

IDENTIFICATION OF VOLATILE ORGANIC
COMPOUNDS AND FORMULATION OF
WHITE-NEST SWIFTLET (*AERODRAMUS
FUCIPHAGUS*) AROMA ATTRACTANT

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

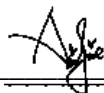


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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Burung walet (*Aerodramus fuciphagus*) merupakan burung pemakan serangga yang banyak ditemui di Asia Tenggara yang menghasilkan sarang yang boleh dimakan (EBN) melalui rembesan air liur. Industri EBN di Malaysia berkembang dengan pesat dan penggunaan aroma adalah salah satu faktor yang dipercayai dapat menarik burung untuk masuk dan membuat sarang di dalam rumah burung. Walau bagaimanapun, penggunaan produk aroma yang sedia ada tidak terbukti secara saintifik dan juga mengandungi bahan kimia yang boleh membahayakan burung walet dan manusia. Fokus utama kajian ini adalah untuk mengenal pasti wap sebatian organik (VOC) daripada aroma EBN, bulu pelepah, dan guano sebagai sampel rujukan dari rumah burung walet yang berjaya. Alat deria hidung elektronik (e-nose) digunakan untuk mengenal pasti indeks persamaan VOC berdasarkan sampel rujukan yang diambil di rumah burung, diikuti dengan analisis pemprofilan kimia menggunakan kromatografi gas/spektrometri jisim (GC/MS) melalui ruang tutupan-pengekstrakan mikro fasa pepejal (HS-SPME). Formulasi aroma yang terdiri daripada bahan berasaskan EBN, bulu pelepah, dan guano yang dilarutkan menggunakan proses hidrolisis enzim dan ekstrak akueus dan seterusnya dikaji untuk perbandingan VOC yang diperoleh daripada data e-nose. Data e-nose menunjukkan peratusan indeks persamaan bulu pelepah (87.06%), guano (67.15%), dan sarang (60.23%) terhadap kawasan yang didiami burung walet di dalam rumah burung. Analisis HS-GC/MS dijalankan menggunakan empat jenis gentian SPME yang berbeza, dan gentian PDMS adalah yang terbaik untuk pengekstrakan VOC daripada sampel. 2,4-di-tert-butilfenol (10.41%) adalah sebatian utama daripada 16 sebatian EBN yang ditemui secara konsisten. Terdapat sebelas sebatian yang dikenal pasti untuk sampel bulu pelepah walet dengan heptadekana (7.26%) dan pentadekana (6.14%) sebagai sebatian utama, diikuti oleh sepuluh sebatian yang diekstrak daripada sampel guano, dengan 2,4-di-tert-butilfenol (3.35%) dan heksadekana (7.39%) sebagai sebatian utama. Seterusnya, teknik hidrolisis enzim digunakan untuk melarutkan sampel EBN dan bulu pelepah untuk formulasi produk. Teknik pengekstrakan akueus selama 24 jam dilakukan ke atas sampel guano. Analisis UV-Vis dilakukan untuk mengkaji keadaan optimum yang diperlukan untuk proses hidrolisis EBN iaitu pada suhu 80 °C selama 90 minit dengan kepekatan 4% enzim alkalase, manakala hidrolisis bulu pelepah adalah yang terbaik pada 80 °C selama 120 minit dengan kepekatan 5% enzim keratinase. Berdasarkan keputusan analisis e-nose, formulasi aroma dihasilkan menggunakan nisbah 80 (hidrolisat bulu pelepah): 15 (ekstrak guano): 5 (hidrolisat EBN). Analisis HS-GC/MS menunjukkan 2,4-di-tert-butilfenol (26.5%) sebagai sebatian utama yang diperolehi daripada produk yang dirumus. ini dapat memberikan maklumat yang bermanfaat berkaitan penggunaan aroma walet sebagai daya penarik dan membantu perusahaan dan penternakan burung walet dan seterusnya meningkatkan produktiviti industri EBN di Malaysia.

