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Phyllanthus emblica - A Biopotential for Hard Water Treatment

R. Padmapriya, T. Saranya and T. Thirunalasundari*

Department of Industrial Biotechnology, Bharathidasan University, Trichirarappalli, Tamil Nadu, India

*Corresponding Author E-mail: drttns@bdu.ac.in

ABSTRACT

Water is essential for life. For its portability it must be free from physical, chemical and biological impurities. Presence of salt in it made it hard and hard water is the major cause of many health problems particularly kidney stone. If it is hard it cannot be used for drinking, cooking, washing and other purposes like irrigation, industrial applications etc,. The hardness of water due to salt is very difficult to remove. Therefore it is necessary to find simple and effective methods to remove hardness in water. The hard water samples were collected from Melachinthamani bore well, Tiruchirappalli. Its physicochemical characters were analyzed by standard methods and it was treated with Phyllanthus embilca. The physicochemical and biological parameters such as colour, odour, taste, pH, acidity, alkalinity, total hardness, calcium, magnesium, chloride, nitrate, phosphate, sulphate and bacteria were examined. The results of this study revealed that the water sample is hard and with microbes. Phyllanthus emblica wood reduced total hardness and microbial load.

Key word: *Phyllanthus embilca, total hardness, hard water treatment, physicochemical nature.*

INTRODUCTION

Water is an elixir of life. It is one of the important and abundant compounds of the ecosystem. It is an odorless, tasteless, transparent and colorless liquid. All living organisms on the earth need water for their survival and growth. Most of the living tissue of a human being is made up of water[1]. In India, the main source of drinking water is rivers, lakes, storage dams, wells, bore wells, etc.,.[2] As of now only earth is the planet having about 70% of water. Many substances are dissolved in water and it is commonly referred as the universal solvent.[1]

According to the physicochemical nature of water, it can be broadly classified into soft water and hard water. The pure water that can be used for drinking purpose (potable) is called soft water. When high amount of magnesium and calcium are dissolved in water, it is called as hard water. Hard water contains high amounts of dissolved minerals and heavy metals such as lead, chromium, iron and mercury etc. Dissolved solids also come from inorganic materials like rocks that may contain calcium bicarbonate, nitrogen, iron, phosphorus, sulfur, magnesium, calcium and other minerals. Water hardness is caused by the presence of calcium, magnesium, carbonate, bicarbonate, chloride and sulfate in water[1]. An indication of hard water interferes with almost every cleaning task, from laundering and dishwashing to bathing and personal grooming. Bathing with soap in hard water leaves a film of sticky soap curd on the skin. It interferes with the return of skin to normal, slightly acid condition and may lead to irritation. Soap curd on hair may make it dull, lifeless and difficult to manage. Hard water may cause, film on glass shower doors, shower walls, bathtubs, sinks, faucets, etc. Skin washed with hard water can become itchy and dry.

In addition depends on the environment in which it is there it may get polluted with microbes, effluent etc. Consumption of contaminated water (with infectious microbes) may lead to ill health.

The different methods used currently for treating hard water includes reverse osmosis, ion exchange resin or a combination of technologies. Physical treatment like UV irradiation and chlorine treatment will remove the biological contaminants in it. Bleaching of water is not preferred as it kills the microbes in the water but it does not purify. Water may contain toxic chemicals and other dissolved minerals. Chlorine treated water may affect liver and lead to hepatic damage. So using chemicals is not preferred. As an alternative, biological methods are preferred over chemical methods[2].

Herbals like *Strychnos potatorum*, *Moringa oleifera* and *Zee mays* has been reported for its ability to reduce alum in drinking water through its coagulation properties. Traditional Siddha Medicine also mentions various methods to purify drinking water. Naturally occurring coagulants are usually presumed safe for `human health. *Moringa oleifera* is a tropical plant known to contain coagulating, flocculating compounds in the seeds and *Phyllanthus emblica* wood has primary coagulant. The wood have shown a high coagulation activity for high-turbidity water and however the coagulation activity has been found to be low for low-turbidity water[3]. Earlier researchers have reported that in India traditionally water is purified by *Phyllanthus emblica* (wood) and it is safe and healthy for drinking. Traditionally water is purified either by adding herbs like *Osimum sanctum* leaf or seed coats of *Eleetaria cardamom* and by storing water in copper vessel and or in mud pot or earthern pot. *Vetiveria zizanoides* plant was reported for its ability to improve the water quality in terms of clearness and pleasant smell[3]. Hence, the aim of this study is to assess the physicochemical characters and its microbial load of drinking water used by a group of residents of Trichy. An attempt was also made in this study to see the effect of *Phyllanthus emblica* on the removal of hardness and bacterial load.

