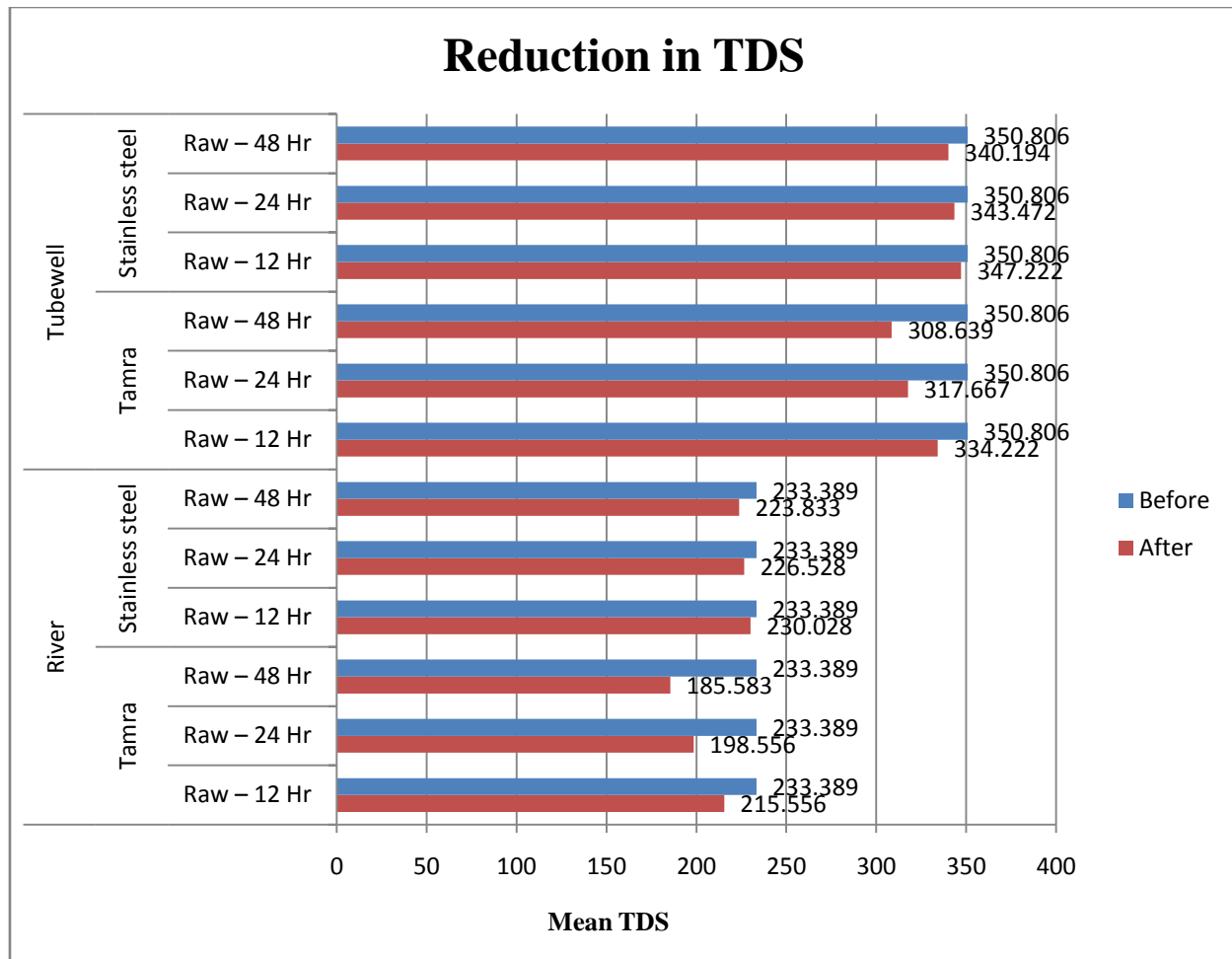
opposite polarity, such as bacteria, viruses and fungi. Positively charged copper ions form electrostatic compounds with negatively charged cell walls of microorganisms. These compounds disturb cell wall permeability and cause nutrient uptake to fail. The copper ions have the ability to pierce the protective outer membrane of cell and disrupt the enzyme balance thereby killing microbes. (Int.J.Curr.Microbiol.App.Sci (2013) 2(11): 24-29)