ABSTRACT

Swiftlets (*Aerodramus fuciphagus*) are small insectivorous birds that breed throughout Southeast Asia and can produce edible birds' nest (EBN) from the secreted saliva. EBN industries in Malaysia expand greatly and the aroma is one of the factors believed to attract swiftlets to enter and build nests in the birdhouse. However, the use of existing aroma products has not been scientifically proven and the products also contain chemicals which are harmful to swiftlets and humans. This study focused on the identification of volatile organic compounds (VOCs) from the aroma of EBN, feather, and guano as reference samples in a successful swiftlet birdhouse. E-nose technology was used to determine the VOC similarity index based on the reference samples collected. Further validation and chemical profile identification were done using the headspace technique coupled with gas chromatography/mass spectrometry (HS-GC/MS). Then, samples solubilization for aroma formulation was developed using enzymatic hydrolysis and aqueous extraction. The VOCs of the formulated product were compared with the e-nose database. The results from the e-nose showed the similarity index of the feather (87.06%), guano (67.15%), and EBN (60.23%) to the area concentrated with the swiftlet population. Next, HS-GC/MS using four different types of solid-phase microextraction (SPME) fibers were used in the analysis. PDMS fiber showed the highest efficiency in extracting the VOCs from the reference samples. 2,4-Di-tert-butylphenol (10.41%) was the main compound from 16 compounds identified in EBN. Eleven compounds were identified in the feather sample with heptadecane (7.26%) and pentadecane (6.14%) as the main compounds, followed by ten compounds extracted from the guano sample, with 2,4-Di-tert-butylphenol (3.35%) and hexadecane (7.39%) as the main compounds. Next, enzymatic hydrolysis was used to facilitate the solubility of the EBN and feather sample for product formulation. Meanwhile, 24-h aqueous extraction was conducted on the guano sample to obtain the extract for aroma formulation. UV-Vis analysis was carried out to obtain the optimum condition for EBN hydrolysis, which was achieved at 80 °C for 90 min with 4% alcalase concentration, while feather hydrolysis was the best at 80 °C for 120 min with 5% keratinase concentration. Based on the similarity index obtained from the e-nose analysis previously, the aroma formulation was produced using the ratio of 80 (feather hydrolysate): 15 (guano extract): 5 (EBN hydrolysate). Further analysis using HS-GC/MS showed that 2,4-di-tert-butylphenol (26.5%) was the main compound obtained from the formulated product. This research provides much beneficial information regarding the use of attractant aroma toward the success of swiftlet ranching in Malaysia and increasing productivity of the EBN industry.

TABLE OF CONTENT

DECLARATION	
TITLE PAGE	
ACKNOWLEDGEMENTS	ii
ABSTRAK	iii
ABSTRACT	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF SYMBOLS	xi
LIST OF ABBREVIATIONS	xii
LIST OF APPENDICES	xiii
CHAPTER 1	1
1.1 Introduction	1
1.2 Problem Statement	3
1.3 Objectives of the Study	4
1.4 Scope of the Study	4
1.5 Significance of the Research	5
CHAPTER 2	6
2.1 Swiftlets	6
2.2 Edible Birds' Nest	6
2.3 Swiftlet Industry	8
2.4 Swiftlet Farming	9
2.4.1 Factor for a Successful Birdhouse	12
2.4.2 Aroma as Attractant Factor	12
2.5 Volatile Organic Compounds in Bird Farming	14
2.5.1 Volatile Organic Compound Analysis using E-Nose Sensor	14

2.5.2	Volatile Organic Compound Analysis using Solid-Phase Microextraction	16
2.5.3	Volatile Organic Compound Analysis using Gas Chromatography/Mass Spectrometry	19
2.6	Formulation of Aroma Attractant	20
2.6.1	Proteolytic Hydrolysis	22
2.6.2	Keratinolytic Hydrolysis	22
2.6.3	Water Extraction	23
2.7	Analysis for Enzyme-Treated and Untreated Samples	23
 CHAPTER 3		 24
3.1	Introduction	24
3.2	Materials	25
3.2.1	Materials and Chemicals	25
3.3	Swiftlet Sample Preparation	26
3.4	Volatile Organic Compound Analysis	26
3.4.1	E-Nose Sensor Technology	27
3.4.2	Solid-Phase Microextraction	28
3.5	Formulation of Aroma	30
3.5.1	Enzymatic Hydrolysis	31
3.5.2	Water Extraction	31
3.5.3	Fourier Transform Infrared Spectroscopy (FTIR)	31
 CHAPTER 4		 33
4.1	Introduction	33
4.1.1	Sample Collection	31
4.2	Odor Analysis using E-Nose Technology	35
4.3	Volatile Organic Compound Analysis for Raw Materials	38
4.3.1	Chromatogram and Structure of the Main Aroma Compound for Edible Birds' Nest	38
4.3.2	Chromatogram and Structure of the Main Aroma Compound for Feather	44

4.3.3	Chromatogram and Structure of the Main Aroma Compound for Guano	48
4.4	Hydrolysis Process and Analysis of Raw Materials	53
4.4.1	Enzymatic Hydrolysis of Edible Birds' Nest	53
4.4.1.1	Fourier Transform Infrared Spectroscopy of EBN	56
4.4.1.2	Chromatogram and Structure of the Main Aroma Compound for Edible Birds' Nest Hydrolysate	56
4.4.2	Enzymatic Hydrolysis of Feather	60
4.4.2.1	Fourier Transform Infrared Spectroscopy of Feather	60
4.4.2.2	Chromatogram and Structure of the Main Aroma Compound for Feather Hydrolysate	65
4.4.3	Aqueous Extraction of Guano	68
4.4.3.1	Fourier Transform Infrared Spectroscopy of Guano	68
4.4.3.2	Chromatogram and Structure of the Main Aroma Compound for the Aqueous Extract of Guano	70
4.5	Aroma Formulation	73
4.5.1	Chromatogram and Structure of the Main Aroma Compound for Aroma Mixture Sample	74
 CHAPTER 5		77
5.1	Conclusion	77
5.2	Recommendations	78
 REFERENCES		79
 APPENDICES		92

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