

**SCREENING OF MICROPLASTICS CONTAMINANTS ON  
COCKLES AND MUSSELS' LANDINGS AT WEST COAST  
PENINSULAR MALAYSIA USING MICROSCOPY, FTIR AND  
PCA ANALYSIS**

**SITI NABILAH BINTI KARIM**

**UNIVERSITI SAINS ISLAM MALAYSIA**

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PCA ANALYSIS**

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Thesis submitted fulfilment for the degree of  
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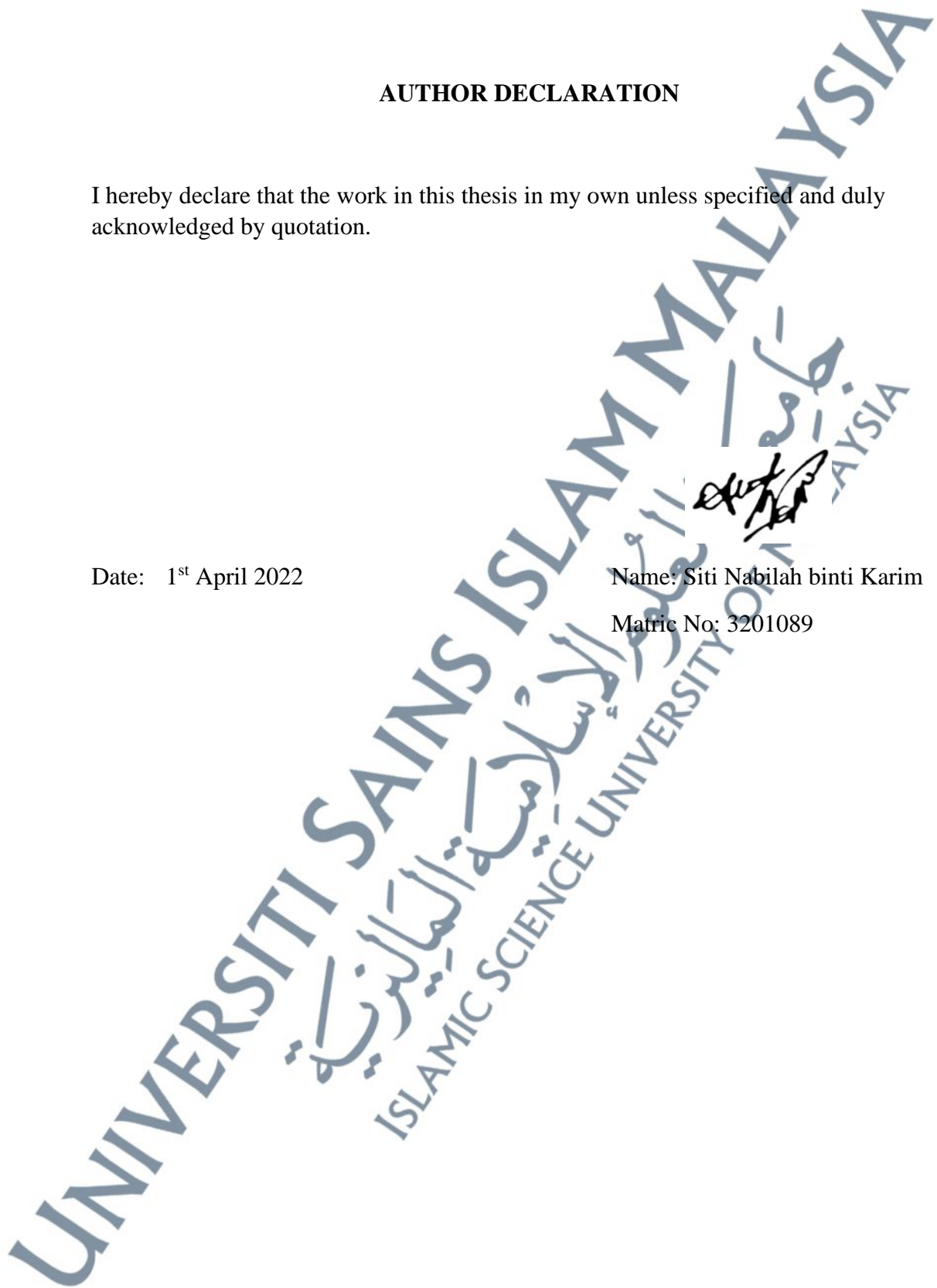
## AUTHOR DECLARATION

I hereby declare that the work in this thesis is my own unless specified and duly acknowledged by quotation.

