Research Article

Effect of soaking of *Phyllanthus emblica* wood in drinking-water for purification

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ABSTRACT

Background: Drinking-water is purified by various methods like UV irradiation, heat treatment, adding disinfectants like chlorine etc. Aims of purification include reducing turbidity and elements, increasing taste and removing microbes. There is no single method available which can fulfill entire expectation. Siddha literatures claim that the purification could be achieved by soaking certain herbals.

Objective: The present study was done to evaluate the water purifying property of *Phyllanthus emblica* wood.

Materials and method: 1.5 L of water was taken in two different containers. Control container water was kept as such. *Phyllanthus emblica* wood pieces (75 g) were soaked in test container. After 48 hrs, two groups of water were filtered and investigated for physical properties, elements and level of microorganisms.

Result: The color, odor, turbidity, conductivity, total dissolved solids, total alkalinity, calcium, iron, chloride and nitrate level were increased in the test container. pH, total hardness, sulphate and magnesium levels were decreased in the test container. Level of *Escherichia coli*, total coliforms and faecal coliforms were reduced in the test container.

Conclusion: Soaking *Phyllanthus emblica* wood improves the purity of water. This beneficial property of *Phyllanthus emblica* may be used in the purification of drinking water.

KEY WORDS: Siddha Medicine, Ayurveda, traditional method, water purification.

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INTRODUCTION

Water is essential for life. The safe and accessibility of drinking water are major concerns throughout the world. Getting safe drinking water is the basic rights of all human beings. Safe drinking water is the one which does not cause any significant risk to health over a lifetime of consumption. All sources of drinking water are likely to be contaminated by microbes and toxic elements like mercury, arsenic, lead etc. Health risks may arise from consumption of water contaminated with infections agents, toxic chemicals and radiological hazards. In March 2012, WHO declared that at least 11% of the world's population (783 million people) is without the access to safe drinking water. Improving access to safe drinking water can result in tangible improvement to health. Assurance of drinking water safety is a powerful environmental determinant of health.[1]

The purification process of drinking water is aimed to alter turbidity, odor, color, bacterial impurities, hardness and toxic elements. Drinking water purification is planned at industry level and at house level. For the domestic purpose, commonly used water purifying methods include boiling, distillation, filtering, chlorination, passing ultraviolet light, using water softener and ozonation. There is always a search for novel water purification methods for domestic use. Traditionally water is purified either by adding few herbals like *Osimum sanctum* leaf or seed coats of *Elettaria cardamom* or by storing water in copper vessel.[2] *Vetiveria zizanoides* plant was reported for its ability to improve the water quality in terms of clearness and pleasant smell.[3] Herbals like *Strychnos potatorum, Moringa oleifera* and *Zee mays* had been reported for its ability to reduce alum in drinking water through its coagulation property.[4,5] Literatures of Indian Traditional Siddha Medicine also mention various methods to purify drinking water. One of the claims is

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that the water soaked with the wood/root of *Phyllanthus emblica* become safe and healthy drinking water.[6] However, no previous study has been done regarding water purifying property of *Phyllanthus emblica* wood. Study in this direction can throw some light on various affordable methods of obtaining safe drinking water. Hence, this study was done to evaluate the effect of soaking *Phyllanthus emblica* wood in drinking water.

MATERIALS AND METHODS

Plant material

Phyllanthus emblica fresh wood was collected locally in Thambaram, Tamilnadu, India. Outer bark was removed and the inner hard wood was made into pieces. Then the pieces were dried under shade and used for the study.

Drinking-water

Drinking water was collected from a house-tap in Thambaram which was upplied by Chennai metropolitan water supply and sewerage board. 3 liters of drinking water was directly collected from the tap into two sterilized plastic containers of 1.5L in each. These containers with water were immediately kept under sterilized laboratory room and normal room temperature was maintained.

Treatment with *Phyllanthus emblica* wood

75 g *Phyllanthus emblica* wood (PEW) pieces were kept in one container containing 1.5 L of water for 48 hrs. Another container with 1.5 L of water was served as a control, which was simply maintained in the same environment as above without any treatment. After 48 hrs, both *Phyllanthus emblica* treated and untreated water samples were used for analysis.

