

**EFFECT OF ULTRASONIC TREATMENT ON  
PESTICIDE RESIDUE, PHYSICAL QUALITY AND  
MICROBIAL AVAILABILITY OF WATER SPINACH  
(*Ipomoea aquatica* Forssk.)**

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**UNIVERSITI SAINS ISLAM MALAYSIA**

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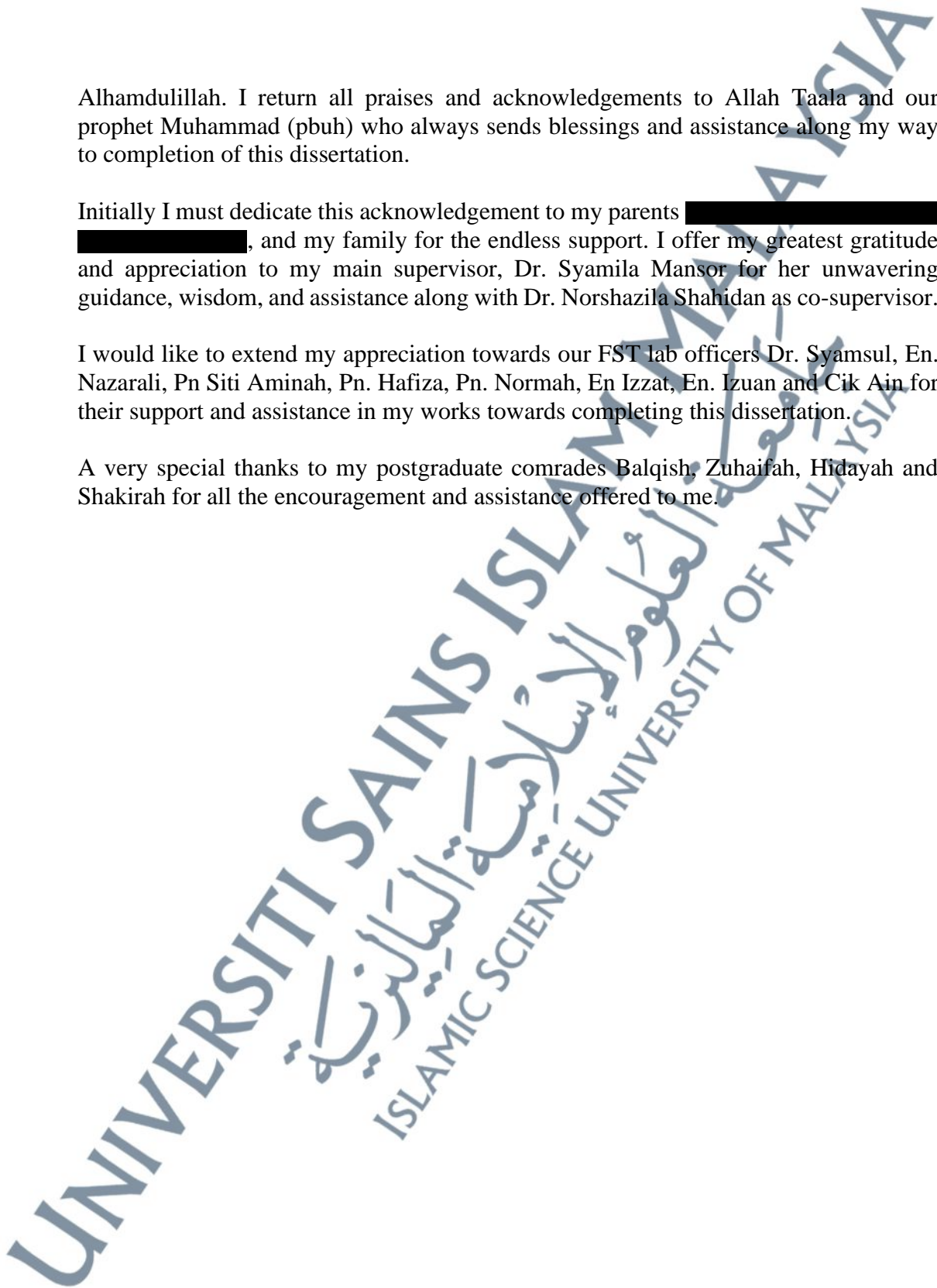
## ACKNOWLEDGEMENTS

