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Use of *Moringa Oleifera* (Drumstick) seed as Natural Coagulant for Well & Bore well Water Treatment

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Abstract
Groundwater is one of the major sources of drinking water. But direct use of water for drinking is not suitable. Because drinking water parameters are not in standard range, developing countries facing problems in potable water because of inadequacy of economic support and technology. They are in need to adopted water treatment. This study deals with low cost water treatment i.e. water purification by using natural coagulant like Moringa Oleifera. After treatment of water sample with Moringa Oleifera seeds powder where analysed for different parameters like pH, turbidity, TDS, TS, Hardness, Chlorides, Alkalinity, Acidity for before and after treatment. All parameters where comes in to the range of drinking water standards after treatment.

Keywords: Drinking water, natural coagulant, Moringa Oleifera, parameters.

Introduction
Water supply is a basic need required for living creatures and human being specifically. In this world the amount of resources available to living creatures are limited. Safe drinking water is essential to the health and welfare of a community, and water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water.

When surface water is used for drinking water production, turbidity removal is an essential part of the treatment process. It is generally achieved using coagulationwith metal salts followed by aggregation of particlesthrough flocculation and separation through sedimentation and filtration. Aluminium (e.g. $Al_2(SO_4)3\ .18H_2O$)and iron salts are mostly used as coagulant reagents.

One of these alternatives is Moringa Oleifera seeds. It is a native tree of the sub-Himalayan parts of Northwest India, Pakistan and Afghanistan. Moringa Oleifera is a perfect example of a socalled "multipurpose tree". Earlier studies have found Moringa Oleifera to be non-toxic and recommended it for use as a coagulant in developing countries. The use of Moringa has an added advantage over the chemical treatment of water because it is biological and has been reported as edible. According to Reference [9], hardness removal efficiency of Moringa Oleifera was found to increase with increasing dosage.

Material and Methodology
Study Area: Ambavade Village, Tal. Panhala, Dist. Kolhapur.
Source: Well andBore well
Moringa Oleifera Seed Powder as natural coagulant
Tree driedMoringa Oleifera seeds are harvested when they were fully matured, wings and coat from seeds are removed fine powder was prepared and sieved. This powder was used as coagulant. 10 gm of seed powder was mixed in 1 litre of distilled water to prepare stock solution of coagulant. Then mixture was kept in rapid mixture for 15 minutes with 120-150 rpm. Then mixture was filtered with ordinary filter paper. Filtered mixture was used for coagulation process.

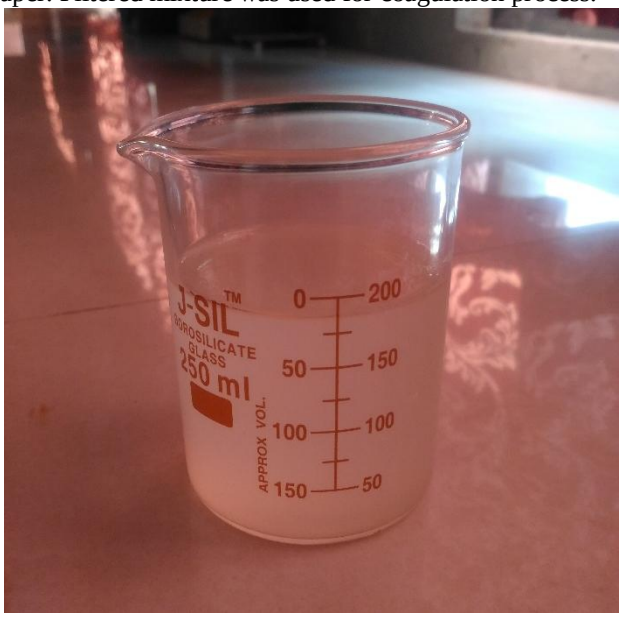


Photo 1: Photograph of Stock Solution for Jar test

Jar test was conductedto determine optimum dosage of natural coagulant. Coagulant was mixed with raw water and stirring it for 30-45 minutes at 120-150 rpm the settling time was 2 hours. After sedimentation optimum dose of coagulant were selected then raw water were treated using optimum dose in proportion of 1 litre raw water treatment. The supernatant of treated water was used for tests for various parameters. The water quality parameters were checked for physico-chemical parameter as per standard methods as given in table no. 1

