Original Article

Effect of Ayurveda water purification method on total dissolved solutes in water

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Abstract

Background: Water is vital for life as the body uses water in all its cells and tissues to maintain vital functions. Hence, water used for drinking should be free from all types of impurities. Acharya Sushruta has mentioned various water purification methods by keeping it in different types of vessels (silver, copper, and clay) and by adding herbs such as *Kataka Beeja* (seeds *Strychnos potatorum* Linn.). With urbanization, there are changes in the lifestyle of individuals and their food habits. Therefore, based on the ease of availability of materials, storage of water needs to be analyzed by simple parameters such as total dissolved solutes (TDS) that comprises inorganic salts such as bicarbonates, sulfates, and chlorides and a small amount of organic matter that is dissolved in water. A high level of TDS indicates water is unfit for consumption and may lead to nausea, vomiting, dizziness, etc., TDS level indicates whether water is suitable for consumption or it requires filtration. **Aim:** To evaluate and compare the TDS of water kept for 24 h in different vessels made up of silver, copper, clay, plastic, and steel and further with the addition of different herbs like *Kataka* seeds, *Tulsi* leaves (*Ocimum tenuiflorum* Linn.), *Nimba* leaves (*Azadirachta indica* A. Juss) separately in different vessels. **Materials and methods:** The effect of different materials used for storage of water was assessed by evaluating TDS in water samples with the help of a well-calibrated TDS meter, on stored water (100 ml) in different types of vessels (silver, copper, clay, plastic, and steel) and further with the addition of different herbs (10 g) *Kataka* seeds, *Tulsi* leaves and *Nimba* leaves individually and separately, by keeping undisturbed for 24 h. **Results:** TDS values of the water samples kept for 24 h in different vessels, i.e., silver, copper, plastic, steel, and clay are 372, 429, 436, 445, 628 ppm, respectively, were found. **Conclusion:** The silver vessel was found to be best in decreasing the TDS value of water among vessels. On evaluating additional effects by adding different herbs, *Nimba* showed its action best among the storage vessels.

Keywords: Clay vessels, copper, *Kataka* seeds, *Nimba* leaves, plastic, silver, steel, total dissolved solutes meter, total dissolved solutes value, *Tulsi* leaves

Introduction

Udakam Ashvasakaranam (water is satiating)[1] as mentioned by Acharya Charaka indicates the significance of water in day-to-day life. A close look at the theory of *Panchamahabhuta* (five basic elements) testifies the basic factors of *Purusha* (cosmic being or self) and *Prakriti* (basic cosmic material) that includes *Apa Mahabhuta* (water element). *Acharya Bhavaprakasha* has mentioned various types of water along with their specific uses, methods of finding impure and pure water, various methods of storing drinking water as well as *Guna* (properties) and *Karma* (action) of pure water, thereby indicating the role of pure water for a healthy life. Hence, there is always a need for maintaining the purity of drinking water, as there is a huge chance of pollution of water due to industrialization in the present era.

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Quick Response Code:

Website: www.ayujournal.org

DOI: 10.4103/ayu.ayu_366_20

In the ancient era, water was stored in vessels made from different types of materials such as *Rajata*[2] (silver), *Tamra*[2] (copper), and *Mrinmaya*[2] (clay) along with the addition of herbs such as *Kataka Beeja* (seeds *Strychnos potatorum* Linn.)[2-5] as it is considered to have *Jala Nirmalakara*[2-5] (cleanses water) property. With the advancement of technology, the use of plastic, steel, and so on vessels for storing of water has come into the light. Dissolved solutes are considered the cause of water

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How to cite this article: Pruthi Z, Kotekar AS, Saranya K. Effect of Ayurveda water purification method on total dissolved solutes in water. AYU 2022;43:18-25.

Submitted: 14-Sep-2020 **Revised:** 08-Jun-2022
Accepted: 21-Apr-2023 **Published:** 24-Jun-2023

contamination. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride. A solution for this constraint was tried to establish with the knowledge of some herbs such as *Tulsi* (*Ocimum tenuiflorum* Linn.),[6-8] *Nimba* (*Azadirachta indica* A. Juss)[9-11] which are easily available. Further, they are not expensive compared to various other measures that require technological support.

Total dissolved solutes (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in water.[12] The principal constituents identified are calcium, magnesium, sodium, potassium, chloride, sulfate, carbonates, and nitrate ions. The presence of dissolved solutes in water may change the taste. The palatability of drinking water has been rated by panels of tasters in relation to TDS level as follows: Excellent: <300 mg/dl; Good: Between 300 and 600 mg/dl; Fair: Between 600 and 900 mg/dl; Poor: Between 900 and 1200 mg/dl; Unacceptable for intake: >1200 mg/dl.[13] Thus, high levels of TDS suggest it is not suitable for consumption as drinking water with an elevated amount of TDS for longer periods expose the body to various chemicals, and toxins and causes chronic health conditions like cancer, liver diseases, kidney failures, nervous system disorders, poor immunity and may also cause birth defects in the newborn.

