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COAGULATION PERFORMANCE OF *MORINGA OLEIFERA* SEEDS STORED UNDER DIFFERENT PRESERVATION CONDITIONS

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By

NG SHU CHIN

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COAGULATION PERFORMANCE OF *MORINGA OLEIFERA* SEEDS STORED UNDER DIFFERENT PRESERVATION CONDITIONS

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July 2006

Chairman: **Katayon Saed, PhD**

Faculty: **Engineering**

The present study was carried out to investigate the effects of storage temperature and packaging methods on the performance of non freeze-dried and freeze-dried *Moringa oleifera* seeds powders in coagulation of synthetic turbid water (200±5 NTU). Non freeze-dried *Moringa oleifera* was stored in different packaging namely open container, closed container and vacuum packing. Whilst, freeze-dried *Moringa oleifera* was stored in closed container and vacuum packing. Each of the packaging was kept in room temperature (30°C to 32°C) and refrigerator (4°C). The turbidity, pH and zeta potential of the water samples, the moisture content and physical appearance of *Moringa oleifera* were examined at monthly interval for 12 months.

The optimum dosages of non freeze-dried and freeze-dried *Moringa oleifera* were 120 mg/L and 260 mg/L respectively. The difference in optimum dosage is attributed to the usage of *Moringa oleifera* from different sources. The coagulation efficiency of non freeze-dried *Moringa oleifera* kept in room temperature significantly reduced from 95.7% to 7% or less in the first month for storage in open container, fifth month in closed container and sixth month in vacuum packing.

However, storage in refrigerator may preserve the efficiency of *Moringa oleifera* seeds powders. In open container, the coagulation efficiency of *Moringa oleifera* was within 95.7% to 18.6% for 12 months storage. In closed container, it remained its efficiency at 95.7% to 83.0% within 10 months storage but showed degradation to 53.3% in twelfth month. For those stored in vacuum packing, the coagulation efficiency ranged from 95.7% to 85.5% for the first 10 months and degraded to 61.6% in twelfth month. Storage in closed container and vacuum packing in the refrigerator were found to be more appropriate for the preservation of non freeze-dried *Moringa oleifera.* Whilst after freeze-drying, *Moringa oleifera*'s coagulation efficiency remained above 70% within the 12 months storage. Comparison between the non freeze-dried and freeze-dried *Moringa oleifera* revealed that freeze-drying had positive effect on the preservation of coagulation efficiency.

The result also indicated a negative correlation between the moisture content and coagulation performance for non freeze-dried *Moringa oleifera* kept in varying conditions but no correlation for freeze-dried *Moringa oleifera*. The physical appearance of non freeze-dried *Moringa oleifera* showed significant changes in colour, texture and solubility in water except for those stored in closed container and vacuum packing in refrigerator. In contrast, freeze-dried *Moringa oleifera* generally did not show significant changes in physical appearances. The studies also showed that *Moringa oleifera* coagulants (non freeze-dried and freeze-dried) do not change the pH of the water being treated where pH remained at 5.9 to 6.4. Generally, there are no correlation between the zeta potential and coagulation efficiency of *Moringa oleifera*.

Moringa oleifera applied in pilot scale treatment plant was able to remove 44-48% of the turbidity from water (200 NTU) in the flocculation/ settling tank at the effective dosage of 100 mg/L. The residual turbidity was further reduced below 1 NTU after filtration.

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

PRESTASI PENGENTALAN BIJI *MORINGA OLEIFERA* YANG DISIMPAN DALAM KEADAAN BERLAINAN

Oleh

NG SHU CHIN

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Kajian ini dijalankan untuk menyelidik kesan suhu dan cara pembungkusan ke atas keupayaan serbuk biji *Moringa oleifera* dalam pengentalan air keruh sintetik (200±5 NTU). Serbuk biji *Moringa oleifera* yang digunakan terdiri daripada jenis yang tidak diproses melalui pengeringan sejukbeku dan yang diproses melalui pengeringan sejukbeku. *Moringa oleifera* yang tidak diproses melalui pengeringan sejukbeku, disimpan dalam bekas terbuka, bekas tertutup dan bungkusan vakum manakala *Moringa oleifera* yang telah diproses disimpan dalam bekas tertutup dan bungkusan vakum sahaja. Setiap pembungkusan disimpan pada suhu bilik (30°C to 32°C) dan di dalam peti sejuk (4°C). Kekeruhan, pH dan keupayaan zeta sampel air serta kelembapan dan rupa bentuk fizikal *Moringa oleifera* dikaji pada setiap bulan selama 12 bulan.

