



**UNIVERSITI PUTRA MALAYSIA**

***EVALUATION OF TURBIDITY REMOVAL USING MORINGA OLEIFERA  
LAM. SEEDS***

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

**EVALUATION OF TURBIDITY REMOVAL USING MORINGA OLEIFERA LAM. SEEDS**

By

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**October 2010**

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Many studies on *Moringa oleifera* have proven that its seeds are highly effective as a natural coagulant in turbidity removal. This study examined various reviews and evaluations, especially of storage and extraction methods, and of the effects of varying water turbidity levels on the efficiency of *Moringa oleifera* in turbidity removal. It is worth highlighting that almost all reviewed works investigating the coagulation effects of *Moringa oleifera* used the jar test as a common, standard laboratory procedure.

First, performance and efficiency of various parts of the *Moringa oleifera* fruits and seeds from different sources on turbidity removal efficiency were investigated. Results showed that Moringa kernels were the only plant part that exhibited coagulation properties. On the other hand, the results also revealed that seeds collected from different sources varied in the efficiency of turbidity removal.

Next, different methods of extracting the active ingredient from the seeds under different pretreatments were investigated. Comparison between sodium chloride (NaCl) and distilled water methods of extraction of *Moringa oleifera* seeds revealed that salt extraction was more efficient, with a dosage 3.5 times lower, than the water extraction in bringing the active coagulant ingredient of Moringa into the aqueous phase. Furthermore, shell-free *Moringa oleifera* seeds were more effective in turbidity removal than the seeds. When compared with alum, the turbidity removals achieved in coagulation process using *Moringa oleifera* seeds were almost identical and around 97%.

In addition to this, turbidity removal efficiency was investigated for shell-free *Moringa oleifera* seeds under different storage conditions; i.e., open and closed containers at room temperatures (27 °C), and durations of storage of 0, 2, 4, 6 and 8 weeks from the time the seeds were picked from the trees. The results of this study additionally indicated that varying the storage conditions and periods of the shell-free *Moringa oleifera* seeds resulted in no significant differences between open and closed-container storage and turbidity removal remained between 97% - 94.2%.

Next to this and based on the above-mentioned findings, the effects of different water quality parameters such as pH, bicarbonate-alkalinity, salinity and calcium and magnesium hardness, on turbidity removal were examined. Results showed that within the range of the pH values considered (pH = 5 - 9) the residual turbidity did not change significantly; it demonstrated an insignificant increase with pH from 5.7 NTU to 8.2 NTU. Moreover, the results of this work demonstrated that the different investigated levels of alkalinity, hardness and salinity had no significant effects on

turbidity removal. For example, increasing the  $\text{HCO}_3^-$  concentration progressively from 25 to 250 mg  $\text{HCO}_3^-/\text{L}$  affected a slight increase in turbidity removal from 92.35% to 94.7%. As to calcium hardness, a minute decline in turbidity removal from 95% to 93.8% was observed upon progressive increases of the levels of calcium hardness from 25 to 250 mg  $\text{Ca}^{2+}/\text{L}$ . Increasing the levels of magnesium hardness successively from 25 to 250 mg  $\text{Mg}^{2+}/\text{L}$  too reduced the residual turbidity; however, to an extent somewhat higher (95.3% to 91.2%) than the corresponding decrease obtained with the attendant levels of calcium hardness. Lastly, increasing the concentration of NaCl in the tested water from 25 to 250 mg NaCl/L lead to a mild decline in turbidity removal; 96.7% to 93.8%.

The properties of dried stock component and the effect of temperature and storage on dried stock solution on the efficiency of turbidity removal were also investigated. Stock solutions of *Moringa oleifera* were either freeze-dried or oven-dried at two temperatures, 70°C and 95°C. The results obtained indicated that the freeze-dried powder was a more effective coagulant than the heat-dried powder with the 96% turbidity removal. Storage of the powder up to two months confirmed that duration of storage of the powdered freeze-dried stock solution did not significantly affect turbidity and reduced from 96% to 93.8%.

In conclusion, the findings of this study agree well with the findings of earlier studies on the potential use of *Moringa oleifera* as a natural coagulant, particularly as an attractive alternative to chemical and synthetic coagulants. It is a user-friendly and environmentally-friendly coagulant with offering 97% turbidity removal efficiencies.

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

**BARU ASPEK DALAM PENILAIAN PENYISIHAN KEKERUHAN OLEH  
MORINGA OLEIFERA LAM. SEEDS**

Oleh

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Kajian ini dijalankan bagi menilai aspek dan perspektif berbeza penyingkiran kekeruhan oleh biji benih Moringa oleifera sebagai sejenis penggumpal semula jadi. Berbagai ulasan dan penilaian dilakukan pada removal kekeruhan, dengan kelor sebagai koagulan alami, dengan menggunakan jar test sebagai prosedur makmal umum dan paling banyak digunakan untuk ujian koagulasi.

