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RESEARCH ARTICLE

LABORATORY EVALUATION OF MORINGA OLEIFERA SEEDS IN THE MANAGEMENT OF WATER HARDNESS

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ABSTRACT

This study investigated the possible use of Moringa oleifera seed for the softening of hard water in a rural endemic community. Three water sources; Well water, Bore hole water, River water at different locations in Ijoun town were used for the study. Complexometric titration test procedures for coagulation studies were used for the experimental runs. Water hardness from the sources varied from 40 up to 152 mg/L as CaCO3. The Moringa oleifera seed dosage of 50mg/L, 100mg/l and 200mg/L was administered at 5 minutes, 15 minutes, 25 minutes, 12 hours and 24 hours respectively. Reduction in hardness was noticed at each dosage level and time of application. The suggested mechanism for softening was by conversion of soluble hardness-causing ions to insoluble products by precipitation reactions. Removal efficiency was found to increase with increasing dosage of Moringa oleifera for the river and Borehole water but the case is different for the well water that has a very high level of residual hardness. Higher dosages were required to achieve equivalent residual hardness for water samples with the same initial hardness but higher number of hardness causing species in the water. Hardness removal was found to be independent of pH of the raw water samples.

Key words: Moringa oleifera, Complexometric titration, water hardness, coagulation studies.

INTRODUCTION

Moringa oleifera is the most widely cultivated species of a monogeneric family, the *Moringaceae* that is native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. *Moringa oleifera* tree was utilized by the ancient Romans, Greeks and it is now widely cultivated and has become very abundant in many locations in the tropics (Bukar *et al*., 2010). It is a perennial softwood tree with timber of low quality and for centuries has been advocated for trado medicine and industrial uses. It is already an important crop in India, Ethiopia, the Philippines and the Sudan, and is being grown in West, East and South Africa, tropical Asia, Latin America, the Caribbean, Florida and the Pacific Islands and most recently in west Africa (Bukar *et al*., 2010). All parts of the *M. oleifera* are edible and have long been consumed by humans. According to Fuglie(1999) the many uses for the plant include: alley cropping, animal forage (leaves and treated seed-cake), biogas (from leaves), domestic cleaning agent (crushed leaves), blue dye (wood), fencing (living trees), fertilizer (seed-cake), foliar nutrient (juice expressed from the leaves), green manure (from leaves), gum (from tree trunks), honey- and sugar cane juice-clarifier(powdered seeds), honey (flower nectar), medicine (all plant parts), ornamental plantings, biopesticide (soil incorporation of leaves to prevent seedling damping off), pulp (wood), rope (bark), water purification (powdered seeds). *Moringa* seed oil (yield 30-40% by weight), also known as Ben oil, is a sweet non-sticking, non- drying oil that resists rancidity. It has been used in salads, for fine machine lubrication, in the manufacture of perfume and hair care products (Tsaknis *et al*., 1999). In the West, one of the best known uses for *Moringa* is the use of powdered seeds to flocculate contaminants and purify drinking water, but the seeds are also eaten green, roasted, powdered and steeped for tea (Gassenschmidt *et al*., 1995). The tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, Ca, Fe, Vitamin C and carotenoids suitable for utilization in many of the developing regions of the world where under nourishment is a major concern (Berger *et al*., 1984). Today, nature has given an assistance through *Moringa* seeds which is potentially used as natural coagulant for purification of our domestic water at reasonable cost with respect to capital and maintenance. Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce a lather. Hard water often produces a noticeable deposit of precipitate (insoluble metals, soaps or salts) in containers, including bathtub ring. It is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cations, although other cations (e.g. aluminium, barium, iron manganese, strontium and zinc) also contribute. Hardness is most commonly expressed as milligrams of calcium carbonate equivalent per litre. Water containing calcium carbonate at concentrations below 60 mg/L is generally considered as soft; 60-120 mg/L, moderately hard and hard 120-180 mg/L, more than 180 mg/L, very hard (McGowan, 2000).

