

Reduction of Total Hardness of Water Using *Phyllanthus emblica*

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Abstract: The temporary hardness of water can be removed by boiling but the permanent hardness of water cannot be removed by boiling only. The permanent hardness is due to the presence of chlorides and sulphates of Magnesium and Calcium and it cannot be removed by just boiling. According to the United States Geological Survey, the water sample having hardness above 180 mg/l is classified as very hard water and it has its own implications. *Phyllanthus emblica*, or Indian gooseberry can help to reduce the hardness of the water sample. The present study aims to reduce the hardness of the water sample by using *Phyllanthus emblica*, as absorbent at different concentrations and different contact times.

Keywords: Total Hardness, *Phyllanthus emblica*, Contact time.

1. Introduction:

Hard water is water that has substantially high mineral content, which is formed when water percolates through deposits of limestone and chalk which are largely made up of calcium and magnesium carbonates.

Hardness is defined as the concentrations of calcium and magnesium ions expressed in terms of calcium carbonate. These minerals in water cause some everyday problems and hard water also has health effects. Hard water may also shorten the life of plumbing and water heaters.

Hard drinking water may have moderate health benefits, but can pose serious problems in industrial settings, where water hardness is monitored to avoid costly breakdowns in boilers, cooling towers, and other equipment that handles water and thereafter when hard water is disposed off in the open areas, it affects plants growth and soil fertility. In domestic settings, hard water is often indicated by a lack of suds formation when soap is agitated in water, and

by the formation of lime-scale in kettles and water heaters.[1]

There are two types of hardness :

Temporary Hardness

It is a type of water hardness caused by the presence of dissolved bicarbonate minerals (calcium bicarbonate and magnesium bicarbonate). When dissolved, these minerals yield calcium and magnesium cations (Ca^{2+} , Mg^{2+}) and carbonate and bicarbonate anions (CO_3^{2-} , HCO_3^-). The presence of the metal cations makes the water hard. However, unlike the permanent hardness caused by sulphate and chloride compounds, this "temporary" hardness can be reduced either by boiling the water.

Permanent Hardness

Permanent hardness is hardness (mineral content) that cannot be removed by boiling. When this is the case, it is usually caused by the presence of calcium sulphate and/or magnesium sulphates in the water, which do not precipitate out as the temperature increases.

In the present investigation, Total Hardness (Permanent Hardness) of water is reduced by treating it with *Phyllanthus emblica*, which is also known as emblic, emblic myrobalan, myrobalan, Indian gooseberry, Malacca tree or amla from Sanskrit amalika is a deciduous tree of the family Phyllanthaceae.

2. Study Area

Study area comprises of Gwalior district of Madhya Pradesh. Gwalior is situated at Latitude : 26.2182871 and Longitude : 78.1828308. Gwalior is a historic and major city in the Indian state of Madhya Pradesh. Located 319 kilometres (198 miles) south of Delhi the capital city of India, Gwalior occupies a strategic location in the Gird region of India. In this research, the groundwater

sample is taken from New Prem Nagar, Near Saibaba Mandir , Gwalior (M.P.)India .

The location of sample undertaken is 26.2184 Latitude and 78.1689 Longitude.

3. Material and Method

In this study we use *Phyllanthus emblica* in the form of fruit(dried fruit).These fruits are reputed to contain high amounts of ascorbic acid (vitamin C), up to 445 mg per 100 g,[2] the specific contents are disputed, and the overall antioxidant strength of amla may derive instead from its high density of ellagitannins[3] such as emblicanin A (37%), emblicanin B (33%), punigluconin (12%) and pedunculagin (14%).[4] It also contains punicafolin and phyllanemblinin A, phyllanemblin other polyphenols: flavonoids, kaempferol, ellagic acid and gallic acid.[3][5]

For the determination of Hardness, specified method was used[6] .

