



UNIVERSITI PUTRA MALAYSIA

***CHARACTERIZATION OF HOUSE AND CAVE BIRD'S NEST IN
MALAYSIA AND OPTIMIZATION OF A BIRD'S NEST-BASED GEL-LIKE
READY-TO-DRINK PRODUCT***

YAP KIM CHUNG

FSTM 2020 24



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By

YAP KIM CHUNG

**Thesis Submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in Fulfilment of the Requirements
for the Degree of Master of Science**

June 2020

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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

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June 2020

Chair : Tan Chin Ping, PhD
Faculty : Food Science and Technology

Edible bird's nest (EBN) from the saliva of swiftlets has been esteemed as a precious food tonic because it possesses antiaging, anticancer, and immunity-enhancing properties. This study was conducted to characterize and determine the physicochemical properties of edible bird's nest from cave nest and house nest (from genus *Aerodramus*) in Malaysia and develop EBN (gel-like) ready-to-drink formulation using RSM. All EBN samples used in this study were genuine raw samples collected from cave and house farm in Malaysia. Expansion rate study and SEM observations were performed to determine the different types and location factors that affect the physical profile of EBN. For chemical profile study, HPLC and HPAEC-PAD method was used to determine amino acid and glycoprotein profile. Based on the expansion and SEM observation, house nest samples have a better expansion rate and result indicated that the simpler (crystal-like) micromorphology of house nests has more surface area to absorb water in comparison to cave nest. Results from the amino acid analysis revealed that EBNS in Malaysia had very similar profiles. Leucine (39.65 – 41.88 mg/g), threonine (40.68 – 41.35 mg/g), and valine (37.90 – 40.44 mg/g) were the three major essential amino acids in both types of samples. There were no significant differences ($P > 0.05$) between the amino acid profiles of house EBN and cave EBN. Through glycoprotein analysis, N-acetylneuraminic acid/N-acetyl-D-galactosamine (Neu/GalN) ratio can be used as a benchmark to identify the quality of EBN. EBN from Kuantan ranked the highest quality among all the samples, with a Neu/GalN ratio of 5.28, while EBN from Parit Buntar ranked the lowest, with a reading of 2.01. The Neu/GalN ratio showed that the quality of EBN from Malaysia is equivalent to or better than EBN from Thailand, Indonesia, and Vietnam. Response surface methodology (RSM) was utilized to investigate the influence of the purified EBN (1–3%) and xanthan gum (0.5–1.5%), as well as the preparation temperature (25–75°C), on the gel strength, adhesiveness, and viscosity. The formulation and optimization of three independent

variables were carried out to obtain an optimum EBN-based ready-to-drink product. The optimal bird's nest (gel-like) ready-to-drink formulation was prepared with 3.00% EBN and 0.97% xanthan gum at 60°C. Currently, the gel-like EBN ready-to-drink products are not common in the market and this product can be used to penetrate new continents and not only relying on exporting raw EBN to China market.



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

**PENCIRIAN SARANG BURUNG WALIT JENIS GUA DAN RUMAH DI
MALAYSIA DAN PENGOPTIMUMAN FORMULASI MINUMAN GEL
BERASASKAN SARANG BURUNG WALIT**