Aim

1. To estimate and compare the TDS of water kept for 24 h in different vessels made up of silver, copper, clay, plastic, and steel
2. To evaluate and compare the TDS of water by adding of herbs such as seeds of *Kataka*, leaves of *Tulsi,* and *Nimba* separately in different vessels kept for 24 h.

Materials and methods

In the present experimental study, vessels made from different materials such as silver, copper, clay as mentioned in *Ayurveda* classics, and plastic and steel that are used in day-to-day life were taken.

A sterile glass container was used to collect a freshwater sample from a common source that is a pond located in *Aanupa Desha*. Coarse powder of *Kataka* seeds (*S. potatorum* Linn.) sieved with mesh no. Twenty was taken, and fine *Nimba* leaves powder (*A. indica* A. Juss) was sieved with mesh no. One hundred and twenty was collected and *Tulsi* leaves (*O. tenuiflorum* Linn.) were freshly collected from the campus botanical garden, shade dried, and powder sieved with mesh no. 80 was obtained. The experiment was performed in a research laboratory at Sri Dharmasthala Manjunatheshwara College of Ayurveda and Hospital, Hassan, Karnataka, India, as follows:

(a) Freshwater sample was collected in a sterile glass container and was transferred to a sterile cylindrical shaped beaker and its TDS value was measured using a well-calibrated TDS meter: HM Digital TDS-3 Handheld TDS Meter
(b) 100 ml of water was measured using a measuring cylinder and was poured into five different cylindrical vessels of silver, copper, clay, plastic, and steel. All the vessels were covered with steel lids individually and left undisturbed for 24 h at average room temperature. After 24 h TDS value was evaluated using a well-calibrated TDS meter
(c) 10 g of herbs namely *Kataka* seeds powder, *Tulsi* leaves powder, and *Nimba* leaves powder were weighed using a weighing balance and poured in 100 ml of water samples, respectively, one by one in five different cylindrical vessels of silver, copper, clay, plastic, and steel and were covered with steel lids and kept undisturbed for 24 h at average room temperature. The next day water was filtered in a sterile container using a cloth and the TDS value was noted. The herb powder to water ratio was taken 1:10 as 1 part of the solute is freely soluble in 10 parts of solvent (extent of solubility).[14] Time period was kept as 24 h as by mere storage, the quality of the water improves. About 90% of the suspended impurities settle down in 24 h by gravity.[15]

Results

In the present study, the following observations were obtained:

(i) The TDS of the freshly collected water sample was 482 ppm [Figure 1]
(ii) TDS value of the water sample kept in different vessels: silver, [Figure 2] copper, [Figure 3] plastic, [Figure 4] steel, [Figure 5] and clay, [Figure 6] and the TDS level of 100 ml of the water sample, [Figure 7] mixed with 10 g of herbs namely *Kataka Beeja,* [Figure 8] *Tulsi Patra,* [Figure 9] *Nimba Patra,* [Figure 10] individually and separately and kept in five different vessels (silver, copper, clay, plastic, and steel) undisturbed for 24 h [Figure 11] varied as mentioned in Table 1. [Figures 12-26]

Table 1: Total dissolved solutes value of water sample kept in different vessels (silver, copper, plastic, steel, clay) along with different herbs such as *Nimba*, *Tulsi* and *Kataka* for 24 h

Type of vessel	TDS value of water (ppm)	Water + *Nimba* leave powder (after 24 h) (TDS in ppm) [Figure 12-16]	Water + *Tulsi* leave powder (after 24 h) (TDS in ppm) [Figure 17-21]	Water + *Kataka* seed powder (after 24 h) (TDS in ppm) [Figure 22-26]
Silver	372	107	155	199
Copper	429	157	199	160
Plastic	436	258	257	281
Steel	445	155	178	160
Clay	628	208	191	169

TDS: Total dissolved solutes

Figure 1: TDS value is 482 ppm of sample water. TDS: Total dissolved solutes

Figure 2: TDS value of water is 372 ppm in silver vessel. TDS: Total dissolved solutes

Figure 3: TDS value of water is 429 ppm in copper vessel. TDS: Total dissolved solutes

Figure 4: TDS value of water is 436 ppm in plastic vessel. TDS: Total dissolved solutes

Figure 5: TDS value of water is 445 ppm in steel vessel. TDS: Total dissolved solutes

Figure 6: TDS value of water is 628 ppm in clayvessel. TDS: Total dissolved solutes