One of the principal mechanisms of biocidal action of these ions is thought to be cell penetration. The positively charged copper ions form electrostatic bonds with negatively charged sites on the cell wall. The cell membrane is thus distorted. (Hambidge 2001) Copper has antimicrobial property and this can inhibit growth of harmful bacteria.

So *tamra* vessel is good choice for storage of water than stainless steel.

Fig. 3 Reduction in MPN

Reduction in MPN — Mean MPN bar chart showing Before and After values for Tubewell and River samples stored in Stainless steel and Tamra vessels at Raw–12 Hr, Raw–24 Hr, and Raw–48 Hr intervals.

Tubewell – Stainless steel:
- Raw – 48 Hr: Before 381.139, After 330.111
- Raw – 24 Hr: Before 381.139, After 339.917
- Raw – 12 Hr: Before 381.139, After 360.833

Tubewell – Tamra:
- Raw – 48 Hr: Before 381.139, After 7.111
- Raw – 24 Hr: Before 381.139, After 14.472
- Raw – 12 Hr: Before 381.139, After 24.139

River – Stainless steel:
- Raw – 48 Hr: Before 408.111, After 361.194
- Raw – 24 Hr: Before 408.111, After 367.722
- Raw – 12 Hr: Before 408.111, After 388.194

River – Tamra:
- Raw – 48 Hr: Before 408.111, After 8.111
- Raw – 24 Hr: Before 408.111, After 15.639
- Raw – 12 Hr: Before 408.111, After 23.5

Also testing of one sample is done with Purified water supplied by Grampanchayat in research area. Observations show that purified water supplied by Grampanchayat at kodoli contain MPN in objectionable amount so there is question about its purity, may be contamination during supply &requires household treatment before using it for drinking.

After storage in vessels of this single sample result shows that for the parameter Turbidity, Temperature, pH, Hardness, TSS & TDS are identical for both vessels. While for MPN water stored in *Tamra*vessel have remarkable reduction than Stainless steel vessel at every time interval. After 24hr MPN /100ml shows nil for water stored in *Tamra* vessel.

Analysis of release of copper ion in water & quantity of copper in malachite (basic copper carbonate) was done for *Tamra*vessel. Observations show that

presence of copper ion in water and also the presence of copper in malachite for the both sources river as well as tube well. Malachite formed by tube well water shows higher concentration of copper than river water.

This difference of copper concentration in two water sources may be due to excess presence of bicarbonates in tube well water which may influence to release excess copper ions from copper vessel.

Discussion on Ideal time duration for storage of water-

The ideal time duration of storage is the duration at which the quality parameters of water stored in vessels are identical with that of Indian Standard Specifications. MPN is the very important parameter among above quality parameters. For river & tube well water after storage in *tamra*vessel there is remarkable reduction in MPN from 12hr storage and found the count decreasing with the passage of time. However, even after storage of water for 48 hrs. MPN was still found and hence even the storage time of 48 hrs. is not sufficient.

Grampanchayat purified water testing after 24hr storage, MPN was found zero. But this is single sample study. This data collected may not be sufficient enough to express definite conclusion about the ideal time

duration for storage of water in above vessels to improve the qualities of water.

It is an attempt to point out the promise Ayurvedic, simple and harmless storage method for household use. Current Project is concerned especially for rural population, where there is scarcity of water purification facilities. In research area purified water supplied by Grampanchayat is available, in fact not daily. It is available alternate day or after every two days. Also time duration of water supply by local agency is early in the morning at 4.30 am to 5.30 am, so it is difficult to obtain for population. Because of this most of the people are using raw water sources for drinking purpose and these are river & tube well. From these use of tube well water is more. Generally this population uses Plastic or Stainless steel pot for storage of water.