Photo 2 & 3: Photograph of Sample After Jar test

Table 1: Methods used for physico-chemical study of raw water and treated water

Sr.No.	Parameter	Method
Physical Parameter		
1	pH	pH meter
2	Turbidity	Nephelometer
3	TS	Evaporation
4	TDS	Evaporation
5	Colour	-
Chemical Parameter		
6	DO	Titration Method
7	BOD	Titration Method
8	Alkalinity	Titration Method
9	Chloride	Titration Method
10	Hardness	Titration Method

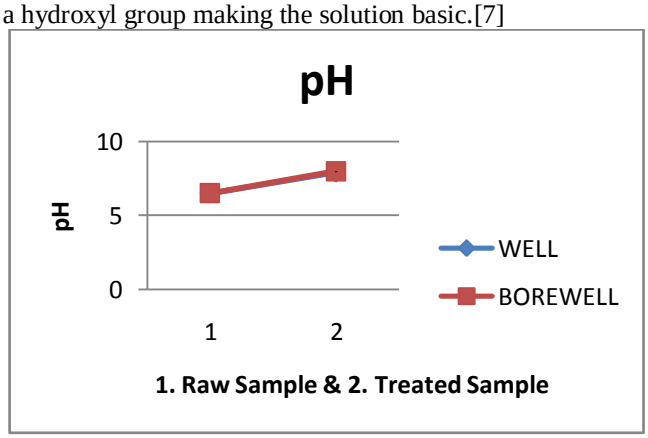
Results and discussions

Table 2: Results Obtained with methods used for physico-chemical study of raw water and treated water

Sr. No.	Parameters	Raw Sample		Treated Sample	
		Well	Bore well	Well	Bore Well
1	pH	6.5 ±0.5	6.5 ±0.5	7.91 ±0.05	7.98 ±0.05
2	Turbidity (NTU)	7.5 ±0.5	7.5 ±0.5	5.8 ±1	4.9 ±1
3	Colour	Faint Brown	Faint Brown	Colourless	Colourless
4	TS (mg/l)	774 ±10	802 ±10	210 ±0.7	206 ±0.7
5	TDS (mg/l)	652 ±10	712 ±10	164 ±0.7	187 ±0.7
6	DO (mg/l)	2.5 ±0.25	1.7 ±0.25	1.7 ±0.6	2.8 ±0.6
7	BOD (mg/l)	2.1 ±0.86	1.8 ±0.86	1 ±0.28	1.4 ±0.28
8	Chlorides (mg/l)	120.7 ±0.3	127.8 ±0.3	115 ±0.25	110.05 ±0.25
9	Acidity (mg/l)	10 ±0.58	6 ±0.58	5 ±0.3	4 ±0.3
10	Alkalinity (mg/l)	182 ±0.6	182 ±0.6	60 ±0.5	113 ±0.5
11	Hardness (mg/l)	264 ±0.5	310 ±0.5	247.2 ±0.2	233 ±0.2