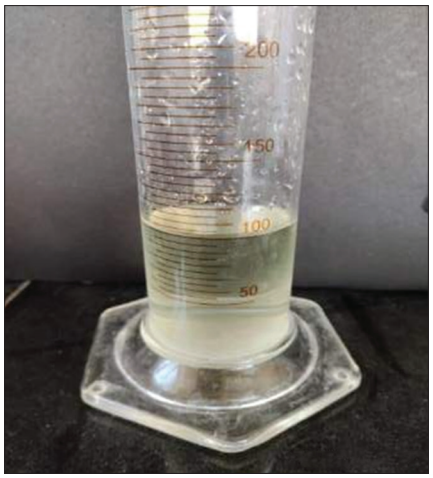

Figure 7: 100 ml of water sample

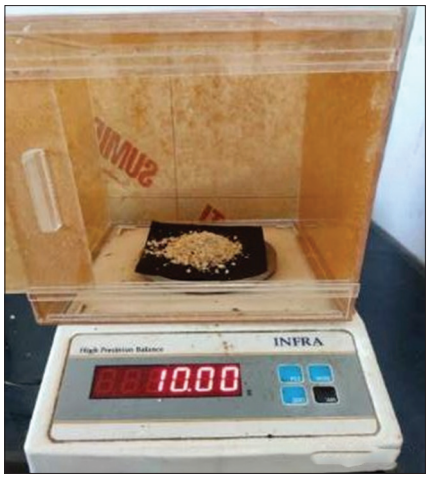

Figure 8: 10 g of *Kataka Beeja Churna*

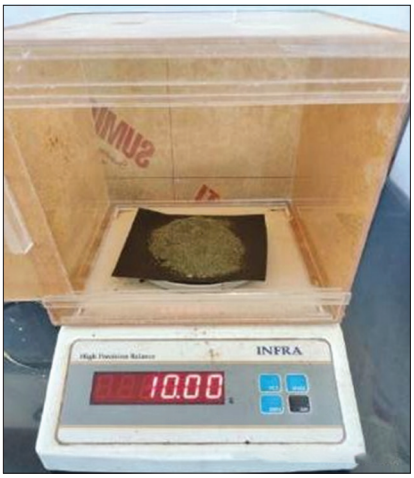

Figure 9: 10 g of *Tulsi Patra Churna*

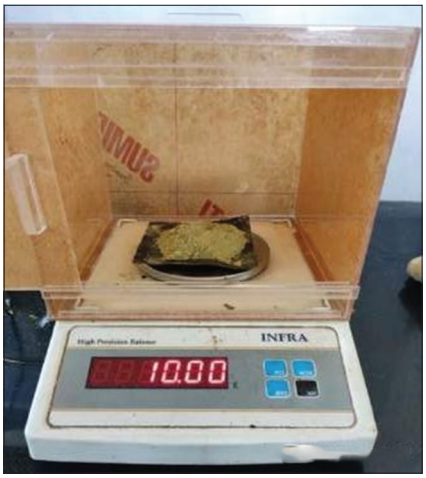

Figure 10: 10 g of *Nimba Patra Churna*

Figure 11: Vessels made up of different materials: plastic, steel, copper, clay, silver respectively covered with steel lids

Figure 12: TDS value of water is 107 ppm after addition of *Nimba Patra Churna* in silver vessel. TDS: Total dissolved solutes

Discussion

In the present study, a measure of TDS was used as a parameter to assess the total concentration of dissolved substances in water. TDS is used as an indication of good quality of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants present in water. Hence, the cost-effective

Figure 13: TDS value of water is 157 ppm after addition of *Nimba Patra Churna* in copper vessel. TDS: Total dissolved solutes

Figure 14: TDS value of water is 258 ppm after addition of *Nimba Patra Churna* in plastic vessel. TDS: Total dissolved solutes

Figure 15: TDS value of water is 155 ppm after addition of *Nimba Patra Churna* in steel vessel. TDS: Total dissolved solutes

Figure 16: TDS value of water is 208 ppm after addition of *Nimba Patra Churna* in clay vessel. TDS: Total dissolved solutes

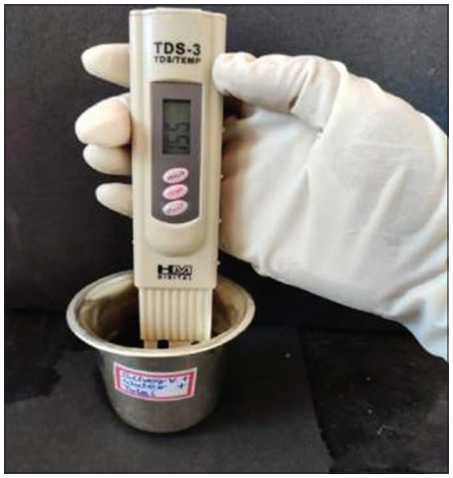

Figure 17: TDS value of water is 155 ppm after addition of *Tulsi Patra Churna* in silver vessel. TDS: Total dissolved solutes