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MATERIALS AND METHODS

Collection of water samples: The study was carried out between November 2011 to January 2012 and the water samples were collected from river, well and bore hole in Ijoun town Yewa south Local Government of Ogun state**.**

Collection of *Moringa oleifera* seeds : The *Moringa oleifera* seeds were plucked from a *Moringa* tree in Ibadan, Oyo state,

Nigeria. The *Moringa oleifera* seeds were sun dried for 3 weeks and later shed from its pods by hand, the seed husks was removed and the seeds were later sun dried for another 4 weeks before crushing to powder using a blender. The seed powder were sieved to get a fine powder.

Experimental procedures: The experiment was carried out in the chemistry laboratory of National institute of science and laboratory technology located at Samonda area in Ibadan, Oyo state. Dosage of *Moringa oleifera* were weighed from 50, 100 and 200mg respectively before application, the time for mixing was for 5 minutes (APHA, 1992). The residual hardness was tested before the dosage application of the *Moringa oleifera* seed powder to know the effect and level of reduction in the water samples hardness (Muyibi and Evison, 1994). After mixing the *Moringa oleifera* seed dosage with the water samples for 5 minutes for each of the titrations, the titration for testing the hardness of each of the water samples was carried out at 5 minutes, 15 minutes, 25 minutes, 12 hours, 24 hours respectively for all the three water samples. The *Moringa oleifera* seed powder was applied at 50, 100 and 200mg/L with each experiment having two replicates. A total of 96 titration was recorded during the course of this research work.

Mode of preparation of the reagents

- 0.02 EDTA; 3.723g of the EDTA was dissolved in about 600ml of distilled water, swirling periodically until the EDTA dissolved and later diluted with distilled water to 1litre.
- Buffer solution (NH_4Cl / NH_4OH); 67.5g of NH_4Cl was dissolved in 200ml of distilled water, 570ml of concentrated NH_3 was added to it and later diluted to 1litre with distilled water.
- Solochrome black indicator solution; 0.5g of solochrome black powder was dissolved in 60ml of ethanol and make to 100ml with distilled water.

Mode of titration

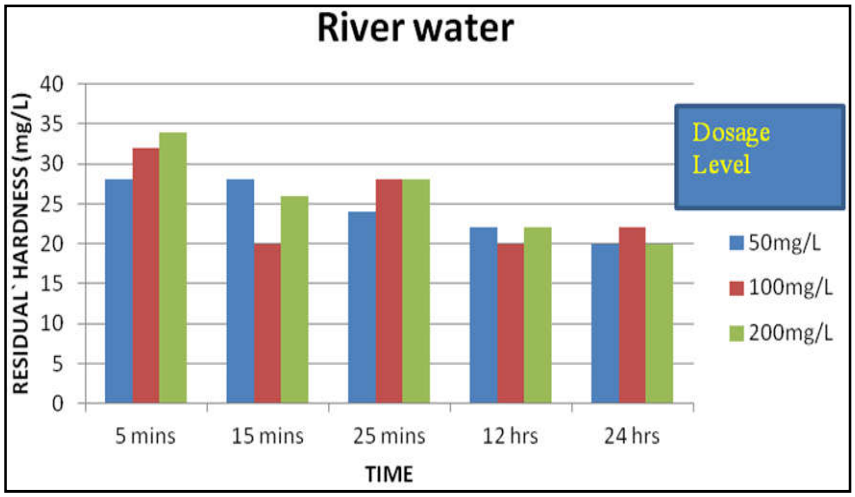
Water sample (50ml) was taken, 1ml of ammonium chloride (buffer) and 3 drops of solochrome black indicator were added and titrated against 0.02M EDTA till the last reddish tinge disappears. Few drops of titrant were also added to give appearance of pure blue colour which marks the end point.