Water analysis

Both the water samples were analyzed for physical properties, elements level and microbial level by using standard protocol, Indian Standard Drinking Water – Specification IS:10500:1991 (Reaffirmed 2009). The color, odor, taste, pH, turbidity, conductivity at 250 C, total dissolved solids, total alkalinity, total hardness, calcium, iron, chloride, nitrates as NO_3, magnesium, sulphate as SO_4, *Escherichia coli* (*E.coli*), total coliforms and fecal coliforms were estimated. Bacterial density is expressed in Most Probable Number per 100 milliliters (MPN/100ml).[7]

RESULTS

Physical properties

Physical properties of untreated water were within the desirable limit. *Phyllanthus emblica* wood treatment had altered the odor and taste which was not within the permissible limit. Though rest of the parameters were altered, they were within the permissible limit (Table 1).

Elements level

Elements level of untreated water was within the desirable limit. *Phyllanthus emblica* wood treatment increased the level of calcium, chloride, nitrate and iron whereas sulphate and magnesium levels were decreased. These alterations did not cross the desirable limit (Table 2).

Table 1: Physical properties of drinking-water samples after 48 hours:

Characteristic test	Protocol	Required/ Desirable limit	Permissible limit (PLAAS)	Control water	PEW treated water
Color	IS 3025 Part 4	5 Hazen	25 Hazen	10 Hazen	25 Hazen
Odor	IS 3025 Part 5	Unobjectionable	Unobjectionable	Unobjectionable	Objectionable
Taste	IS 3025 Part 8	Agreeable	Agreeable	Agreeable	Disagreeable
Turbidity	IS 3025 Part 10	5 NTU	10 NTU	0.6 NTU	6.12 NTU
pH value	IS 3025 Part 11	6.5 to 8.5	6.5 to 8.5	7.53	6.12
Total Dissolved Solids	IS 3025 Part 16	500 mg/lit	2000 mg/lit	425 mg/lit	542 mg/lit
Total Hardness as $CaCO_3$	IS 3025 Part 21	300 mg/lit	600 mg/lit	246 mg/lit	201 mg/lit
Total Alkalinity as $CaCO_3$	IS 3025 Part 23	200 mg/lit	600 mg/lit	164 mg/lit	208 mg/lit
Conductivity @ 25°C	IS 3025 Part 14	6000	80000	689	894

PLAAS - Permissible limit in the absence of alternate source

PEW - *Phyllanthus emblica* wood

NTU = Nephelometric Turbidity Unit

Conductivity @ 25°C is expressed in µmhos/cm

Table 2: Elements level of drinking-water samples after 48 hours:

Characteristic test	Protocol Desirable limit	Required/ (PLAAS)	Permissible limit water	Control water	PEW treated water
Calcium as Ca	IS 3025 Part 40	75	200	47	65
Chloride as Cl	IS 3025 Part 32	250	1000	89	105
Nitrate as NO_3	IS 3025 Part 34	45	100	3	31
Iron as Fe	IS 3025 Part 53	0.3	1.0	0.07	0.5
Sulphate as SO_4	IS 3025 Part 24	200	400	37	4
Magnesium as Mg	IS 3025 Part 46	30	100	31	9

Values are given in mg/lit

PLAAS - Permissible limit in the absence of alternate source

PEW - *Phyllanthus emblica* wood

Level of microorganisms

Microorganism level of untreated water was not within the desirable limit. Bacterial density of *E.coli*, total coliforms and fecal coliforms were high in the water. Although *Phyllanthus emblica* wood treatment reduced the bacterial density, it failed to kill maximum bacteria for the permissible limit (Table-3).

