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Water Clarification using Moringa oleifera

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Water born diseases are one of the main problems in developing countries, about 1,6 million people are compelled to use contaminated water. However in many communities of these countries water clarification methods like flocculation, coagulation and sedimentation are often inappropriate because of the high cost and low availabity of chemical coagulants. The use of natural materials

of fairly turbid water is not a new idea. Among all the plant materials that have been tested over the years, the seeds from Moringa oleifeira have been shown to be one of the most effective as a primary coagulant for water treatment and can be compared to those as of alum (conventional chemical coagulant) .

General information about the tree

Moringa oleifera was originally an ornamental tree in the Sudan, planted during British rule. That was where Dr. Samia Al azharia Jahns (a german scientist) laboratory tests confirmed the presence of a very efficient coagulant in seeds of Moringa oleifera. Moringaceae is a single-genus family with 14 known species thus far, which are indigenous to Africa (9) , Madagascar (2) , Arabia (1), and India (2). Half of them are relativeiy common and already sporadically cultivated, yet only Moringa oleifeira (horseradish or drummstick tree) because of its many uses, is planted in the whole tropical belt.

Moringa Tree

Botany

The Moringa oleifera Lam. is a small, fast-growing, drought deciduous tree that ranges in height from 5-12 m with an open, umbrella shaped crown, straight trunk (10-30cm thick) with corky, whitish bark. The evergreen foliage (depending on climate) has leaflets 1-2 cm in diameter; the flowers are white or craem coloured. The fruits (pods) are initially light green, slim and tender, eventually becpming dark green, firm and upto 120 cm long,

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depending on the variety. Fully mature, dried seeds are round or triangular shaped, the kernel being surrounded by a lightly wooded shell with three papery wings. It tends to be deeply rooted, has a wide open typically-umbrella shaped crown and usually a single stem.

Cultivation

Moringa oleifera can be easily established by cutting or by seed. Seeds can be sown either directly or in containers and no seed treatment is required. The Plants raised from 1m cutting beat pods from the second year and growth on wards with maximun production at 4 to 5 years. In a favorable environment an individual tree can yield 50 to 70 kg of pods in one year.

Originally considered a tree of hot, semi-

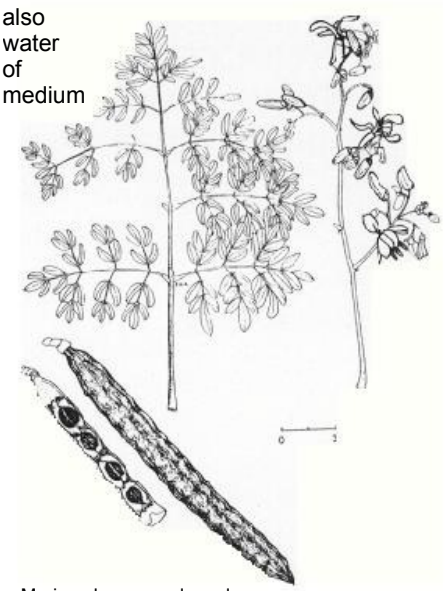
used as a natural coagulant (primary coagulant) in household water treatment as well as in the community water treatment systems. Natural coagulant properties were found in 6 different Moringa species by laboratory studies. The seed kernels of Moringa oleifera contain significant quantities of low molecular-weight, (water-soluble proteins) which carry a positive charge. When the crusheed seeds are added to raw water, the proteins produce positive charges acting like magnets and attracking the predominantly negatively charged particles (such as clay, silk, bacterias, and other toxic particles in water). The flocculation process occurs when the proteins bind the negatives charges forming flocs through the aggregation of particles which are present in water. These flocs are easly to remove by settling or filtration. The material can clarify not only highly turbid

arid regions (annual rainfall 250-1500 mm) it has also been found to be well adapted to hot, humid, wet conditions with annual rainfall in excess of 3000 mm. However It does best where temperature ranges from 26 to 40C and annual total rainfall at least 500 mm. It grows well from sea level to 1000m in elevation. Its big adaptability is also shown in the variety of soil conditions where it grows continuosly under water stress.

Coagulation with Moringa seeds

Generally, coagulants are used for (physical and chemical) purification of turbid raw waters. At very high turbidity the water can no longer be adequately treated by using filters. Coagulants have to be applied to transform water constituents into forms that can be seperated out physically. In large scale treatment plants Aluminium Sulphate is used as a conventional chemical coagulant.

As an alternative to conventional coagulants, Moringa oleifera seeds can be used not only in muddy water but also water of medium and low turbidity.



Moringa leaves and seeds

The level of turbidity influences the required time for the floculation. As with all

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coagulants, the effectiveness of the seeds may vary from one raw water to another. The practical application of dosing solutions is exactly the same as for all other coagulants. Studies have been carried out to determine the potential risks associated with the use of Moringa seeds in water treatment. To date, no evidence has found that the seeds cause secondary effects in humans, especially at the low doses required for water treatment.

Preparation of the coagulant solution and the method of treatment

Seed solutions may be prepared from either seed kernels or the solid residue (presscake) obtained following extraction of seed oil.