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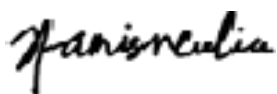
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## APPROVAL FOR SUBMISSION

I certify that this thesis entitled “**SCREENING OF MICROPLASTICS CONTAMINANTS ON COCKLES AND MUSSELS LANDINGS’ AT WEST COAST PENINSULAR MALAYSIA USING MICROSCOPY, FTIR AND PCA ANALYSIS**” was prepared by **SITI NABILAH BINTI KARIM** has met the required standard for submission in partial fulfilment of the requirements for the Master of Science (Food Biotechnology).

Approved by,



Dr. Hanis Nadia Bt. Yahya

Faculty of Science and Technology

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Date: 1<sup>st</sup> April 2022

## ACKNOWLEDGEMENT

In the name of Allah, the Compassionate, the Merciful. All praises belong to Allah, Lord of the world, the Hereafter is for the righteous, and blessings and peace be upon His noble Messenger, his family, and Companions, all of them.

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## ABSTRAK

Kegunaan plastik dalam kehidupan seharian sangat penting memandangkan penggunaan plastik bungkusan barangan dan makanan sangat banyak digunakan disebabkan penghantaran barang dan makanan. Hal ini telah mengakibatkan pembuangan sisa plastik dan meningkatkan ancaman terhadap alam sekitar termasuklah mencemarkan air dan mengganggu sumber makanan yang menyebabkan makanan bertoksid. Plastik merupakan antara cebisan plastik yang paling banyak ditemui di dalam laut dan yang mempunyai panjang kurang daripada lima millimeter dikenali sebagai mikroplastik. Sehubungan dengan itu, dalam jurang saiz ini, hidupan pemakan penapis seperti kerang dan kupang amat mudah untuk memakan mikroplastik yang hadir di dalam laut yang secara tidak langsung berpotensi membahayakan pengguna terakhir. Kerang, dan kupang telah dikutip dari dua kawasan yang strategik di Tanjung Karang, Selangor dan Sebatu, Melaka, Malaysia sebagai kawasan antropogenik yang tinggi pencemaran, bertujuan untuk mengesan potensi pencemaran mikroplastik pada hidupan bercengkerang. Pemerhatian mikroplastik telah dilakukan menggunakan mikroskop cahaya dan mikroskop pendarfluor (magnifikasi: 40x) untuk mengesahkan kehadiran mikroplastik pada biota. Hasil pemerhatian bawah kedua-dua mikroskop mendapati potensi kehadiran mikroplastik pada tisu kerang dan kupang dengan ciri-ciri seperti halus, merah, filamen panjang, serpihan yang tidak teratur dan pellet berbentuk sfera. Jenis mikroplastik yang hadir telah disahkan menggunakan analisis FTIR ( $4\text{ cm}^{-1}$ ) termasuk polipropilena, polisterin dan polietilena. Pengedaran dan longgokan mikroplastik adalah bergantung secara spatial dengan analisis komponen utama (PCA) yang menunjukkan bahawa 96% daripada jumlah variasi dalam longgokan telah dikesan pada kedua-dua sampel bercengkerang dari kedua-dua lokasi strategik yang berbeza di mana semua sampel adalah berbeza secara signifikan ( $\rho < 0.05$ ). Maklumat terkumpul daripada hasil kajian ini berguna dalam pengurusan kawalan keselamatan makanan dan langkah kawalan alam sekitar.