pH

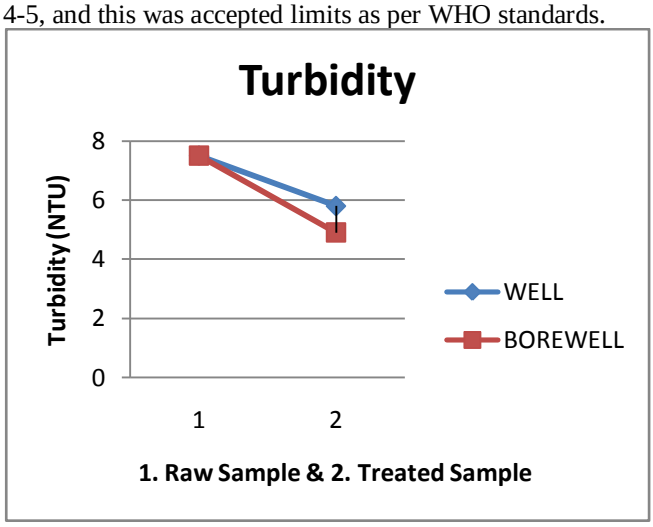
Ground water was treated with natural coagulant stock solution which was prepared with Moringa Oleifera seed powder. During the analysis it was observed that after coagulation process the pH of well and bore well was increased partially as compare to raw well and bore well sample. After treatment pH was in the range 7-8 and within the limit. According to WHO standards accepted limit is 6-8. The pH increase with increasing concentration of Moringa Oleifera seed powder as a coagulant it represents that water soluble cations are present in the seed in the form of proteins. It was reported that the action of Moringa Oleifera as a coagulant lies in the presence of water soluble cationic proteins in the seeds. This suggests that in water, the basic amino acids present in the protein of Moringa would accept a proton from water resulting in the release of a hydroxyl group making the solution basic.[7]



Graph 1: Results for pH.

Turbidity

Before treatment turbidity was observed in range of 7.5-8.5, which was not within the range of drinking water standards it was observed that after completion of coagulation process the turbidity of both the sample were reduced up to range of 4-5, and this was accepted limits as per WHO standards.



Graph 2: Results for Turbidity.

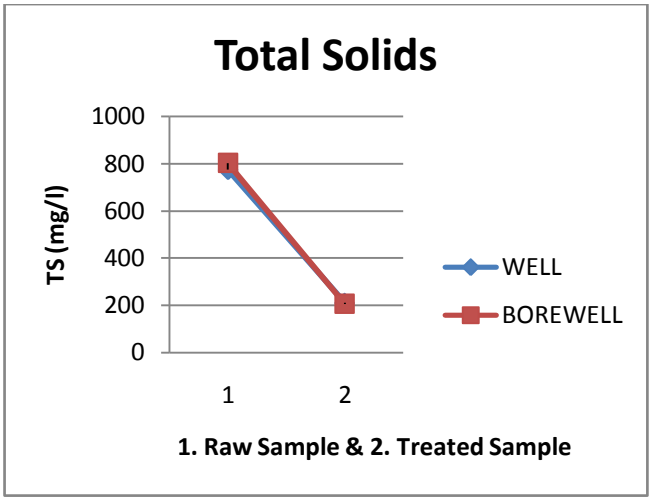
Colour

The initial colour of water was completely removed after the treatment. The Moringa Oleiferaseeds show absorbent properties

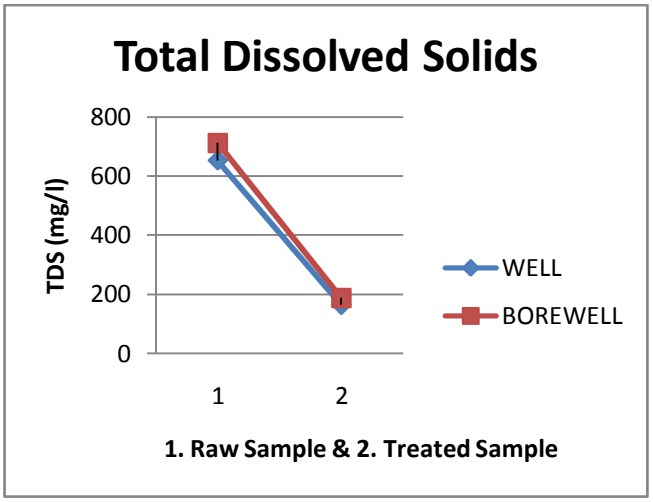
Photo 4: Photograph of Raw sample and Treated Sample of Water