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## ABSTRAK

Antara kebimbangan mengenai keselamatan memakan sayur-sayuran berdaun yang biasanya dimakan mentah atau diproses secara minimum ialah kehadiran bahan cemar seperti sisa racun makhluk perosak dan mikroorganisma. Penyelidikan ini mengkaji kesan rawatan ultrasonik (frekuensi 40kHz dan kuasa 350W) selama 1,7 dan 15 minit pada tahap sisa racun perosak terpilih (diazinon), perubahan kualitatif dan kuantitatif dalam penampilan fizikal dan ketersediaan mikrob pada kangkung (*Ipomoea aquatica* Forssk.) yang dijual di beberapa pasar raya besar di Negeri Sembilan. Tahap sisa diazinon diukur menggunakan kaedah pengekstrakan QuEChERS diikuti dengan analisis pengesanan nyala kromatografi gas (GC-FID). Perubahan penampilan fizikal diukur melalui perbandingan imej, perubahan warna keseluruhan dan perbandingan kepejalan daun sebelum rawatan dan selepas rawatan. Ketersediaan mikrob diukur dengan jumlah kiraan plat (TPC). Sisa diazinon telah dikesan dengan kuantiti sebanyak 3.07 mg/kg pada satu sampel, iaitu melebihi paras sisa maksimum (MRL) yang dibenarkan iaitu 0.2 mg/kg menurut Peraturan-Peraturan Makanan 1985, manakala tiada sisa racun perosak dikesan pada sampel kawalan dan yang dirawat dengan gelombang ultrasonik. Memanjangkan rawatan ultrasonik melebihi 7 minit merosakkan daun kangkung, sehingga menjejaskan rupa fizikalnya. Daun yang dirawat dengan gelombang ultrasonik menunjukkan jumlah perubahan warna ( $\Delta E$ ) yang lebih rendah berbanding dengan rawatan kawalan. Kepejalan daun kangkung meningkat dengan peningkatan tempoh rawatan dengan peningkatan maksimum yang diperolehi melalui rawatan ultrasonik selama 7 minit. Rawatan ultrasonik didapati lebih berkesan dalam mengurangkan ketersediaan mikrob pada kangkung berbanding merendam sahaja tidak kira tempoh rawatan, dengan pengurangan log sehingga 1.82 selepas rawatan selama 15 minit. Rawatan ultrasonik boleh digunakan sebagai kaedah dekontaminasi bagi kangkung dan sayuran berdaun kerana keupayaannya untuk membuang sisa racun perosak dan menurunkan ketersediaan mikrob dalam masa 7 minit sambil mengekalkan kualiti kangkung.

Kata kunci: rawatan ultrasonik, sisa racun perosak, kualiti fizikal, ketersediaan mikrob, kangkung, diazinon

## ABSTRACT

Among the concerns on the safety of consuming leafy vegetables which are usually eaten raw or minimally processed is presence of contaminants such as pesticide residues and microorganisms. This research studied the effect of ultrasonic treatment (40kHz frequency and 350W power output) for 1, 7 and 15 minutes on residue level of a selected pesticide (diazinon), qualitative and quantitative changes in physical appearance and the microbial availability on water spinach (*Ipomoea aquatica* Forssk.). Diazinon residue level was quantified using QuEChERS extraction method followed by gas chromatography flame ionization detector (GC-FID) analysis. The changes in physical appearance were measured by image comparison, the total colour change and comparison of leaf firmness pre-treatment and post-treatment. Microbial availability was measured by total plate count (TPC). One sample was found to have traces of diazinon at 3.07 mg/kg, which exceeded the permitted maximum residual level (MRL) of 0.2 mg/kg according to Malaysia Food Regulations 1985, while no pesticide residue was detected on other samples treated with control and ultrasonic waves. Prolonging ultrasonic treatment beyond 7 minutes damaged water spinach leaves, thus affecting the physical appearance. Leaves treated with ultrasonic waves showed lower total colour change ( $\Delta E$ ) compared to control treatment. The firmness of water spinach leaves increases with increasing treatment duration with maximum increase obtained with 7 minutes' ultrasonic treatment. Regardless of sonication time, ultrasonic treatment was found to be more efficient in reducing microbial availability on water spinach compared to soaking alone, with up to 1.82 log reduction after 15 minutes' treatment. Ultrasonic treatment can be utilised as a decontamination method for water spinach and other leafy vegetables owing to its ability to remove pesticide residues and lowering microbial availability in 7 minutes' sonication time while preserving the quality of water spinach.