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Sarang burung (EBN) dari air liur burung walit telah dianggap sebagai makanan tonik kerana ia digunakan sebagai ubatan tradisional untuk anti-penuaan, anti-kanser, dan menguatkan imuniti badan. Oleh itu, kajian ini dijalankan bertujuan untuk mencirikan EBN (genus *Aerodramus*) jenis sarang gua dan sarang rumah di Malaysia secara segi fizik and kimia. Selain itu, kajian in juga bertujuan pengoptimuman formulasi minuman gel berasaskan sarang burung walit dengan menggunakan Kaedah Permukaan Respons (RSM). Sampel yang digunakan dalam kajian ini adalah sampel mentah yang dikumpulkan dari gua dan perladangan rumah di Malaysia. Kajian kadar pengembangan dan pemerhatian SEM dilakukan untuk menentukan sama ada faktor jenis dan lokasi mempengaruhi profil fizikal EBN. Untuk kajian profil kimia, kaedah HPLC dan HPAEC-PAD digunakan untuk menentukan profil asid amino dan glycoprotein. Berdasarkan kadar pengembangan dan pemerhatian SEM, sampel sarang rumah mempunyai kadar pengembangan yang lebih baik dan hasilnya menunjukkan bahawa sarang rumah mempunyai mikromorfologi yang lebih ringkas (seperti kristal) dan mempunyai lebih banyak luas permukaan untuk menyerap air berbanding dengan sarang gua. Secara keseluruhan, analisis asid amino mendedahkan bahawa EBN di Malaysia mempunyai profil asid amino yang sangat serupa. Leucine (39.65 - 41.88 mg / g), Threonine (40.68 - 41.35 mg / g) dan Valine (37.90 - 40.44 mg / g) adalah 3 jenis asid amino paling utama dalam kedua-dua jenis EBN (rumah dan gua). Perbezaan profil asid amino antara dua jenis EBN adalah tidak ketara ($P > 0.05$). Melalui analisis glycoprotein, bacaan N-Acetyl-neuraminic acid/N-Acetyl-D-galactosamine (Neu/GalN) digunakan sebagai penanda untuk mengenal pasti kualiti EBN dan EBN dari Kuantan merupakan EBN yang paling berkualiti di antara semua sampel dengan bacaan Neu/GalN-5.28, manakala EBN dari Parit Buntar mempunyai kualiti yang paling rendah dengan bacaan 2.01. Bacaan Neu/GalN menunjukkan bahawa kualiti EBN dari Malaysia adalah sama atau lebih baik daripada EBN dari Thailand,

Indonesia dan Vietnam. Kaedah Permukaan Respons (RSM) digunakan untuk menyiasat pengaruh EBN (1-3%) dan xanthan gum (0.5-1.5%) serta suhu penyediaan (25-75°C) terhadap kekuatan gel, kelekatan dan kelikatan. Formulasi dan pengoptimuman tiga pembolehubah bebas telah dijalankan untuk mendapatkan produk minuman EBN yang paling optimum. Formulasi optimum untuk minuman sarang burung adalah 3.00% EBN, 0.97% xanthan gum dan diproseskan pada suhu 60°C. Berdasarkan kajian ini, formulasi optimum yang diperolehi daripada kajian ini bukan sahaja memberi manfaat kepada penyelidikan minimum EBN. Pada masa ini, produk minuman gel menggunakan EBN masih tidak popular di pasaran dan produk ini boleh digunakan untuk menembusi pasaran baru dan tidak hanya bergantung kepada pengeksportan EBN mentah ke pasaran China.



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LIST OF ABBREVIATIONS

%	Percent
°C	Degree celcius
2-DE	Two-dimensional gel electrophoresis
ANOVA	Analysis of variance
CCD	Central composite design
cm	Centimetre
CNCA	Certification and Accreditation Administration of the People's Republic of China
DOSM	Department of Statistics, Malaysia
EBN	Edible bird nest
et al.	Et alia (and others)
e.g.	For example
ETP	Economic transformation programme
fl.oz	Fluid ounce
g	Gram
h	Hour
H0	Null hypothesis
HA	Alternative Hypothesis
HPLC	High performance liquid chromatography
FTIR	Fourier transform infrared
kDa	Kilodaltons (molecular weight)
kg	Kilogram
L	Liter
mg	Milligram
Min	Minute
ml	Milliliter
MOH	Ministry of health
N	Newton
Pa	Pascal
Pa.s	Pascal-second
Ppm	Parts per million
Rpm	Revolution per minute
RSM	Response surface methodology
RTD	Ready to drink
SA	Sialic acid
SEM	Scanning electron microscopy
SD	Standard deviation

