



**UNIVERSITI PUTRA MALAYSIA**

***WATER PURIFICATION VIA REMOVAL OF TURBIDITY AND BACTERIA  
USING *Moringa oleifera* Lam. SEED POWDER***

**SURES S/O NARAYASAMY**

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USING *Moringa oleifera* Lam. SEED POWDER**

By

**SURES S/O NARAYASAMY**

**Thesis Submitted to the School of Graduate Studies,  
Universiti Putra Malaysia in Fulfilment of the  
Requirements for the Degree of Master of Science.**

**November 2014**

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Abstract of this thesis presented to the senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

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**November 2014**

**Chairman : Associate Professor Halimi b Mohd Saud,  
PhD**  
**Faculty : Agriculture**

Malaysian waters are highly turbid and comprising of suspended material such as mud, heavy metals, and bacteria which is not safe for human. Most of the illnesses that are associated with waterborne diseases are cholera, diarrhea, and dysentery. Conventional chemical coagulants in water treatments plants are unsuitable because of cost (economical factor), non-biodegradable and not safe for human consumption. This study evaluated the efficiency of *Moringa oleifera* seeds in removing turbidity, maintaining water pH level, water color index and reducing bacterial population using most probable number method (MPN). Water samples were treated with dry season and rainy season moringa seeds and iron (ii) sulfate at 0 g/l – 4.0 g/l. The greater turbidity removal was achieved with iron (ii) sulfate (98.5 %) while drought season moringa seeds removed turbidity up to 89 % whereas rainy season moringa seeds removed turbidity by 79.7 %. Meanwhile, the water pH level slightly increases but still within drinkable range that is 6.0-8.0 for moringa treated waters but the water pH level dropped drastically to acidity level (3.0) for iron (ii) sulfate. In addition, moringa treated waters reduced bacterial population by 99 % but waters treated with iron (ii) sulfate only managed to reduce bacterial population by 74.60 %. In summary, moringa can be used as an alternative coagulant in treatment plants along with iron (ii) sulfate to purify waters.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan Ijazah Master Sains

**PEMULIHAN AIR MENGGUNAKAN SERBUK BIJI *Moringa oleifera* Lam.  
UNTUK MENGASINGKAN KERUH DAN BAKTERIA**

Oleh

**SURES A/L NARAYASAMY**

**November 2014**

**Pengerusi : Prof. Madya Halimi b Mohd Saud, PhD**  
**Fakulti : Pertanian**

Kualiti air di Malaysia adalah sangat keruh dan mengandungi lumpur, logam berat, dan bakteria dimana bahaya untuk kesihatan manusia. Kebanyakan penyakit yang dikaitkan dengan penyakit bawaan air adalah kolera, cirit-birit, dan disentri. Koagulan kimia yang digunakan dalam loji rawatan air tidak sesuai kerana mahal (faktor ekonomi), tidak boleh terurai dan tidak selamat untuk penggunaan manusia. Kajian ini menilai kecekapan benih *Moringa oleifera* dalam menurunkan kekeruhan air, mengekalkan paras pH air, indeks warna air dan mengurangkan populasi bakteria. Sampel air dirawat dengan menggunakan biji moringa yang dituai pada musim kering dan musim hujan dan ferum (ii) sulfat pada 0 g/l - 4.0 g/l. Peratusan penyingkiran kekeruhan yang optimum dicapai dengan ferum (ii) sulfat (98.5%) manakala biji benih moringa yang dituai pada musim kemarau menyingkirkan kekeruhan sehingga 89% dan biji benih moringa yang dituai pada musim hujan menyingkirkan kekeruhan air sehingga 79.7 %. Sementara itu, nilai pH air yang dirawat dengan moringa meningkat sedikit tetapi masih dalam lingkungan yang boleh diminum iaitu 6.0-8.0 manakala ferum (ii) sulfat menyebabkan pH air menurun mencecah paras asid iaitu 3.0. Di samping itu, moringa juga mengurangkan populasi bakteria sebanyak 99% berbanding dengan ferum (ii) sulfat. Secara keseluruhannya, moringa boleh digunakan sebagai koagulan alternatif di dalam loji rawatan air bersama-sama dengan ferum (ii) sulfat.

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Finally, I pray that I shall be a good steward of this honor.