Presscake

Presscake should be ground to a fine powder and sieved. Solution preparation is the same as for seed kernels.

Note

Solution containers should be cleaned between batches to remove insoluble seed material and fresh solution should be prepared every 8 hours. For practical reasons of solution preparation, the use of powdered seed kernels is only recommended for treatment systems up to 10m /hour.

Dosage of the coagulant

Raw	

Seed kernels

- matured seeds are removed from the pods, and shelled.
- Seed kernels are crushed and sieved (0.8 mm mesh or similar).
- The seed powder is mixed with a small amount of clean water to form a paste. The paste is then diluted to the required strength before using it (Dosing solutions can be prepared from 0.5 to 5% concentration, e.g. 0.5 to 5 g/l.).
- Insoluble material is filtered out using either a fine mesh screen or muslin cloth.
- The milky white suspension is added to the turbid water and stirred fast at least for half a minute.
- Then the water must be slowly and regularly stirred (15 to 20 rotation per minute) for about five minutes.
- After stirring the treated water should be covered and left to settle for at least one hour. If moved or shaken before then, clarification will take much longer or fail to reach completion.

water turbidity NTU	Dose range mg/l
<50	10 - 50
50-150	30 - 100
>150	50 - 200

The amount of seed required will vary depending on the raw water source and on the raw water quality. The advantage of seed use is that, there is a wide dose range over which effective treatment may be achieved and maintained. The table above gives a rough guide to determine the dose requirement. Dosages are given as equivalent weight of seed powder or presscake material required to make up the dosing solution.

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Advantages and Disadvantages of using Moringa coagulant

Advantages:

- Cheap and easy method for developing countries (especially at household level).
- The efficiency is independent of raw water pH.
- The processing doesnt modify the pH of the water.
- It doesnt alter the water taste (unless a very high dosis is added).
- The low volume of sludge precipitated is biodegradable and hence an environmentally sound technology.

Disadvantages:

- The treatment

The wood is light and cant be used for heavy constructions but it provides a fairly good fuel for cooking.

The leaves can be also used as fertilizer.

Powered seeds are used to heal bacterial skin infection (all parts of the plant are used in a variety of traditional medicines).

Conclusion

Application of plant flocculants such as Moringa oleifera is highly recommended for domestic water purification in developing countries, where people are used to drink contaminated turbid water. Moringa does not guarantee that the raw water ends up completely (100%) free of pathogenic germs. It is cleaned and drinkable

- The treatment makes the water clear and drinkable but the purified water might still carry some (very few) pathegonic germs or microorganisms.
- A secondary increase of the bacterial after the water coagulation could be possible.
- Coagulant is not available in pure form (should be prepared fresh).

Additional uses of M. oleifera

It is a multipurpose tree for semi-arid and drought-prone areas. Even though it is a non nitrogen fixing tree, its different parts can be usefull for other purposes.

- Pods, leaves and seeds can be eaten as vegetable and are highly nutritious.
- The extracted oil from the seeds are used for cooking, soap making, cosmetics, fuels and lamps.
- Wood pulp may be used for paper making.

Since it reduces the number of suspended particles drastically (flocculates) it also reduces the quantity of microorganisms in raw water automatically. Consequently, this method might reduce waterborn deseases in those countries considerably.
Moringa o. trees can be cultivated very cheaply at the household level or in small communal nuseries which is to be encouraged among the rural population .
The harvest of a mature single tree (3 kg) will treat about 30000 liters of water.
To guarantee coagulant supplies of high quality, along with speedy fruit production, big seed size, and rich yields, cultivation all over the tropical belt should be coordinated by global exchange of seed materials from the most suitable clones, special breeding efforts and subsequent local application of vegetative propagation and grafting.

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Folkard G., Shaw R. and Sutherland J. 1999: Technical brief No. 60., Vol 17, Waterlines.

Samia Al Azharia Jahn and Hamid Dirar.1979: Studies on natural water coagulants in the Sudan, with special reference to Moringa oleifera seeds. Vol. 5, No 2, WATER SA.

Useful Links

http://www.echonet.org/moringa

http://www.hort.purdue.edu/newcrop/duke_energy/moringa-oleifera.html

http://www.infolanka.com/org/diary/13.html

http://www.unv.org/projects/pdrca/pdrca22.htm

http://www.lboro.ac.uk/departments/cv/wedc/garnet/allcase6.html

http://www.mobot.org/MOBOT/research/gradstudents/olson/moringa/html

http://agrss.sherman.hawaii.edu/onfarm/veg/veg0000a.html.

http://www.le.ac.uk/engineering/staff/sutherland/moringa/general/general.htm

http://www.winrock.org/forestry/factpub/factsh/moringa.htm

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		www.echonet.org/moringa	
The Seed Savers Network	P.O.Box 975 Byron Bay, NSW 2481 Australia	Tel: + 2-6685 7560 Fax:+ 2-6685 6624 info@seedsavers.net michel@seedsavers.net	On request
Peter B Dow &Co. P	**O Box 696** Gisborne 3800 New Zealand	(NZ) 79 78844	On request
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