Calculation:

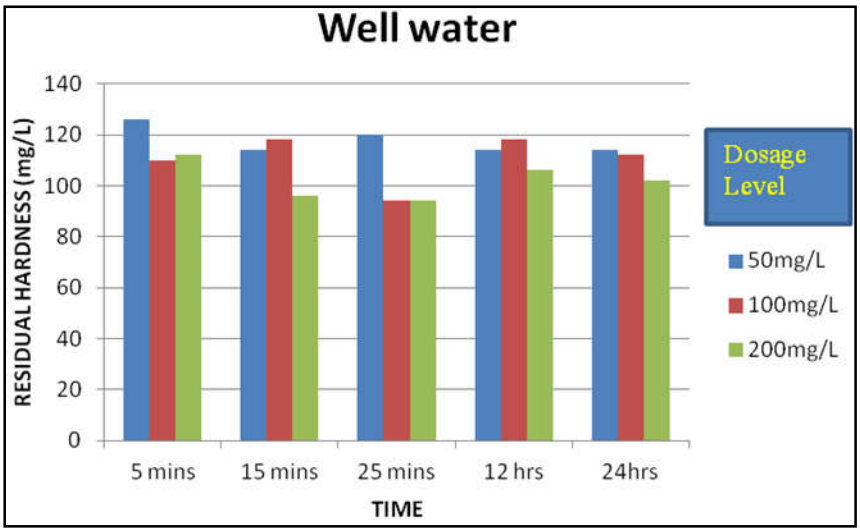
$$\text{Hardness (EDTA) mg/L } CaCO_3 = \frac{V \times M \times 100 \times 1000}{1000 \quad 0.05}$$

V = Titre value
M = Molarity of EDTA

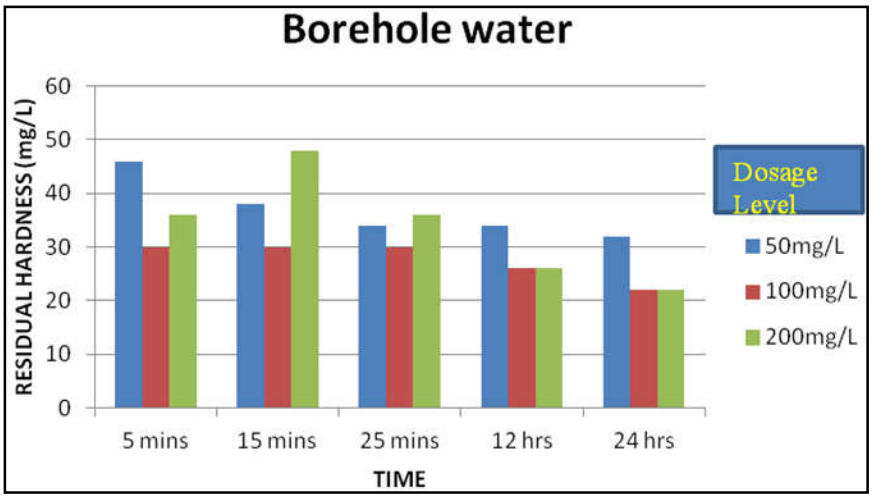
RESULTS



River water: softening with *Moringa oleifera* seed



Well water: softening with *Moringa oleifera* seed



Borehole water: softening with *Moringa oleifera* seed

DISCUSSION AND CONCLUSION

Results of this study have shown that *Moringa oleifera* seeds have considerable potential to be used in the treatment of hardwater, especially in tropical developing countries in rural communities for small scale facilities or individual households. *Moringa oleifera* is a natural product, and the chemical constituent and structure is not fully known (Muyibi and Evison, 1994). The interaction of the seed with chemical and other substances in raw water are also not fully understood and the products of interaction are not all known (Muyibi and Evison, 1994). Further studies would therefore have to be carried out to provide insight into the interaction between *Moringa oleifera* seed and the constituents of raw water, and the product of the interactions. *Moringa oleifera* is available in viable quantities in some of these tropical developing countries and may also be cultivated easily in others since *Moringa* is a tropical plant. One of the active agents (4α-4-rhamnosyloxy-benzyl-isothiocynate) in *Moringa oleifera* isolated by Eilert *et al.* (1981) and identified as an active antimicrobial agent is readily soluble in water at 1.3 µmol/l and is non-volatile. Information on the fate of this active agent in treated water is presently not available. Research needs to be carried out to find out the fate of this agent in treated water (Berger *et al.,* 1984). The results of the study by Berger *et al.* (1984). In that study it was concluded that *Moringa oleifera* seeds as water purifiers may not constitute a serious health hazard. However, further studies should be carried out to ensure the safety of the users of this common tropical plant, since when the leaves and other parts of the plant are used as food.

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