Table 3: Level of microorganisms in drinking-water samples after 48 hours:

Characteristic test	Protocol	Required/ Desirable limit	Permissible limit (PLAAS)	Control water	PEW treated water
Escherichia coli	IS : 1622 :1981	0	0	11	8
Total Coliform	IS : 1622 :1981	0	< 50	110	80
Faecal Coliform	IS : 1622 :1981	0	0	50	23

Values are given in Most Probable Number per 100 milliliters (MPN/100ml)

PLAAS - Permissible limit in the absence of alternate source

PEW - *Phyllanthus emblica* wood

DISCUSSION

Household water treatment interventions may play a important role in protecting public health where existing water sources, including those delivered via a piped network or other improved sources, are not treated properly or become contaminated during distribution or storage. Thus purification process is emphasized at the house level.[8]

Disagreeable taste and objectionable odor render the drinking-water unacceptable. In our study, altered odor and taste of drinking water might be due to the putrefaction of organic wood with long soaking time of 48 hrs. This could be avoided by reducing the soaking time.

Water hardness is caused by the presence of calcium, magnesium, carbonate, bicarbonate, chloride and sulfate in water. Water hardness < 75 mg/L, 75-150 mg/L, 150-300 mg/L and > 300 mg/L are classified as soft, moderate, hard and very hard respectively by Sawyer and McCarthy.[9] PEW treatment did not change the level of hardness.

Released calcium and iron from the PEW might have increased the level of these elements in the drinking water. Increased calcium level by PEW would serve as a good calcium supplement for all peoples especially elderly people with osteoporosis. Significant increase in iron level is another important observation in PEW treated water which again suggests the nutritional value of this method. 0.5-1mg iron intake in adult male meets the daily requirement, which can be supplied by simply having one liter of this drinking water. But higher iron content in water affects the taste of beverages and causes stains. [10, 11]

Reduction in sulphate and magnesium level in test water might be due to the chelation property of PEW. High sulphate in drinking water causes water unpalatable, digestive abnormality and pitting effect on red blood corpuscles. In this regard, significant sulphate level reducing effect of PEW is beneficial. Magnesium salts are more soluble than calcium, hence they increase hardness of water and gives unpleasant taste. Moreover, magnesium salts may have laxative effects when consumed in higher concentration. Although magnesium is good for health, chronic intake by drinking water leads to hypermagnesemia especially in renal failure cases. Besides causing osmotic diarrhea, when the serum level is > 5 mmol/L, magnesium uncouples excitation-contraction in cardiac and smooth muscles and inhibits cellular action potential. At higher serum level > 7 mmol/L, magnesium causes cardiac arrhythmias, respiratory depression and even cardiac arrest. [7, 12] Thus, reduction in magnesium level is another beneficial effect of PEW.

Although there is a reduction in *E.coli*, total coliforms and fecal coliforms level, a complete eradication was not achieved by PEW. Coliform bacteria are most commonly associated with water quality. Coliforms are defined as facultatively anaerobic, gram negative, non-sporing, rod-shaped bacteria including *E.coli*, are members of the family Enterobacteriaceae, which also includes *Enterobacter aerogenes* and *Klebsiella pneumoniae.* These bacteria makeup approximately 10% of the intestinal microorganisms of human and animals, and used as indicator organism for fecal contamination of drinking-water. Thus, total number of coliform bacteria indicates the degree of microbial contamination. If such bacteria are not detectable in 100 ml of water, the water can be considered as suitable for drinking.[13] Eradication of organisms could be achieved by boiling the water before or after PEW treatment.

The physical properties, element levels and microbes level of test and control water were not assessed before PEW treatment. Hence the true alteration in the various parameters is not clear in this study.

CONCLUSION

Traditional practices are ritualistic practices with valid scientific reasons, hence cannot be simply ignored. Siddha medicine suggests using certain herbals to obtain pure drinking water at house level.

Phyllanthus emblica wood treatment has reduced the hardness of water, amount of magnesium and sulphate in drinking-water. It also increased the amount of calcium and iron. However, this method could not completely kill microbes in water. Thus, this method could be used in places where the drinking water possesses high magnesium and sulphate level without microbes. Pre boiled drinking water could be soaked with *Phyllanthus emblica* wood to serve as a source of calcium and iron. This scientific study has revealed that soaking *Phyllanthus emblica* wood certainly alters the properties of drinking water and makes it healthy. Further studies are required to reveal the required amount of wood and soaking time required to obtain healthy drinking water and mechanism by which it alters the characteristics of water.

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