Pertama, penyelidikan dilakukan ke atas pelaksanaan dan kecekapan pelbagai bahagian buah Moringa oleifera dan sumber-sumbernya yang berbeza benih. Keputusan menunjukkan isirong Moringa oleifera itu ialah satu-satunya bahagian tumbuhan yang mempamerkan ciri-ciri penggumpalan. Sebaliknya, hasil-hasil kajian mendedahkan benih-benih yang dikutip dari sumber-sumber yang berbeza dapat mengubah kecekapan penyingkiran kekeruhan.

seterusnya, penyelidikan dijalankan menggunakan kaedah-kaedah berbeza bagi mengeluarkan bahan aktif daripada benih-benih dengan melakukan prarawatan yang berbeza keatas biji benih sebagai contoh biji benih dengan dan tanpa kulit.

Pengekstrakan benih-benih *Moringa oleifera* menggunakan Natrium Klorida (NaCl) dan air suling mendedahkan pengekstrakan menggunakan garam itu adalah lebih baik berbanding air suling dan dikupas biji *Moringa oleifera* lebih berkesan daripada yang bukan kupas. Juga sisa kekeruhan semua dengan menggunakan tawas dan biji kelor hampir identik. Di sisi lain, jumlah yang lebih kecil dari SMOS-NaCl dan NSMOS-NaCl, hampir tiga kali lebih kecil, daripada jumlah tawas yang diperlukan untuk memberikan tahap yang sama dari sisa kekeruhan tawas yang menghasilkan. Tambahan kepada ini, kecekapan penyingkiran kekeruhan telah diselidik bagi biji benih *Moringa oleifera* tanpa kulit sebelum dikeringkan dalam ketuhar di bawah keadaan storan yang berbeza.

Keadaan ini sejajar dengan kontena terbuka dan tertutup pada suhu bilik ( $27\text{ }^{\circ}\text{C}$ ), bagi kedua-dua benih baru dan benih bawah tempoh storan yang berbeza-beza, iaitu, storan untuk dua, empat, enam, dan lapan minggu dari masa benih-benih itu dipetik dari pokok. Hasil-hasil kajian menunjukkan dengan mempelbagaikan tempoh dan keadaan simpanan untuk biji benih *Moringa oleifera* tanpa kulit menunjukkan tiada perbezaan yang ketara dalam kecekapan penggumpalan dan seterusnya dalam penyingkiran kekeruhan. Hasil kajian menunjukkan perbezaan tertinggi nilai penyingkiran kekeruhan diantara biji yang disimpan dengan biji segar adalah 2.8% untuk biji yang disimpan dalam balang yang kontena terbuka selama 8 minggu.

Berdasarkan hasil penyelidikan tersebut, kesan-kesan parameter kualiti air berbeza seperti pH, kealkalian bikarbonat, kemasinan dan kekerasan kalsium dan magnesium dikaji ke atas penyingkiran kekeruhan. Keputusan kajian menunjukkan bahawa parameter kualiti air yang diteliti tidak berpengaruh nyata pada saat penghilangan

kekeruhan biji kelor. Dengan kata lainnya, potensi penggumpalan bagi pengekstrakan dengan NaCl bagi *Moringa oleifera* tanpa kulit merujuk kepada dos optimum adalah mematuhi hampir pelbagai keadaan persekitaran air.

Sifat komponen saham kering, ciri-ciri suhu, dan pengaruh simpanan pada penyelesaian saham kering pada kecekapan penyisihan kekeruhan juga boleh diselidiki. Stok penyelesaian kelor entah-beku kering atau oven-kering di dua suhu, 70 ° C dan 95 ° C. Keputusan yang diperolehi menunjukkan bahawa serbuk beku-kering penyelesaian saham lebih berkesan koagulan dari penyelesaian panas-kering. Simpanan serbuk ini hingga dua bulan mengesahkan bahawa tempoh simpanan serbuk dari penyelesaian stok beku-kering tidak menjejaskan prestasi koagulasi nya. Oleh kerana itu, kajian ini memperkenalkan cara baru yang lebih berkesan simpanan serbuk biji *Moringa oleifera*.

Kesimpulannya, hasil- hasil kajian ini sangat bersetuju dengan hasil kajian yang terdahulu akan potensi penggunaan *Moringa* sebagai koagulan semula jadi khususnya menarik sebagai tukar ganti kepada koagulan/penggumpal sintetik/kimia memandangkan ianya penggumpal yang mesra alam sekitar dan terurai secara biologi dalam persekitaran akueus dan memberikan kecekapan penyingkiran kekeruhan yang luar biasa.

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I certify that an Examination Committee has met on October 2010 to conduct the final examination of Mohammad Golestan Bagh on his Master of Science thesis entitled “Evaluation of Turbidity Removal by *Moringa Oleifera* Lam. Seeds ” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows

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## DECLARATION

I hereby declare that the thesis is based on my original work except for equation and citations, which have been duly acknowledged also, declare that it has not been previously, and is not currently, submitted for any other degree at University Putra Malaysia or other institution.

**MOHAMMAD GOLESTAN BAGH**

Date: 19 October 2010



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