



## Review Article

### ROLE OF STORAGE VESSELS ON DRINKING WATER QUALITY: AN AYURVEDIC REVIEW

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#### ABSTRACT

Access to safe drinking water is still a farfetched reality in most of the developing countries. Storage of water for safe drinking is as important as clean and purified water. The concept of storage of water in vessels made of gold, silver, copper, or mud dates to ancient times. In some recent studies it has also been proved that storing water in vessels like copper, gold, silver etc leaches into the water and hence fortifies the quality. This effect of storage in various metals was also mentioned in Ayurveda under *Samskara*. *Susruta*, in his treatise has mentioned about use of copper and silver for water storage. The way, use of metals and earthen vessels as water storage can benefit every living being, similarly, use of plastics on the other hand can be proven detrimental to health. It has been proven that plastic and other metals if leaches more than limit as set by WHO, becomes toxic and harmful for the body. The present article has highlighted the effect of various storage vessels on the quality of water and its impact on human body as mentioned in Ayurvedic classics. It has also tried to critically analyse the recent studies and research work on water storage and its effect on body due to heavy metal poisoning.

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#### INTRODUCTION

Environment is the external factor present around human and has got influence on the health of the human body. According to ecologists, health is a state of dynamic equilibrium between man and his environment and when this equilibrium is disturbed, disease occurs. In India most of the communicable diseases are caused due to poor sanitation, i.e., contaminated water. Water is one of the essential environmental factor(s) which has got an influence on health both directly and indirectly. This is essential for digestion, removal of waste from body, regulation of temperature etc. It is related indirectly because it acts as a vehicle for transmission of many communicable diseases like poliomyelitis, typhoid, viral hepatitis A, diarrhoea etc.<sup>[1]</sup> So, for drinking purpose water must be safe and wholesome. Water is a basic need of human being. World Health Assembly in a resolution emphasized that safe drinking water is the basic element of "Primary Health Care". Drinking water should be free from any contamination, safe and should be adequate quantity. According to WHO, waterborne diseases account for an estimated 3.6%

of the total disability- adjusted life year global burden of disease, and cause about 1.5 million human deaths annually. 80% of diseases worldwide are waterborne. Alarmingly, groundwater in one-third of India's 600 districts is deemed unfit for drinking. <sup>[2]</sup>

Ayurveda is the science of life. It gives importance to cure diseases as well as prevention of diseases.<sup>[3]</sup> Various types of water sources, qualities of water, purification procedure were mentioned in Ayurveda. For preventive measures this ancient science also mentioned various purification procedures. We all know that the quality of food depends upon their chemical constituents. There are several things which affect the chemical composition of a food like heat, time, contact, storage etc. In Ayurveda, *Ashta Ahara Vidhi Visheshaayatana* (eight factors that affects the quality of food) explained the effect of food by such factors.<sup>[4]</sup> These eight factors are *Prakriti* (nature of food), *Karana* (processing done on food), *Samyoga* (combination of different food item), *Rasi* (quantity of food), *Desa* (origin of food item), *Kala* (for how long), *Upayogasamstha*

(rules of taking food), *Upayokta* (person consuming the food).<sup>[5]</sup> Among these factors *Karana* (any processes done on food) is also known as *Samskara*, i.e., transformation of the exiting qualities of food. These process includes *Toya Agni Sannikarsha* (contact with water and *Agni*), *Soucha* (cleaning), *Manthana* (churning), *Vasana* (flavouring), *Bhavana* (trituration), *Desa* (proper place), *Kala* (time), *Kala prakarsha* (passage of time) and *Bhajana* (storage container).<sup>[6]</sup> Among them, *Bhajana* is the factor which plays vital role to preserve the quality of food. Our science has mentioned some different materials for cooking, storing etc. in different classical texts. Similarly storage container for drinking water is also listed in some contexts. The present study proposes to determine the effect of different storage containers in preserving the purity of water and suggestion have been given to maintain healthy life.

## MATERIAL AND METHODS

The review article gives an overview on effect of storage vessels on quality of water as mentioned in classics and explains the concept with logical interpretations.