TS & TDS

The initial TS was in range of 700-800 mg/l for raw water which was beyond the limits of WHO. In case of TDS, initial range was 650-750 mg/l above permissible limit. After the treatment Moringa Oleifera seed powder, the total solids and total dissolved solids were reduced from raw water. The range of total solids was found in between 150-250 mg/l and for total dissolved solids range was 150-200 mg/l. These were present within the limit according to WHO standards. Moringa Oleifera is known to be a natural cationic polyelectrolyte and flocculent with a chemical composition of basic polypeptides with molecular weightsranging from 6000 to 16,000 daltons, containing up to six aminoacids of mainly glutamic acid, methionine and arginine[7].



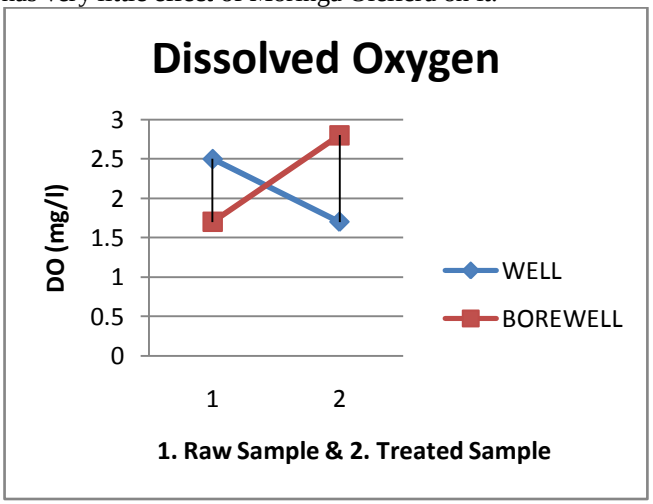
Graph 3: Results for Total Solids.



Graph 4: Results for Total Dissolved Solids.

DO

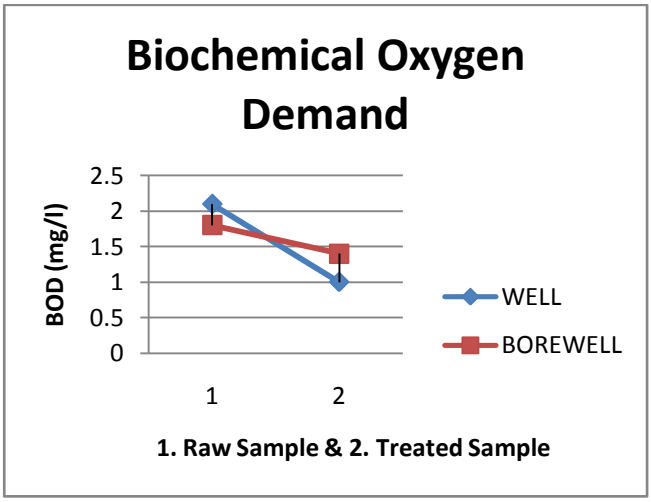
The initial dissolved oxygen level of raw water sample is in the range of 2-3 mg/l. after the treatment of raw water with Moringa Oleifera the dissolved oxygen measured was in the range of 1.5-3 mg/l. as per WHO standards there has been no limiting values are given for dissolved oxygen in the drinking water, hence here we can say that dissolved oxygen has very little effect of Moringa Oleifera on it.



Graph 5: Results for DO.