MATERIALS AND METHODS

Five liter water sample was collected from Melachinthamani, Tiruchirappalli, Tamil Nadu. Melachinthamani, an area in Trichy where people use bore water and Cauvery water supplied by Trichy Corporation for drinking, cooking and other domestic applications. The water samples were collected from bore well of the selected site in polythene bottles and were kept in room temperature till use. The samples were collected in the month of February, 2014. The water samples were immediately brought to the laboratory to assess various physicochemical and biological parameters. Water temperature and pH were recorded at the time of sample collection, by using thermometer and pocket digital pH meter respectively. While other parameters such as hardness, chlorides, alkalinity and nitrate were estimated in the laboratory by standard methods as prescribed by APHA, (1998). Biological characteristics of the collected water sample were analyzed as per standard methods.

Preparation of plant material

Good quality dried *Phyllanthus emblica* (Nellikattai) wood were collected from local shop (Nattu Marunthu Kadai) Tiruchirappalli. Wood was cleaned and dried under shade. The coat from the wood was removed. Fine powder was prepared by using mortar and pestle and this powder was stored in an air tight container and this was used for further study.

Treatment with *Phyllanthus emblica*

Water samples for study purpose were collected from bore well water from sites of Melachinthamani, Tiruchirappalli. Treatment was given directly to the water by using *Phyllanthus emblica* powder at a concentration of 50g/L and the treatment is for a period of a week to 30 days. The physicochemical and biological parameters were checked before and after treatment at 7 days interval.

RESULTS

The results revealed that the colour and odour of the hard water before and after treatment with *Phyllanthus emblica* remains same (Table 1 & 2). Before treatment the taste was too salty to taste but after treatment with *Phyllanthus emblica* the taste became bearable and the changes was gradual (Table 1 & 2). The temperature of the water was same before and after treatment (Table 1& 2). Before treatment

the pH of the water was 5.71 but after treatment the pH was raised gradually and at the end of the 35th day the pH was almost neutral (6.99) (Table1 & 2).

The alkalinity was found to be 1550mg/L before treatment (Table 3) and after treatment with *Phyllanthus emblica*, it was reduced gradually and on 35th day it was found to be 270mg/L (Table 4). The acidity was found to be 150mg/L before treatment (Table 3), and after treatment it was increased and on 35th day it was found to be 386mg/L (Table 4). The total hardness was found to be 384mg/L before treatment (Table 3) and after treatment it was reduced and on 35th day it was 120mg/L (Table 4). The calcium content was found to be 140mg/L before treatment (Table 3), and after treatment with *Phyllanthus emblica*, it was reduced gradually and at the end of 35thday it was 20mg/L (Table 4). The magnesium content was 244mg/L before treatment (Table 3), *Phyllanthus emblica* treatment reduced the content of magnesium and on 35th day it was 100mg/L (Table 4). The chloride content was 75mg/L before treatment (Table 3), it was reduced gradually and on 35th day it was found to be 25mg/L (Table: 4). Before treatment DO content was found to be 6mg/L (Table 3), and after treatment it was reduced gradually and on 35th day it was found to be 1.2mg/L (Table 4). The BOD was found to be 166mg/L before treatment (Table 3) and after treatment with *Phyllanthus emblica* it was reduced gradually and on 35th day it was found to be 12mg/L (Table 4). Before treating the water, the COD content was found to be 672mg/L (Table 3), after treatment the COD content was reduced and at the end of 35th day the COD content was found to be 600mg/L (Table 4).

Before treating the water had innumerable number of bacterial colonies but after treatment with *Phyllanthus emblica*, the number of bacteria got reduced. At the end of 35th day the number of bacterial colonies was 120 (Table 5).

Table 1. Physical characteristics of hard water before treatment

S.No.	Parameter analysed	Physical character
1	Colour	Colour less
2	Odour	Odour less
3	Taste	Too salty to taste
4	Temperature	37^0 C
5	pH	5.71

Table 2. Physical characteristics of hard water after treatment with *Phyllanthus emblica*

S.No.	Parameter analysed	Duration and physical character					
		1st Day	8th Day	15th Day	21st Day	28th Day	35st Day
1	Colour	Colour less	Colour less	Colour less	Colour less	Colour less	Colour less
2	Odour	Odour less	Odour less	Odour less	Odour less	Odour less	Odour less
3	Taste	Too salty to taste	Too salty to taste	Salty to taste	Salty to taste	Slightly bearable taste	Bearable taste
4	Temperature	37^0 C	37^0 C	37^0 C	37^0 C	37^0 C	37^0 C
5	pH	5.48	6.65	6.45	6.89	6.45	6.99