Figure 18: TDS value of water is 199 ppm after addition of *Tulsi Patra Churna* in copper vessel. TDS: Total dissolved solutes

and easy method of identifying the concentration of organic and inorganic salts in the given sample of water indirectly gives an idea of the quality of water that ranges between excellent for drinking or unacceptable for drinking based on TDS level that is

Figure 19: TDS value of water is 257 ppm after addition of *Tulsi Patra Churna* in plastic vessel. TDS: Total dissolved solutes

Figure 20: TDS value of water is 178 ppm after addition of *Tulsi Patra Churna* in steel vessel. TDS: Total dissolved solutes

Figure 21: TDS value of water is 191 ppm after addition of *Tulsi Patra Churna* in clay vessel. TDS: Total dissolved solutes

Figure 22: TDS value of water is 199 ppm after addition of *Kataka Beeja Churna* in silver vessel. TDS: Total dissolved solutes

Figure 23: TDS value of water is 160 ppm after addition of *Kataka Beeja Churna* in copper vessel. TDS: Total dissolved solutes

Figure 24: TDS value of water is 281 ppm after addition of *Kataka Beeja Churna* in plastic vessel. TDS: Total dissolved solutes

one among the criteria of pure drinking water. The concentration of solutes increases the TDS of water, thus indicating the degree of water impurity in terms of TDS. The water sample collected from a common source had a TDS value of 482 ppm.

Figure 25: TDS value of water is 160 ppm after addition of *Kataka Beeja Churna* in steel vessel. TDS: Total dissolved solutes

Figure 26: TDS value of water is 169 ppm after addition of *Kataka Beeja Churna* in clay. TDS: Total dissolved solutes

On storage in a silver vessel for 24 h, the TDS value was reduced to 372 ppm. This reduction in the value of the TDS of water may be attributed to the property of deionization. Whereas, the TDS value of water kept in clay vessels for 24 h showed an increase in TDS value to 628 ppm. The increase in the TDS value of water after storing it in a clay vessel may be due to the use of freshly prepared clay vessels as the minerals and salts present in clay probably get transfused into water. Water stored in copper, steel, and plastic vessel for 24 h did not show much decrease in TDS value demonstrating its weak ability in influencing the change of TDS value. However, the reduction noted in the TDS value of water after keeping it in plastic and steel vessels may be attributed to the property of sedimentation. In a copper vessel, the reduction of the TDS value of water may be due to the ability to absorb minerals through the copper vessel.

Water was placed for 24 h with the addition of herbs such as *Nimba*, *Tulsi,* and *Kataka* (separately) in the vessels made from silver, copper, clay, plastic, and steel, respectively. On addition of *Nimba* and *Tulsi,* significant reduction was observed in the TDS of water. Flavonoids are widely distributed in *Nimba*, high flavonoid content indicates the probability of significant antioxidant potential. Furthermore, Rutin is a natural antioxidant present in *Nimba*. Other antioxidants present are quercetin and ellagic acid.[16] These all phytoconstituents may have attributed to the reduction of TDS due to free radical scavenging property. It has been reported that *Tulsi* contains various compounds such as flavonoids, alkaloids, and phenol, and essential oil contains flavonoid compounds with the potential as an antioxidant.[17] This may have contributed to the free radical scavenging activity, and hence, the reduction in TDS of water that was noted after the addition of *Tulsi* in water.

Furthermore, *Nimba* contains amino acids and *Tulsi* contains ursolic acid in leaves. As TDS value increases mainly due to the presence of alkalies, so there are chances of neutralization of the water after the addition of these two herbs hence leading to a decrease in TDS value.

In addition of *Kataka* seeds powder in the water sample, kept in different types of vessels for 24 h, a considerable reduction in TDS value was noted as the albumin of the seeds acts as a precipitant of the suspended impurities.[18] Furthermore, there is the presence of polyelectrolytes, proteins, lipids, carbohydrates, and alkaloids containing the –COOH and free–OH surface groups in the seed attributing to clarifying the water.[19]

Further, it was observed that on addition of *Nimba*, taste of water changed to bitter, the color of water changed to brownish yellow, and no smell was observed. On addition of *Tulsi*, slight bitter taste was felt, color of water changed to brown and fragrance of *Tulsi* was observed. On addition of *Kataka*, no change in taste, color or smell was observed.

Conclusion

The silver vessel was found to be best in decreasing the TDS value of water among vessels. On evaluating additional effects by adding different herbs, *Nimba* showed its action best among the storage vessels.

Financial support and sponsorship

This study was financially supported by Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka. Short-term research grant for undergraduate students with Project Name- Evaluation of water purification in Ayurveda and Project code-UGAYU048.

Conflicts of interest

There are no conflicts of interest.

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