BOD

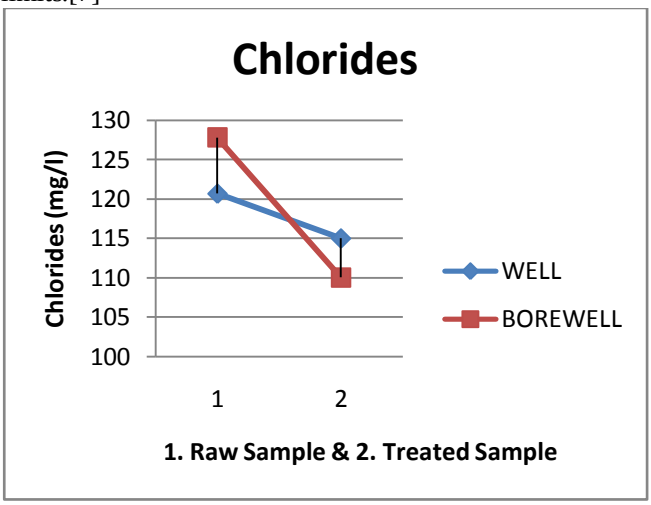
Biochemical Oxygen Demand is gives the presence of organic matter in the water/wastewater. Hence BOD has been measured for raw sample and treated sample. The initial BOD of raw water is determined with a range of 1.5-2.5 mg/l. Then the same sample is treated with Moringa Oleifera, after treatment BOD is in the range of 1-1.5 mg/l. As per WHO standards the BOD for drinking water should be nil. But after comparison we can say that there is reduction has been observed in BOD.



Graph 6: Results for BOD.

Chlorides

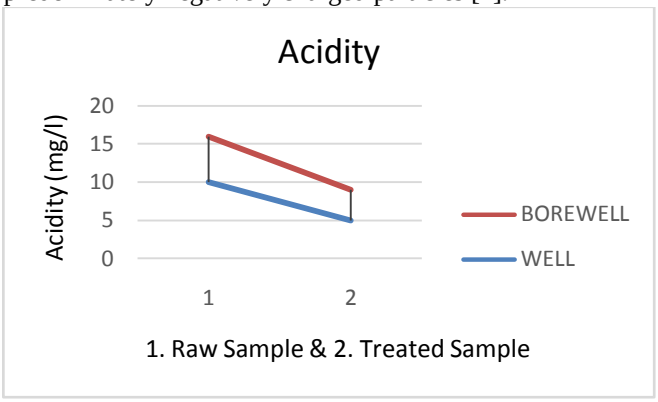
The Chlorides were present in the range of 120-130 mg/l in the raw water samples. It was observed that Moringa seed treatmentwith chloride ions reduces the chloride level, because cations from the seed attract negatively charged chloride ions present inraw water and neutralize the chlorides and therefore Chlorideions range between 115-120 mg/l in ground water samples which iswithin standard limits.[7]



Graph 7: Results for Chlorides.

Acidity

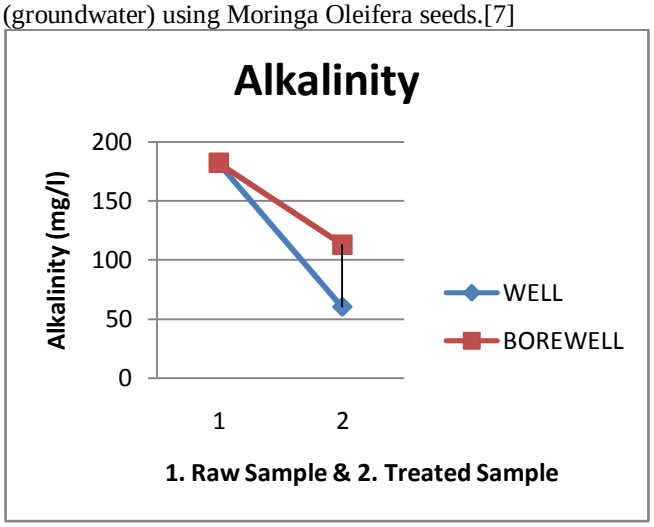
The acidity observed was in the range 10-15 mg/l for raw water. After treatment it was observed that acidity decreased and found in the range of 3-5 mg/l. which is within the limits accordingly WHO standards.Because the seeds of Moringa Oleifera contain lower molecular weight water-soluble proteinswhich carry a positive charge. When the seeds we crashed andadded to water, the protein produces positive charge acting likemagnets and attracting predominately negatively charged particles [7].