Dos optimum *Moringa oleifera* yang tidak diproses dan yang diproses melalui pengeringan sejukbeku adalah masing-masing 120 mg/L and 260 mg/L. Perbezaan ini adalah disebabkan oleh penggunaan *Moringa oleif*era dari sumber yang berlainan. *Moringa oleifera* tidak diproses melalui pengeringan sejukbeku yang

disimpan pada suhu bilik, menunjukkan kemerosotan keberkesanan pengentalan dari 95.7% ke 7% atau ke bawah pada bulan pertama untuk kes penyimpanan di dalam bekas terbuka, bulan kelima untuk penyimpanan di dalam bekas tertutup and bulan keenam untuk penyimpanan di dalam bungkusan vakum. Manakala, *Moringa oleifera* yang disimpan dalam peti sejuk dapat mengekalkan keberkesanan pengentalannya. Di dalam bekas terbuka, keberkesanan pengentalan *Moringa oleifera* adalah dalam lingkungan 95.7% ke 18.6% dalam masa 12 bulan. Di dalam bekas tertutup, ia dapat mengekalkan keberkesanannya pada 95.7% hingga 83.0% selama 10 bulan namun menunjukkan kemerosotan ke 53.3% pada bulan kedua belas. Untuk *Moringa oleifera* yang disimpan di dalam bungkusan vakum, keberkesanan pengentalannya adalah 95.7% ke 85.5% selama 10 bulan dan menurun ke 61.6% pada bulan kedua belas. Sementara itu, selepas pengeringan sejukbeku, *Moringa oleifera* dapat mengekalkan keberkesanannya sebagai pengental pada 70% ke atas dalam jangka penyimpanan selama 12 bulan. Perbandingan antara kedua-dua jenis *Moringa oleifera* menunjukkan pengeringan sejukbeku mempunyai kesan positif ke atas pengekalan keberkesanan pengentalan.

Keputusan juga menunjukkan kolerasi negatif wujud di antara kelembapan dan keupayaan pengentalan *Moringa oleifera* yang tidak diproses melalui pengeringan sejukbeku. Sebaliknya tiada kolerasi wujud antara kelembapan dan keupayaan pengentalan *Moringa oleifera* yang diproses melalui pengeringan sejukbeku. Rupa bentuk fizikal *Moringa oleifera* yang tidak diproses melalui pengeringan sejukbeku, menunjukkan perubahan warna, struktur dan kelarutan dalam air yang bererti kecuali untuk jenis yang disimpan dalam bekas tertutup dan bungkusan vakum di dalam peti sejuk. Manakala, *Moringa oleifera* yang diproses melalui pengeringan sejukbeku

tidak menunjukkan perubahan fizikal yang bererti. Kajian juga menunjukkan pengentalan *Moringa oleifera* (yang tidak diproses dan yang diproses) tidak menyebabkan perubahan pH air dirawat di mana nilai pH kekal pada 5.9 ke 6.4. Secara umumnya, tiada kolerasi wujud di antara keupayaan zeta dan keberkesanan pengentalan *Moringa oleifera*.

Penggunaan *Moringa oleifera* dalam loji perintis pada dos optimum sebanyak 100 mg/L dapat mengurangkan 44-48% kekeruhan awal sebanyak 200 NTU daripada tangki flokulasi/pemendapan. Kekeruhan baki dapat dikurangkan ke bawah 1 NTU selepas penurasan.

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I certify that an Examination Committee has met on 27th July 2006 to conduct the final examination of Ng Shu Chin on her Master of Science thesis entitled "Coagulation Performance of *Moringa oleifera* Seeds Stored Under Different Preservation Conditions" 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 quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM of other institutions.

_____

NG SHU CHIN

Date : 12 October 2006

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LIST OF ABBREVIATIONS/ SYMBOLS/UNITS

Abbreviations

A	Alanine
Arg	Arginine
C	Cysteine
D	Aspartic Acid
ES	Effective Size
F	Phenylalanine
G	Glycine
Glx	Glutamine
H	Histidine
I	Isoleucine
L	Leucine
M	Methionine
M.O.	*Moringa oleifera*
N	Asparagine
P	Proline
pI	Isoelectric Point
Q	Glutamine
R	Arginine
S	Serine
T	Threonine
UC	Uniformity Coefficient
V	Valine

WHO	World Health Organization
Y	Tyrosine
ZP	Zeta Potential

Symbols

ω	Perpendicular spacing between the surfaces
θ	Angle of surface inclination
C	Concentration
L_p	Length of surface
Q	Flow rate
T	Detention time
T_d	Safe final product temperature
U_θ	Liquid velocity between the surfaces
U_t	Settling velocity of the particles
V	Volume
v	Surface area of the filter

Units

%	Percentage
°C	Degree celsius
μm	Micrometres
cm	Centimetres
g	Grams
h	Hours
kDa	Kilodalton

kg	Kilograms
L	Litres
L/min	Litres per minute
m	Metres
m^3/day	Cubic metres per day
mg/L	Milligram per litre
min	Minutes
mL	Millilitres
mL/min	Millilitres per minute
mm	Millimetres
mV	Millivolts
nm	Nanometers
NTU	Nephelometric turbidity units
rpm	Rotations per minute