I certify that a Thesis Examination Committee has met on **xx Jun 2018** to conduct the final examination of Sures A/L Narayasamy on his thesis entitled "Water Phytoremediation by Sedimentation using *Moringa oleifera* Seed Powder to Remove Water Turbid and Microorganisms from Malaysian Water" in accordance with the Universities and University colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science. Member of the Thesis Examination Committee were as follows:

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**Name of Examiner 2, PhD**

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Name of Department and/or Faculty

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---

**(Insert name of current Deputy Dean)**

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Professor and Deputy Dean

School of Graduate Studies

Universiti Putra Malaysia



This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

**Halimi bin Mohd Saud, PhD**

Associate Professor  
Faculty of Agriculture  
Universiti Putra Malaysia  
(Chairman)

**Maheran binti Abd Aziz, PhD**

Associate Professor  
Faculty of Agriculture  
Universiti Putra Malaysia  
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## CHAPTER 1

### INTRODUCTION

In most developing countries throughout South East Asia, Asia, Africa and South America, people are struggling every day to obtain clean water. They depend fully on untreated surface water for their domestic usage. During the rainy season, the surface water and ground water used for consumption and domestic usage can be highly turbid and contain suspended material such as suspension, mud, heavy metals, bacteria and other microbes. Statistic shows children in developing countries die due to toxicities caused by polluted water and unhygienic water. Most of the common illness in these countries are water related diseases such as cholera, diarrhea, and dysentery. Two and a half billion people have no access to better-quality sanitation, and more than 1.5 million offspring die each year from diarrheal diseases (Fenwick, 2006). WHO also declared that, the mortality of water related diseases surpasses 5 million people per year; more that 50% are microbial intestinal infections, with cholera standing out in the first place (World Health Organization, 2014). Drinking water that is contaminated with human or animal feces is considered the utmost infection risks. Wastewater releases in fresh waters and seawaters are the major source of fecal microorganisms (Cabral, 2010).

Therefore, drinking water is essential to the health and welfare of a community and water from any sources should undergo some form of sanitization before consumption. Generally, water purification is done using chemical coagulants such aluminum sulfate, ferric chloride, lime and aluminum polymers. These coagulants are not always available at a sensible amount and value to the populaces of third world countries. Latest studies (Suleyman, 2004; Ndabigengsere et al, 1996) have showed high aluminum residuals in treated water increase the occurrence of Alzheimer's disease. Aluminum salts also reflects the extreme sludge production and variations in water chemistry due to reactions with the OH<sup>-</sup> and alkalinity of water. Hence, the alternative natural coagulants in the distillation process of turbid water and to reduce bacteria production are plant parts, rocks, sands and beneficial microbes.

The process using biological therapy like plant parts to clean up water contagions and to treat the ecological problems found in soil, water and sediments are so-called phyto-purification. For years in rural areas of Africa and Asia, seeds from *Moringa oleifera* has been used for water purification and to remove microorganisms in water. *Moringa oleifera* belongs to the family Moringaceae, consisting of the genus *Moringa* only, which is composed of fourteen known species. Native to the Northern region of India, *Moringa oleifera* has been cultivated in several tropical countries such Indonesia, Malaysia, Philippines, Honduras and African countries. The seed pods are

legume-like in appearance, but different from the typical two-sided legumes, these pods are triangular and have a large number of seeds (Jose et al, 2010). The *M. oleifera* is a tall tree up to 10 m height, with thick stalk and long-petiolate leaves, which are bi-pinnate with obovate folioles about 3 cm long. It has edible fruits and leaves, and the roots are described to have abortive properties (Schwarz, 2000; Correa, 1984). Recent findings have indicated *M. oleifera* triturated seeds as an alternative to purify water, at costs as low as a small fraction of the conventional chemical treatments (Jose et al, 2010). Moreover, nearly all parts of the tree have high degree of nutritional value from young leaves to the root. It contains Vitamin A, Vitamin B1, Vitamin B2, Vitamin C, chromium, calcium, copper, iron, protein, and all the essential amino acids that are required by human body (Supa Nutri, 2016). Furthermore, other parts of the tree such as the leaves, young roots, and young shoots can be used as animal feeds, fertilizers, biofuel and as medicine. There are a lot of advantages of using *Moringa* coagulant as it is cheap, does not modify the pH of the water and it is biodegradable while conventional chemical coagulant such aluminum sulfate is non-biodegradable and not safe for human consumption. Besides that, to date, no proof has been found that the seed causes secondary effects on humans. Furthermore, it is believed that the seeds and the waste can be used as bioorganic fertilizers.

The study was attempted to complement existing knowledge on *Moringa oleifera*, which the main objective lies on the effectiveness of *Moringa oleifera* in reducing the water turbidity compared to chemical coagulants in Malaysian water levels. The study is also done to identify the effects of *Moringa oleifera* seeds collected during two different seasons, drought and rainy season on reducing the water turbidity level, the effects of *Moringa oleifera* seed coagulants on water pH and the effectiveness of *Moringa oleifera* seed powder to remove bacteria from water. This is because acid rains have a significant impact on the *Moringa oleifera* protein content in the seeds which is the main component that attracts the turbid in the water.

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