Keywords: ultrasonic treatment, pesticide residue, physical quality, microbial availability, water spinach, diazinon

## الملخص

من بين المخاوف المتعلقة بسلامة استهلاك الخضار الورقية التي تؤكل عادة نيئة أو معالجة بشكل طفيف، وجود ملوثات مثل بقايا المبيدات الحشرية والكائنات الحية الدقيقة. قام هذا البحث بدراسة تأثير المعالجة بالموجات فوق الصوتية (تردد 40 كيلو هرتز وقدرة 350 واط) لمدة 1,7 و 15 دقيقة على مستوى بقايا مبيد مختار (ديازينون)، والتغيرات النوعية والكمية في المظهر الجسدي والتوافر الميكروبي في ماء السبانخ (*Ipomoea aquatica* Forssk.) تُباع في العديد من محلات السوبر ماركت في Negeri Sembilan. تم قياس مستوى بقايا الديازينون باستخدام طريقة استخلاص QuEChERS متبوعة بتحليل كاشف تآين اللهب اللوني للغاز (GC-FID). تم قياس التغيرات في المظهر الجسدي من خلال مقارنة الصور وتغير اللون الكلي ومقارنة صلابة الأوراق قبل المعالجة وبعد المعالجة. تم قياس التوافر الميكروبي عن طريق عدد اللوحات الإجمالي (TPC). تم العثور على عينة واحدة تحتوي على آثار للديازينون بنسبة 3.07 مغ/كغ، وهو ما يتجاوز الحد الأقصى المسموح به للمستوى المتبقي (MRL) البالغ 0.2 مغ/كغ وفقاً للوائح Peraturan-Peraturan Makanan 1985 بينما لم يتم اكتشاف أي بقايا مبيدات حشرية في العينات الأخرى التي تمت معالجتها بالمراقبة والمراقبة. الموجات فوق الصوتية. إطالة العلاج بالموجات فوق الصوتية لأكثر من 7 دقائق بأوراق السبانخ التالفة مما يؤثر على المظهر الجسدي. أظهرت الأوراق المعالجة بالموجات فوق الصوتية تغيراً إجمالياً في اللون ( $\Delta E$ ) أقل مقارنةً بمعاملة التحكم. تزداد صلابة أوراق السبانخ المائية مع زيادة مدة العلاج مع الحد الأقصى للزيادة التي يتم الحصول عليها من خلال العلاج بالموجات فوق الصوتية لمدة 7 دقائق. بغض النظر عن وقت الصوتنة، وجد أن العلاج بالموجات فوق الصوتية أكثر كفاءة في تقليل توافر الميكروبات في ماء السبانخ مقارنة بالنقع وحده، مع انخفاض يصل إلى 1.82 سجل بعد 15 دقيقة من العلاج. يمكن استخدام العلاج بالموجات فوق الصوتية كوسيلة لإزالة التلوث من السبانخ المائية والخضروات الورقية الأخرى نظراً لقدرتها على إزالة بقايا المبيدات الحشرية وخفض توافر الميكروبات في وقت صوتنة مدته 7 دقائق مع الحفاظ على جودة السبانخ المائية.

الكلمات المفتاحية: المعالجة بالموجات فوق الصوتية، بقايا المبيدات، الجودة الفيزيائية، التوفر الميكروبي، السبانخ المائية، الديازينون

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## LIST OF UNITS OF MEASUREMENTS

Area of land	Ha
Density	g/cm <sup>3</sup>
Radiation dose	kGy
Total microbial count	log CFU/g
Ultrasonic wave frequency	kHz
Ultrasonic power output	W
Parts per million	ppm
Length	cm
Mass	g, mg
Volume	mL
Centrifuge speed	rpm
Compression force	N

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## LIST OF SYMBOLS

%	Percentage
°C	Degree Celsius

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## LIST OF ABBREVIATIONS

RH	Relative Humidity
MRL	Maximum Residue Limits
QuEChERS	Quick, Easy, Cheap, Effective, Rugged and Safe
PSA	Primary Secondary Amine
GC-FID	Gas Chromatography-Flame Ion Detector
FAO	Food and Agriculture Organization
WHO	World Health Organization
EU	European Union

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