### Storage Vessels in Ancient Era

*Acharya Sushruta* has mentioned some easy water storage procedure in various containers to make it safe and suitable for drinking. Water stored in metallic pots like *Souvarna* (gold), *Rajat* (silver), *Tamra* (copper), *Kanshya* (bronze), *Mani* (precious stone), *Mrittika Patra* (earthen pot) and fragrant water by using scented flowers into it should be used for drinking purpose.<sup>[7]</sup> *Tamra jalapatra* (copper pot) is *Uttama* (best) and in absence of copper one should use mud pot which is *Hitakari*.<sup>[8]</sup> In other texts we find various types of storage vessels of water and its quality. These storage vessels have been suggested by *Acharyas* after long years of observation.

**Table 1: Qualities of Storage Container of Water** <sup>[9]</sup>

Different types of vessels	Qualities of water
<i>Hema/Souvarna</i> (gold) <i>Bhajana</i>	<i>Suswadu</i> (sweet) <i>Vipaka</i> , <i>Sheetala</i> (cold in potency), <i>Laghu</i> (light), <i>Tridosha samana</i> (balances all three <i>Doshas</i> ), <i>Virya-Bala-Medhakara</i> (improves fertility, immunity, intelligence), <i>Subha</i> (auspicious)
<i>Trapusa</i> (tin) <i>Bhajana</i>	<i>Picchila</i> (sticky), <i>Madhura rasa</i> (sweet taste), <i>Kaphakara</i> (increases <i>Kapha dosha</i> ), <i>Sheeta</i> (coolant), <i>Agni vardhana</i> (improves digestion), <i>Malakara</i> (increases the bulk of faeces and urine), <i>Vata vardhana</i> (increases <i>Vata dosha</i> )
<i>Tamra</i> (copper) <i>Bhajana</i>	<i>Ushna Virya</i> (hot in potency), <i>Swadu</i> (sweet), <i>Katu Rasa</i> (pungent in taste), <i>Katu Vipaka</i> (pungent in potency), <i>Pitta-anilaprada</i> (vitiates <i>Pitta</i> & stimulates digestive fire), <i>Sakritmarutanasana</i> (decreases quantity of faeces and flatus)
<i>Ghosa</i> (bell-metal) <i>Bhajana</i>	<i>Usna Vipaka</i> (hot in potency), <i>Katu</i> (pungent), <i>Guru</i> (heavy to digest), <i>Pittasleshmaprada</i> (aggravates <i>Pitta</i> & <i>Sleshma dosha</i> ), <i>Marutanasanam</i> (destroy <i>Vata dosha</i> )
<i>Pittala/Rittika</i> (brass) <i>Bhajana</i>	<i>Katu rasa</i> (pungent in taste), <i>Sleshma piita vinasha</i> (reduces <i>Kapha</i> & <i>Pitta dosha</i> ), <i>Usna</i> (hot in potency), <i>Meharoga vivardhanam</i> (causes progression of <i>Prameha</i> )
<i>Louha</i> (iron) <i>Bhajana</i>	<i>Atyanta ruksha</i> (very dry), <i>Raktapittahara</i> (treats bleeding disorders), <i>Kanduhara</i> (reduces itching), <i>Tridoshasamana</i> (vitiations of all three <i>Doshas</i> )

**Table 2: Qualities of Heated Water in Different Vessels** <sup>[10]</sup>

Water heated in particular vessels	Properties
<i>Louhabhajana santaptam</i> (heated in iron vessel)	<i>Mandagnikara</i> (diminished <i>Agni</i> ), <i>Malanam Rechana</i> (purges the <i>Malas</i> ), <i>Amashaya Kshalana</i> (cleanses stomach)
<i>Madhudumbarabhajana taptitam</i> (heated over the vessel prepared from the wood of <i>Udumbara</i> )	<i>Uttam</i> (ideal for body), <i>Bapukantiprada</i> (increases lustre of body), <i>Pittakara</i> (alleviates <i>Pitta</i> )
<i>Mrittikabhajana taptam</i> (heated over an earthen vessel)	<i>Malakshalana</i> (cleanse out waste products), <i>Hitam</i> (wholesome), <i>Dhatu Satmya</i> (wholesome for tissues of the body), <i>Virya- Bala-Oja-Parivardhanam</i> (promotes vitality, strength & vitality)