The main object of this research study is to give better choice to above said population where is need of two to three days storage of water. Moreover the treated water can get contaminated depending on storage conditions. So there is a need of easy & affordable method for water treatment & storage. By employing this simple, effective and cheap method for storage of water at individual or family level if the individual or

the locality is benefited, then the purpose of this study shall be considered as fulfilled.

CONCLUSION

Raw water taken from both the sources requires sufficient treatment before drinking because it exceeds the desirable limit of MPN according to Indian standard specifications for drinking water.*Tamra* vessel seems to be more effective than Stainless Steel Vessel for improving the qualities of raw water taken from river & tube well in every *rutu.Tamra* Vessel is more effective to reduce MPN count of raw water throughout the study period for both the sources, River & Tube well in each *rutu.* *Tamra* vessel has effect on parameters like Turbidity, Hardness, TSS and TDS up to certain limit.

Data collected may not be sufficient enough to express definite conclusion about the ideal time duration for storage of water in above vessels to improve the qualities of raw water from both sources.

Final conclusion would be drawn that *Tamra* Vessel may be good choice for storage of purified water for house hold purpose.

REFERENCES

1. Dalhana, (1997*). SushrutSamhita (Nibandhasangraha).* 6thEdition. Varanasi: ChaukhambhaOrientalia.

2. Dr.AmbicadattaShastri, (2003). *SushrutSamhita.Ayurvedtatvasandipika).*14th Edition. Varanasi: ChaukhambhaSanskitSansthan.

3. Dr.BhaskarGovindGhanekar, (2008). *SushrutSamhita –Sutrasthana. (Sanskit text with Ayurvedarahasyadeipika).* New Delhi: MeharchandLachhmandas Publication.

4. Chakrapani,(2001*.) CharakSamhita. (Sanskit text with Ayurveddipika).* 5thEdition.Varanasi: ChaukhambhaSurbharatiPrakashan.

5. Vd. HrishchandraKushavaha, (2005). *CharakSamhita(Chakrapani).* Varanasi: ChaukhambhaOrientalia .

6. Indu,(2006). *AshtangaSamgraha Sanskrit text with Shashilekhaby Indu.* Varanasi: Sanskrit Series Office.

7. AcharyaPriyavat Sharma, (1996). *Ashtangahridaya Sanskrit text with Sarvangasundara by Arunadatta.* 2nd Edition. Varanasi: Chaukhambha Orientalia.

8. Late Dr. Anna MoreshwaraKunte, (1998). *Ashtangahridaya Sanskrit text with Sarvangasundaraby Arunadatta&Ayurvedarasayanaby Hemadri.* 8th Edition. Varanasi: ChaukhambhaOrientalia .

9. Dr.KrushnachandraChunekar,(1993). BhavaprakashNighantu. 9th Edition. Varanasi: ChaukhambhaBharati Academy.

10. Ghanekar B G, vaidyakiyasubhashitasahityam.edited by Dr P L Vaidya. 6th edition 1997.Chaukhmbha Sanskrit SansthanVaranshi.

11. Priyavat Sharma. Dravyagunavigyan ,Part- 2. Chaukhmbhabhartiacadmy Varanasi.

12. RadhkantaDevBhadhur ,Shabakalpadruma. edited by Haricharan, (2002) Nag publishers.

13. Vd. RajeshwardattaShastri , 11th edition(1985). SwasthavrittaSamucchya. VdRajeshwardattaShastri

14. Ramnaryan Sharma .ArogyaPrakash .BaidyanathAyurvedbhavan.

15. K Park, (2002). *Preventive and Social Medicine.* 20thEdition. Jabalpur: M/s BanarsidasBhanot Publishers.

16. Dr.B.Subbarao ,Dr.S.V.Ranade,Prof.J.N.Gadgil,Shri.S.D.K hambe ,(1991). Laboratory Manual for Environmental Quality Testing. Environmental Protection Research Foundation, Sangli.

