MORINGA OLEIFERA SEEDS AS NATURAL COAGULANT FOR WATER TREATMENT

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ABSTRACT

Developing countries and third world countries are facing potable water supply problems because of inadequate financial resources. The cost of water treatment is increasing and the quality of river water is not stable due to suspended and colloidal particle load caused by land development and high storm runoff during the rainy seasons especially in a country like Malaysia. During the rainy seasons the turbidity level increases and the need for water treatment chemicals increase as well, which leads to high cost of treatment which the water treatment companies cannot sustain. As a result, the drinking water that reaches the consumer is not properly treated. Therefore, it is of great importance to find a natural alternative for water coagulant to treat the turbidity. It has been found that ***Moringa oleifera*** is the best natural coagulant discovered yet, that can replace aluminium sulphate (Alum) which is used widely all around the world.

This study is focusing on ***Moringa oleifera*** seeds to find the active constituents which are responsible about the coagulation mechanism and improving the coagulation property. This will help in producing this alternative locally as ***Moringa oleifera*** is grown in Malaysia and other tropical countries and can be of great benefit for water treatment.

Keywords: Moringa oleifera, water treatment, natural coagulant, river water, alternatives, Turbidity, bioactive constituents.

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.

About 75% of the present world population lives in the developing countries of the world. About 1.2 billion people still lack safe drinking water and more than 6 million children die from diarrhea in developing countries every year.

However, it is untenable and unbelievable under all situations that waterborne diseases still kill on the average 25,000 people every day in developing countries while millions suffer the debilitating effects of these diseases (Kalbamatten & Burns, 1983).

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. One of the problems with treatment of surface water is the large seasonal variation in turbidity (McConnachie, G.L, et al 1999).

Current operational procedures at many treatment works in developing countries are based on arbitrary guidelines, particularly in relation to the dosage of chemicals. Besides that, there is also the problem of inadequate number of skilled workers and inadequate laboratory facilities to monitor process performances required to operate the plants (Muyibi, S. A. (1998).

Coagulation-flocculation followed by sedimentation, filtration and disinfection, often by chlorine, is used worldwide in the water treatment industry before distribution of treated water to consumers (Ndabigengesere, A. and Narasiah, K. S. 1998).

Many coagulants are widely used in conventional water treatment processes for potable water production. These coagulants can be classified into inorganic coagulant, synthetic organic polymer, and naturally occurring coagulant. Synthetic polyelectrolytes are used as primary coagulant as well as coagulant aid to improve the strength of particle aggregates, enhance coagulation and deposition (filtration) (Muyibi, S. A., et al 2001).

Naturally occurring coagulants are usually presumed safe for human health while there is a fear by using aluminum salts that may induce Alzheimer's disease (Martyn *et al.,* 1989). Some studies on natural coagulants have been carried out and various natural coagulants were produced or extracted from microorganisms, animals or plants (Ganjidoust, H., et al 1997; Kawamura, S. 1991; Lee, S.H., et al 1995).

Recently, however, there has been a resurgence of interest in natural coagulants for water treatment in developing countries (Ndabigengesere, A. and Narasiah, K. S. (1998).

Moringa oleifera is one of the most wide spread plant species that grows quickly at low altitudes in the whole tropical belt, including arid zones. It can grow on medium

soils having relatively low humidity (Ndabigengesere, A., et al 1995). *Moringa oleifera* seeds are an organic natural polymer.

Jahn (1984) has presented *Moringa oleifera* as a coagulant after her studies in the Sudan (Jahn, S.A.A. 1984; Jahn, S.A.A. 1988) when she noticed that Sudanese village women used it at home to clear the turbid Nile water. Later, many researchers have reported on the various uses of *Moringa oleifera* seeds as coagulant and coagulant aid in the last 20 years. *Moringa oleifera* coagulant has been found to have high coagulation activity only for high turbidity water. The activity is low for low turbid water (Muyibi, S. A. and Evison L.M., 1995). Therefore, it is important to improve the characteristics of this plant by identifying its bioactive constituents, which has high coagulation activity. This is one of the objectives of this study.

METHODOLOGY

1- Materials

Dry *Moringa oleifera* seeds used in this study were collected from gardeners in Serdang area, Selangor Darul Ehsan, Malaysia (Figure 1, 2, shows the tree and pods with seeds). The extraction of oil carried out by electro thermal Soxhlet using hexane. The bioactive constituents were extracted from *Moringa oleifera* using phosphate buffer (0.1M), jar test for measuring coagulation activity, turbidimeter for turbidity measurements, and the river water samples (low, medium, and high turbidity from Sungai Pusu, International Islamic University Malaysia) were collected to apply jar test.

Figure 1. *Moringa oleifera* Tree

Figure 2. *Moringa oleifera* Pods and Seeds from Serdang, Malaysia

2- Oil Extraction

The extraction of oil carried out by electro thermal Soxhlet using hexane. The oil percentage was 35% w/w. The dried cake was used in this study while the oil kept for other research work.

3- Extraction of bioactive constituents

Weighing of 10gm of *Moringa oleifera* cake, adding of 100ml of phosphate buffer (0.1M) with pH 7.5, mix with gentle stirring at 4ºC for 2hours to extract the bioactive constituents, then centrifuge the contents at 6000 rpm for 30 min, the supernatant was injected to the Ion Exchange column to separate the bioactive constituents (Gassenschmidt, U., et al, 1995).

4- Jar Test

Jar test for measuring coagulation activity, turbidimeter for turbidity measurements, and the river water samples (low, medium, and high turbidity from Sungai Pusu, IIUM) were used to apply jar test. The turbidity for river water samples were 43.9, 91, and 333 for low, medium and high turbidity, respectively.

Figure 3. Jar test for high turbidity river water

RESULTS AND DISCUSSION

The processed *Moringa oleifera* was improved by isolation of bioactive constituents from the seeds as a coagulant/flocculant which gave turbidity removal of 95.5%, 98.5%, and 99.3% for the treatment of river water with low, medium and high turbidity, respectively and by using the dosage tabulated in Table 1.

The results showed that the dosage of coagulant to be added was decreased which means decreasing of sludge volume produced (which consider as one of the main problems associated with using aluminum salts and as a sequence need to be treated with more chemicals).

The residual turbidity for all samples was lower than 5NTU, which is the standard set by WHO for drinking water.

Table 1. Jar test results

Initial turbidity NTU	**Dosage of processed *Moringa oleifera* (mg/l)**	**Residual turbidity NTU**	**Turbidity removal %**
Low (43.9)	0.05	1.99	95.5
Medium (91)	0.15	1.40	98.5
High (333)	0.30	2.20	99.3

CONCLUSION

Moringa oleifera can be used as a natural coagulant/flocculants alternative to the aluminum and other metallic salts.

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