## DISCUSSION

*Acharya Sushruta* suggested total six vessels made of gold, silver, copper, bronze, precious stone, mud pots which were used at that time. Based upon their economical status people were using these pots in their houses. When water is stored in metal vessels, metal ions release in water and microorganisms get killed in such water due to oligodynamic effects. The Oligodynamic effect is a toxic effect of metal-ions on living cells, algae, fungi, spores, prokaryotic eukaryotic microorganisms. Some metals have anti microbial properties which can inhibit the growth of bacteria. This oligodynamic effect of metals is a modern concept.<sup>[11]</sup> It is message that during that time, people were sensuously aware of drinking water, water pollution and water born diseases without knowledge of microorganisms. According to modern science Copper is one of the heavy metal, due to oligodynamic affect of copper with water it kill harmful bacteria. As per Ayurveda copper container is the best for storage of drinking water.<sup>[12]</sup> Some authors have mentioned properties of *Tamra* in classical texts, which give a clear concept of its purity. Various research works also back up the concept of water storage in copper vessels for its beneficial qualities.

Table 3: Properties of *Tamra* as Per *Nighantus*

Name of <i>Nighantus</i>	Properties
<i>Bhavaprakasha nighantu</i> <sup>[13]</sup>	<i>Kashaya</i> (astringent), <i>Madhura</i> (sweet), <i>Tikta</i> (bitter), <i>Amlarasa</i> (sour), <i>Katu Vipaka</i> (pungent), <i>Pittakaphanasak</i> (reduces <i>Pitta</i> & <i>Kapha dosha</i> ), <i>Sheeta</i> (cool), <i>Ropana</i> (heals up), <i>Laghu</i> (light), <i>Lekhaniya</i> (scrapes out unwanted tissues), <i>Pandu</i> (anaemia), <i>Udararogahara</i> (abdominal diseases), <i>Jwarahara</i> (reduces fever), <i>Arsahara</i> (reduces piles), <i>Amlapittahara</i> (reduces hyperacidity), <i>Sothanasak</i> (cures oedema), <i>Kriminasak</i> (destroys worms), <i>Sulahara</i> (reduces pain)
<i>Kaiyadeva nighantu</i> <sup>[14]</sup>	<i>Tikta</i> (bitter), <i>Kashaya</i> (astringent), <i>Madhura</i> (sweet), <i>Amlarasa</i> (sour in taste), <i>Katu Vipak</i> (pungent), <i>Sheeta Virya</i> (cool in potency), <i>Laghu</i> (light), <i>Lekhaniya</i> (scrapes out unwanted tissues), <i>Vranaropana</i> (heals wound), <i>Kapha pittanasak</i> (destroys <i>Kapha</i> & <i>Pitta dosha</i> ), <i>Kasaswasahara</i> (reduces cough and breathing difficulty), <i>Arsanasak</i> (cures piles), <i>Sothapandunasak</i> (cures oedema and anemia)
<i>Raja nighantu</i> <sup>[15]</sup>	<i>Madhura</i> (sweet), <i>Kashaya</i> (astringent), <i>Tikta Rasa</i> (bitter), <i>Katu</i> (pungent), <i>Sheeta</i> (cooling) <i>Vipaka</i> (metabolic end product), <i>Kaphapittahara</i> (reduces <i>Kapha</i> & <i>pitta</i> ), <i>Sulaghna</i> (Reduces pain), <i>Pandunasa</i> (destroys anaemia), <i>Udaranasa</i> (destroys abdominal disorders)
<i>Dhwanwantari nighantu</i> <sup>[16]</sup>	<i>Kusthahara</i> (destroys skin disorders), <i>Dahahara</i> (reduces burning sensation), <i>Sulahara</i> (relives pain), <i>Sothahara</i> (reduces oedema)
<i>Priya nighantu</i> <sup>[17]</sup>	<i>Tikta</i> (bitter), <i>Kashaya</i> (astringent), <i>Madhura</i> (sweet), <i>Amla Rasa</i> (sour in taste), <i>Usna</i> (hot) <i>Virya</i> , <i>Kaphapitta Samak</i> (balances <i>Kapha</i> & <i>pitta</i> ), <i>Rechak</i> (removes waste products), <i>Lekhaniya</i> (scrapes out unwanted tissue), <i>Krimighna</i> (destroy worms), <i>Deepaniya</i> (appetizer), <i>Amlapittahara</i> (reduces acidity problems), <i>Pandu</i> (anaemia), <i>Swasahara</i> (reduces breathing difficulty), <i>Visahara</i> (effective in poisoning), <i>Udararogahara</i> (reduces abdominal disorders)