4.Experimental Section

Phyllanthus emblica fruit was collected and dried naturally for 15 days. Thereafter, it was crushed and taken in powdered form with the help of Grinder .The powder was then filtered by perforated plate of mesh size 0.20 mm .It was stored in plastic bag.

The experiment of determination of total hardness was conducted [8] and the hardness of the water sample was found out to be 620mg/l.

This water sample was treated with *Phyllanthus emblica* to reduce total hardness by varying its concentration and contact time.

5. Results

5.1 25 mg *Phyllanthus emblica* dissolved in 50ml Water Sample

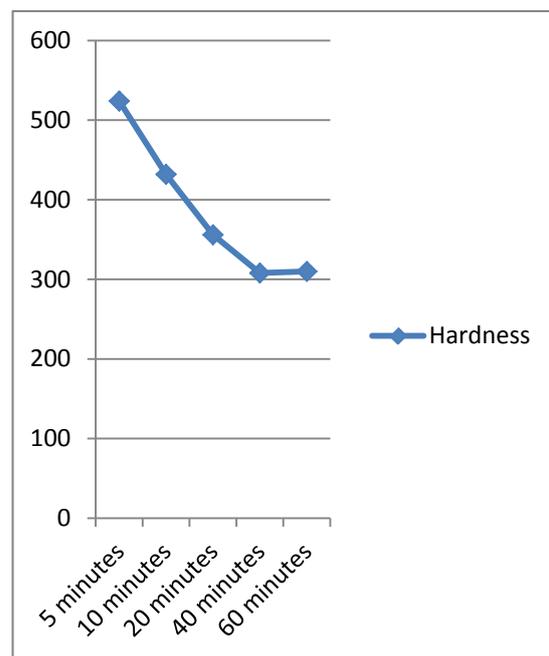
25mg *Phyllanthus emblica* was dissolved in 50 ml water sample for time intervals of 5,10,20, 40and 60 minutes by using rotary shaker and then filtered by using Whatman filter paper no.40 .

And the end point is when color changes from dark red -pink to dark (blackish)blue. Due to the presence of *Phyllanthus emblica*, the color change has to be minutely observed.

Table 1 : Total Hardness of the water sample

Serial Number	Contact Time (Minutes)	Initial Hardness(mg/l)	Total Hardness (mg/l)	% Reduction
1.	5	620	524	15.4838
2.	10	620	432	30.3225
3.	20	620	356	42.5806
4.	40	620	308	50.3225
5.	60	620	310	50.0000

Graph 1: Total Hardness Vs Contact Time (25mg in 50ml Composition)



5.2 50 mg *Phyllanthus emblica* dissolved in 50ml Water Sample

50mg *Phyllanthus emblica* was dissolved in 50 ml water sample for time intervals of 5,10,20, 40and 60 minutes by using rotary shaker and then filtered by using Whatmann filter paper no.40 . The experiment of determination of total hardness was conducted [8] And the end point is when color changes from dark red -pink to dark (blackish)blue. Due to the presence of *Phyllanthus emblica*, the color change has to be minutely observed.

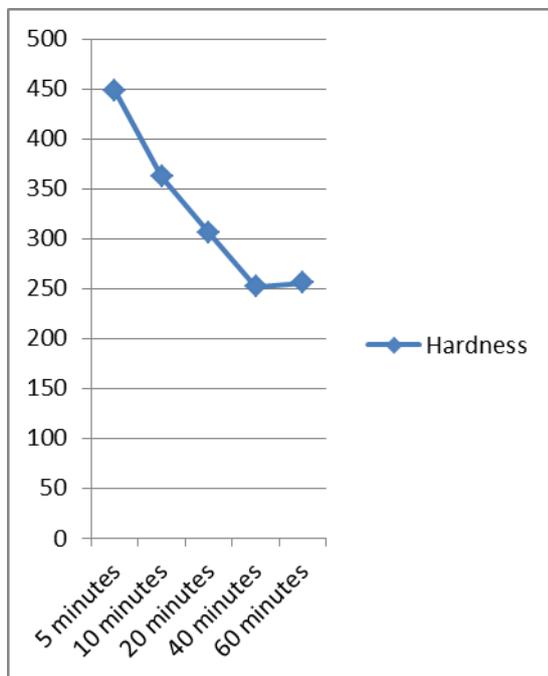
Table 2: Total Hardness of the water sample