Graph 8: Results for Acidity.

Alkalinity

Alkalinity during the present research work was observed to be 180 mg/l for raw water. At dose of Moringa Oleifera seed powder, it was observed that the alkalinity reduced after the treatment. The alkalinity was present in the range of 50-120 mg/l which was within limits of WHO standards. The slight decrease in alkalinity and pH of all water samples may be due to precipitation of insoluble products of the reaction between the Moringa Oleifera and the hardness-causing ions similar to precipitation softening using lime/soda ash. The Moringa Oleifera seed extract appears to have natural buffering capacity. The precipitates (solids / flocks) were light and did not settle easily. The chemical constituent of the precipitate is however not known. It was also confirmed that alkalinity reduction in the coagulation of water sources (groundwater) using Moringa Oleifera seeds.[7]

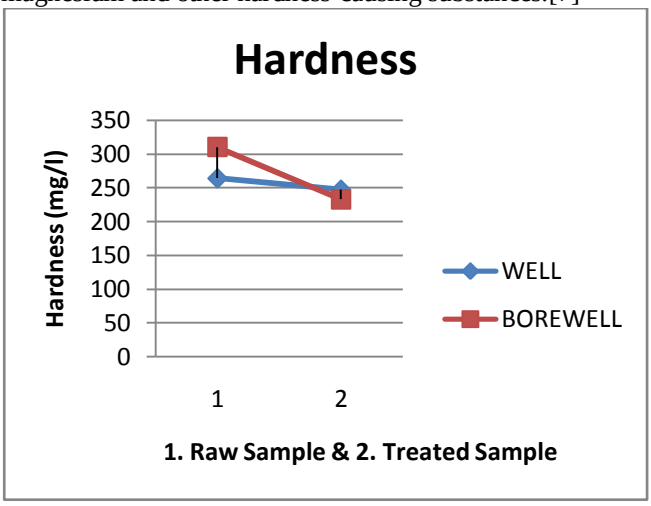


Graph 9: Results for Alkalinity.

Hardness

Hardness was 250-320 mg/l for raw water sample. It was observed that hardness of water is decreased with dose of Moringa seed powder. Hardness range was 200-250 mg/l and within the limitof WHO standards. As a polyelectrolyte, it may therefore be postulated that Moringa Oleifera removes hardness in water through adsorption and inter-particle bridging. According to reference [9] as a polyelectrolyte it may therefore be postulated that Moringa

Oleifera removes hardness in water through adsorption and inter-particle bridging. Secondly, with the observation that light, slow-settling solids/flocks were formed and precipitation reaction lead to the conversion of soluble hardness-causing ions to insoluble compounds would also be a good prediction of the reaction mechanism. The higher value for the surface water and groundwater samples is due to the fact that they contain hardness due to calcium, magnesium and other hardness-causing substances.[7]



Graph 10: Results for Hardness.

Conclusion

Moringa Oleifera seeds acts as a natural coagulant, flocculent, absorbent for the treatment of ground water. It reduces the total hardness, Turbidity, acidity, alkalinity, chloride, BOD, DO. It also acts as a naturally occurring antimicrobial active agent against the microorganisms which are present in the drinking water and decrease the number of bacteria [7]. Moringa Oleifera seed is not giving toxic effect. It is eco-friendly and cheaper method of water treatment. Moringa seeds can be used in the rural areas where no facilities are available for the drinking water treatment. After the treatment the sludge settled at the bottom of tank, can be used as bio-fertilizers is an added advantage of this method in rural areas.[7]

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