Table 3. Chemical characteristics of hard water before treatment

S.No.	Parameter analysed	Chemical character in (mg/L)
1	Alkalinity	1550
2	Acidity	150
3	Total hardness	384
4	Calcium	140
5	Magnesium	244
6	Chloride	75
7	Dissolved oxygen	6
8	Biochemical oxygen demand	166
9	Chemical oxygen demand	672

Table 4. Chemical characteristics of hard water after treatment with *Phyllanthus emblica*

S.No.	Parameter analysed	Duration and physical character					
		1st Day	8th Day	15th Day	21st Day	28th Day	35st Day
1	Alkalinity	850	700	650	450	350	270
2	Acidity	171	196	246	291	341	386
3	Total hardness	230	200	180	160	150	120
4	Calcium	70	70	60	40	30	20
5	Magnesium	160	130	120	120	120	100
6	Chloride	75	68	50	50	37.4	25
7	Dissolved oxygen	6	4.8	4	3.2	2.4	1.2
8	Biochemical oxygen demand	166	66.6	50	33	16	12
9	Chemical oxygen demand	672	654	656	640	632	600

Table 5. Biological characteristics of hard water before and after treatment with *Phyllanthus emblica*

S.No.	Sample code	Before treatment	Duration and microbial load after treatment						
			0th Day	1st Day	8th Day	15th Day	21st Day	28th Day	35st Day
1	Trichy Hard water	Innumerable	Innumerable	200	200	190	180	150	120

DISCUSSSION

Household water treatment interventions may play an important role in protecting public health. Thus purification process is emphasized at the house level. Disagreeable taste and objectable odour render the drinking water unacceptable and the chemical properties of untreated water is due to undesirable limit. The alkalinity, acidity, total hardness, chloride, magnesium, DO, BOD, COD was high initially in the water sample used in this study. *Phyllanthus emblica* wood altered the physicochemical properties of water. Reduction of magnesium level in water may be due to the chelation property of *Phyllanthus emblica* wood. Magnesium salts are more soluble than calcium, hence they increase hardness of water and gives unpleasant taste and it may have laxative effects consumed in higher concentration. It causes renal failure, respiratory depression and cardiac arrest. Thus reduction in magnesium level in this study is another beneficial effect of *Phyllanthus emblica* wood. Although there is a reduction in microbial load, complete eradication was not achieved by *Phyllanthus emblica* wood. Eradication of organisms could be achieved by boiling the water before and / or after *Phyllanthus emblica* wood treatment[4].

Phyllanthus emblica wood, a natural product of biological origin was selected in this study to reduce the hardness and to remove biological impurities, as it is commonly practiced for drinking water treatment in rural areas in India and in many African countries[5].

The nature of hard water can be altered by vetiver root (55.93%), Indian gooseberry bark (42.14%), lemon peel (42%), and peanut husk (41.14%). The reduction of total hardness was reported in earlier studies[2] by treating the water with Vetiver root and other plants. Peanut husk showed the lowest % decrease of total hardness. Thus Vetiver root seems to be more effective in reducing total hardness of hard water than any other plant materials. And also peanut husk is capable of retaining its adsorptive property than other plant materials. The Indian gooseberry though reduces total hardness in both loading (1002ppm) and reloading (810 ppm) of hard water samples, also proved that it can be used only for few recycles when compared to other plant parts as it has low %decrease in hard water samples reloading (19.16%) than sample first loading (28.43%). All the plant materials showed decrease in total hardness reduction between first and second sample loading[2].

The physicochemical characters of this study sample was undesirable before treatment. But after treatment with *Phyllanthus emblica* wood the pH was brought near neutral, taste was bearable. Chemical properties like alkalinity was reduced and acidity was increased. Total hardness was reduced due to

secondary metabolites; calcium, magnesium and chloride content were also reduced. The DO, BOD, COD level were reduced after treatment with *Phyllanthus emblica* wood. Microbial load also was reduced after treatment with *Phyllanthus emlica* which may be due to biological agents present in the plant and its antimicrobial activity.

CONCLUSION

In the present study an attempt was made to assess the physicochemical nature of Melachinthamani bore well water before and after treatment with *Phyllanthus emblica* . From the results of this study, it is understood that *Phyllanthus emblica* wood reduced total hardness, calcium, magnesium and chloride. Microbial load also was reduced.

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