Serial Number	Contact Time (Minutes)	Initial Hardness (mg/l)	Reduced Hardness(mg/l)	% Reduction
1.	5	620	448	27.7419
2.	10	620	362	41.6129
3.	20	620	306	50.6451
4.	40	620	252	59.3548
5.	60	620	256	58.7096

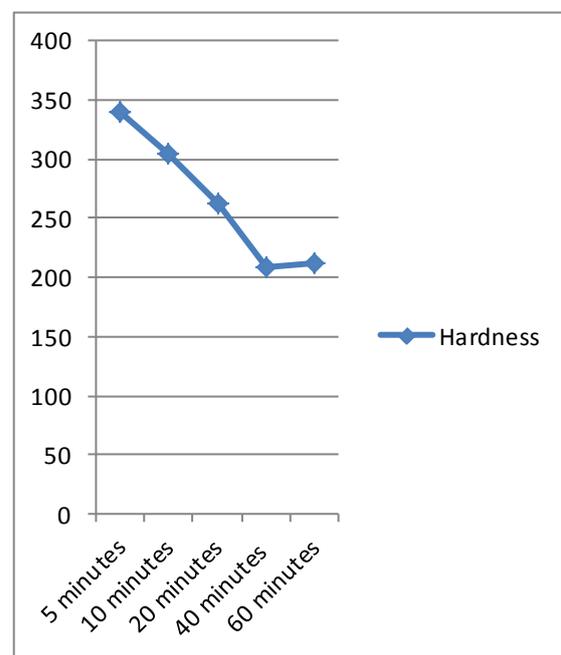
Table 2: Total Hardness of the water sample

Serial Number	Contact Time (Minutes)	Initial Hardness (mg/l)	Reduced Hardness(mg/l)	% Reduction
1.	5	620	340	45.4161
2.	10	620	304	50.9677
3.	20	620	262	57.7419
4.	40	620	208	66.4516
5.	60	620	212	65.8064

Graph 2: Total Hardness Vs Contact Time (50mg in 50ml Composition)



Graph 3: Total Hardness Vs Contact Time (100mg in 50ml Composition)



5.3 100 mg *Phyllanthus emblica* dissolved in 50ml Water Sample

100mg *Phyllanthus emblica* was dissolved in 50 ml water sample for time intervals of 5,10,20, 40and 60 minutes by using rotary shaker and then filtered by using Whatmann filter paper no.40 . The experiment of determination of total hardness was conducted [8] And the end point is when color changes from dark red -pink to dark (blackish)blue. Due to the presence of *Phyllanthus emblica*, the color change has to be minutely observed.

Discussion

It is found out that due to presence of *Phyllanthus emblica* ,the hardness of water sample is reduced .The best results were found when the 100 mg of *Phyllanthus emblica* was dissolved and treated with water sample and the contact time was 40 minutes .It reduced the hardness to 66.4516% .Another important observation was that if the contact time is increased beyond 40 minutes then there is no substantial reduction in total hardness of the water sample .

The total hardness reduces with the increase in concentration of *Phyllanthus emblica* and also with increase in contact time .But when experiments were tried by further increasing the concentration of *Phyllanthus emblica* , due to its color ,we could not detect the end points.

Although, the present investigation is essentially a primary work and needs to be further investigated to arrive at specified conclusion with respect to other implications.

Acknowledgment

We are highly thankful to the staff of Analitika Ecolab Pvt.Ltd., Gwalior, India for their cooperation and grateful guidance.

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