***Kunci kata: Plastik, kerang, kupang, pemakan penapis, keselamatan makanan***

## ABSTRACT

Currently, the role of plastics in daily life is significant as usage of wrappers and food packaging are extensively used prior to food and packages deliveries. This triggered the disposal of the plastic waste therefore posing environmental threats especially when the plastics enter the food web and cause food toxicity. Degraded plastics that are less than five millimetres are called microplastics. Therefore, within this size range, filter feeders such as cockles and mussels are likely to ingest microplastics that sunk at the ocean's floor unintentionally. Hence, the samples of cockles, mussels and seawater samples were collected at different anthropogenic sites in Tanjung Karang, Selangor and Sebatu, Melaka, Malaysia to screen potential microplastics contaminant on the shellfish landings. Observation of microplastics were performed using light microscope as well as fluorescence microscope (magnification: 40x) to confirm the presence of microplastics in the biota. The observations under both microscopes showed the potential microplastics presence in the tissues of cockles and mussels with characteristics of thin, red, elongated filaments, irregular fragments and spheruloid-shaped pellets. Types of possible polymer microplastics were identified using FTIR analysis ( $4\text{ cm}^{-1}$  resolution) includes polypropylene, polystyrene and polyethylene. The distribution of microplastics were spatially dependent with principal component analysis (PCA) explaining that 96% of total variation was detected on both shellfish samples from different strategic sites, where all the samples were significantly different ( $p < 0.05$ ). Information generated in this study are useful as food safety management measures as well as for environmental monitoring health measures.

**Keywords:** *Plastics, cockles, mussels, filter feeders, food safety*

## المخلص

متأخرة، رفع استخدام البلاستيك في الحياة اليومية بالنظر إلى استخدام عبوات بلاستيكية وكثرة تغليق الطعام يستخدم بسبب توصيل البضائع والأطعمة. هذا الحال يؤدي إلى التخلص من النفايات السامة خلال الجائحة ورفع التهديد على البيئة بما فيها تلوث المياه وتزعج مصادر الأطعمة ثم يضر الناس. البلاستيك هو قطع من البلاستيك أكثر وجوده، والذي طول أقل من خمسة ملليمترًا معروف بالبلاستيك الدقيق. لذلك، ضمن هذا النطاق، مغذيات الترشيح مثل البطليينوس وبلح البحر اللذان يسهلان لأكل البلاستيك الدقيق يحضر في البحر وفي النفس الوقت يحتمل أن يضر الناس. إذن، حصد البطليينوس وبلح البحر من المنطقتين الإستراتيجيتين وهما تانجونج كارانج، سيلانجور وسباتو، ملاكا، ماليزيا كمنطقة بكثير التلوث بسبب النشاط البشري، بهدف لتحديد التلوث المحتمل البلاستيك الدقيق لدى الحياة القذيفة. الملاحظة عن البلاستيك الدقيق يستخدم المجهر الضوئي والمجهر المضان (التكبير: 40x) للتأكيد بوجود البلاستيك الدقيق لدى الكائنات الحية. نتائج المراقبة باستخدام المجهر، توجد المحتمل للمواد البلاستيكية الدقيقة لدى المنادل البطليينوس وبلح البحر بمميزات مثل صغير الحجم، أحمر، الخيوط طويلة، الجزء غير منتظم والكريات الكروية. نوع البوليمر البلاستيك الدقيق قد تم تأكيده بحضوره باستخدام جهاز 'فوريه' لتحويل طبق الأشعة تحت الحمراء (FTIR) بما فيها المعايير المستخدمة هي البولي بروبلين، والبولي سترين والبولي إيثيلين. كانت وفرة وتوزيع البلاستيك الدقيقة تعتمد مكانيا مع تحليل المكون الرئيسي (PCA) مما يشير إلى اكتشاف 96 % من التباين الكلي في الوفرة من كل عينات المحار من كلا المجالين الاستراتيجيين، حيث كانت جميع العينات مختلفة بشكل كبير ( $p < 0.05$ ). المعلومات تحصل من هذا البحث سيستعمل في إدارة مراقبة سلامة الأطعمة وتدابير الرقابة البيئية.

*الكلمات الدالة: البلاستيك، البطليينوس، بلح البحر، المغذيات الترشيح، سلامة الأطعمة*

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## LIST OF ABBREVIATIONS

ATR	Attenuated Total Reflectance
ASEAN	Association of Southeast Asian Nations
BPA	Bisphenol A
FTIR	Fourier-Transform Infrared Spectroscopy
HCH	Hexachlorinated Hexane
HOC	Hydrophobic Organic Contaminant
IR	Infrared
LKIM	The Fisheries Development Authority of Malaysia
MIDA	Malaysian Investment Development Authority
PBDE	Polybrominated Diphenyl Ether
PCA	Principal Component Analysis
PCB	Polychlorinated Biphenyl
PAH	Polyaromatic Hydrocarbons
PFC	Perfluorinated Surfactant
U.S.FDA	United States Food and Drug Administration
WHO	World Health Organization
WPO	Wet Peroxide Oxidation