17. Davidson, 10th edition. Davidson's principles and practice of medicine. edited

by Halest Nicholas Boon .Churichillivingstone, edinbursh London .

18. C. R. Kothari, 2nd Edition, (1995). Research Methodology. New Delhi:WishwaPrakashan.

19. B.K.Mahajan , 6th Edition, (2006). *Methods in Biostatistics*. New Delhi: Jaypee Brothers Medical Publishers.

20. M S Kumarswamy, 2015-16, Chemistry – Reference Study Material for summative assessment I, KendriyaVidyalayaGachibowli.

21. Guidelines for Water Quality Management, Central Pollution Control Board 'PariveshBhawan', East Arjun Nagar, Delhi.

22. Hambidge , A. 2001. *Reviewing efficacy of alternative water treatment techniques.* Health Estate 55:23-25

23. Sudha V B, Singh KO, Prasad SR, VenkatasubramanianP, 2009 Aug.Killing of enteric bacteria in drinking water by a copper device for use in home :laboratory evidence. Trans R Soc Trop Med Hyg. 103(8):819-22.

24. RitiSharan[1], Sanjay Chhibber[2] and Robert H Reed[1]*, July 2011.Inactivation and sub-lethal injury of salmonella typhi, salmonella typhimurium and vibrio choleraein copper water storage vessels,

Research article, BMC Infectious Diseases. 11:204 doi:10.1186/1471- 23 34-11-204.

25. Manoj Kumar and Avinash Puri1, 2012, A review of permissible limits of drinking water, IJOEM Indian Journal of Occupational & Environmental Medicine, 2012 Jan-Apr; 16(1): 40–44.dx.doi.org:10.4103/0019-5278.99696

26. PavitraSampath, 10 benefits of drinking water from a copper vessel, Article , www.the healthsite .com Feb 19, 2014.

27. Radha.R* and Susheela.P, Comparative Microbiological Analysis Of Water Stored In Different Storage Vessels, Research Article International Journal of Pharma and Bio Sciences ISSN 0975- 6299

28. M. S. Islam,1 A. Siddika,1 M. N. H. Khan,1 M. M. Goldar,1 M. A. Sadique,1 A. N. M. H. Kabir,1Anwar Huq,2,3 and R. R. Colwell 2,3,2001, Microbiological Analysis of Tube-Well Water in a Rural Area of Bangladesh, Appl Environ Microbiol. 2001 Jul; 67(7): 3328–3330. PMCID: PMC93023

29. Mintz E, Reiff F, Tauxe R, Safe water treatment and storage in the home: A practical new Strategy to prevent waterborne disease, Research Article, JAMA 1995; 273: 948-953.

30. R.J. Oliphant (Feb.2003) Causes of copper corrosion in plumbing system FR/ R

0007, Revised Sept. 2010, Foundation for water research, A review of current knowledge.

31. Th. Alexander Singh1, Dr.N.Sanamacha Meetei2, Dr. L. Bijen Meitei*3 Seasonal Variation of Some Physico-ChemicalCharacteristics of Three Major Rivers in Imphal, Manipur: A Comparative Evaluation, Research Article, Current World Environment, An International Research Journal of Environmental Science, ISSN: 0973-4929, Online ISSN: 2320-8031

Websites :-

1. www.censusindia.net/

2. www.Kolhapur.nic.in/kolhapur

3. www.gemswater.org/publications/pdf/gw qi.pdf

4. www.water-research.net/ helpguide. htm

5. www.water.usgs.gov

6. www.biomedcentral.com

7. www.chemistryexplained.com/elements/ C-K/Copper

8. www.ekshiksha.org.in

9. www.cpcb.nic.in

10. www.nfhsindia.org/india

11. www.mohfw.nic.in/nfhsfactsheet.htm

12. www.resources.worldbank.org/HEALT HNUTRITIONANDPOPULATION/Resour ces

13. www. Google.com

14. www.yahoo.com