Various diseases can be prevented through safe drinking water. Classics states that *Tikta*, *Kashaya* rasa acts as *Deepaniya* (appetizer), *Lekhaniya* (scrapes away unwanted tissue), *Pittakapha samak* (reduces *Pitta* & *kapha*), *Rechaka* (removes wastes) and prevents *Krimi* (worms), *Pandu roga* (anaemia), *Sula* (pain), *Amlapitta* (hyperacidity), *Jwara* (fever), *Daha* (burning sensation). By the *Lekhaniya* and *Roopana* (heals up) *Karma* it heals *Vrana* (wound), *Sotha* (oedema), *Kustha* (skin diseases). *Madhura Rasa* is *Tarpaniya* (nourishes tissue), *Jeevaniya* (improves lifespan) in nature which acts on *Kshaya* (depletion of tissue). Due to *Kaphavardhaka*, *Vatapittahara* character of

*Madhura rasa* it works on *Visa* (poisoning), *Daha* (burning sensation). *Amla Rasa* improves digestion power.<sup>[18]</sup> The water stored in copper vessels or stainless steel vessels improves the quality of water.<sup>[19]</sup> In laboratory experimental study, copper has been shown to kill meticcillin resistant *Staphylococcus aureus*, *S. enteric*. Other studies have shown that copper is lethal to *E.coli* in water at different pH level. Copper vessels are active in regular drinking water (pH 7.83±0.4). Physiochemical parameters of drinking water remain unchanged in some studies which makes them open to public use.<sup>[20]</sup> Other than *Tamra*, *Hema*, *Louha*, *Rajat* etc are costly meal and we have needs further

studies. Storing water in copper vessels is killing the harmful bacteria and also delays the ageing process.<sup>[21]</sup> Water stored in copper vessels for overnight and drinking it in the next day morning is considered as healthy. Storing water in copper pots finds mention in Ayurveda for purification of water. In a published literature, author mentioned copper metal is the most effective metals in killing the coliforms.<sup>[22]</sup> It is more poisonous to bacteria than others metals such as aluminium or stainless steel.<sup>[23]</sup> In a study silver has shows most antibacterial activity in compare to copper as evaluated by the antibacterial effects of Ag and Cu on gram positive and gram negative bacteria.<sup>[24]</sup> Excessive presence of copper in drinking water leads to health hazards. Some of the researches from Europe, USA signify that copper levels in drinking water can range from <0.005 to >30mg/lit.<sup>[25]</sup>

Now people are using plastic materials for storage of food and water which have toxic health effect. Plastics are widely used and most dangerous for living beings on this planet. Fast of all they are non- recyclable material made of different composition which is toxic in nature. Secondly, it may the cause of cancer, ulcers, indigestion, skin disease, birth defects, genetic changes, liver dysfunction (polyvinylchloride- used in plumbing). Plastic bottles are made with BPA (Bishenol A). BPA is a hormone disrupting chemical that in animal studies, it has been associated with reproductive abnormalities such as lower sperm counts, hormonal changes on puberty, enlarged prostate glands, abnormalities in chromosomes, pre-cancerous changes in prostate and breast etc. It reduces the testosterone levels. It has been associated with insulin resistance, obesity and diabetes. Along these hazards of plastics it also hampers the function of body immune system.<sup>[26]</sup>

Mud pot is porous, it provides chilled water on the principles of vaporization, which helps in cooling down the temperature of water. With its cooling effect, it is gentle in the throat and can be easily taken by patient suffering from cough and cold. Some of the article mentioned, vitamins and minerals of water stored in clay pot which helps in maintaining the body glucose level. Human body in acidic in nature, where mud pot is alkaline nature. Water of mud pot helps in balancing pH of our body and prevents acidity and stomach problems. Because of temperature decrease it also reduces microbial population.<sup>[27]</sup> Another study shows there is less change in the water parameters and quality of clay pot water not decreases.<sup>[28]</sup> Many studies indicate that the copper and brass is a low cost microbial safety drinking water storage vessel.<sup>[29]</sup> A study on effect of storage containers on Coliforms in drinking

water shows, significant reduction of coliforms bacteria was observed in the water stored in clay pot, brass, copper and silver container.<sup>[30]</sup>

## CONCLUSION

Storage container plays a major role that affects the quality of water. Proper textual knowledge about healthy benefits of metals like copper, mud pot etc. and the bad effects of different materials like plastics etc., on water as well as living beings can help to prevent many diseases and restore health. So, it is essential to have only clean and safe drinking water.

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