CHAPTER 1

INTRODUCTION

There are several species of swiftlets such as *Collocalia fuciphaga*, *Collocalia germanis*, *Collocalia maxima* that produce edible bird's nests (EBNs) are consumed by humans as a delicacy or medicinal food. The benefits of EBN have been evaluated in different fields, namely, food, cosmetics and medicine (Norhayati et al., 2010). The main component of EBN is glycoprotein, which is derived from *Collocalia* mucoid prepared by aqueous extraction and was first discovered by Howe, Lee, and Rose (1961). The glycoprotein present is capable of promoting cell division, and the presence of an epidermal growth factor-like protein has been proven (Ng et al., 1986; Kong et al., 1987). EBN has a good effect on the skin and has become attractive to women due to its properties of making the skin appear delicate and radiant.

The distribution of swiftlets is restricted to tropical and subtropical regions extending from the western Indian Ocean through southern continental Asia, Indonesia, Palawan in the Philippines, northern Australia, New Guinea and islands in the southwest Pacific. However, the swiftlets that can produce EBN are mainly located in Southeast Asian countries. The main producers of EBN include Indonesia, Thailand, Malaysia, Vietnam and Myanmar (Lim 2011, Ma and Liu, 2012). Gomantong cave and Niah cave located in Sabah and Sarawak were the most common sites of limestone cave for harvesting EBN with approximately 1.5 million swiftlets (Gausset, 2004).

EBN is a high-value agricultural product that contributes approximately 1% to Malaysia's GDP, and the main market for EBN is China. In 2010, the total production of EBN in Malaysia was 275 tons, which was worth approximately RM1.5 billion (ETP, 2011; Swiftlet Eco Park, 2012). Unfortunately, this industry underwent its first downturn when China implemented a ban on Malaysian EBN in early July 2011. Consequently, the EBN industry in Malaysia has experienced large losses, indirectly affecting our country's economic growth. To restore lucrative trade, Malaysian governments have signed Memoranda of Understanding with the Chinese government. Certification and Accreditation Administration of the People's Republic of China (CNCA) has issued an order to inspect all the facilities involved in EBN processing but only a few Malaysian suppliers have succeeded in passing the certification process to legally export to China (Lee, 2014). After all the difficulties, 15 Malaysian companies were allowed to export EBN to China exclusively in 2015 under the inspection of CNCA (Looi & Omar, 2016). In food manufacturing, formulation and optimization are two important processes for the creation of a new product. The process of optimizing parameters increases not only the utility of the technology but also the quality of the product. Considering the lack of a model to optimize the use of EBN in gel-like ready-to-drink (RTD) formulations, this study aimed to find an optimal EBN-based RTD formulation using response surface methodology (RSM). RSM is an effective and simple technique for

analyzing, improving and optimizing structures over the practicable domain of parameter settings (Shokuhfar et al., 2008). Over the years, RSM has been the most popular optimization method used in product development (Chellamboli and Perumalsamy, 2014; Amdoun et al., 2010; Baş and Boyacı, 2007), and many studies have been investigated based on the application of RSM in industrial processes. The RSM method is a set of mathematical and statistical techniques in which a response of interest is influenced by several variables, and the aim is to optimize this response by determining the correlation between the response and independent variables (Raissi and Farsani, 2009).

EBN has been used for several hundred years, and its usage is based mainly on historical, anecdotal and observational reports of its benefits. Considering that scientific evaluations of the compositional properties and knowledge about the glycoproteins of EBN are still limited, the physical and chemical composition of EBN is worth studying.

Therefore, the research objectives of this study were as follows:

1. To characterize and determine the physicochemical properties of edible bird's nest from cave nest and house nest (from genus *Aerodramus*) in Malaysia.
2. To optimize the formulation of EBN based gel-like ready-to-drink products with 3 variables namely xanthan gum concentration, EBN concentration and temperature using RSM.

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Yap Kim Chung was born in Klang, Malaysia. He finished his primary and secondary studies in Seremban. He then pursued his bachelor's degree in Food Study Universiti Putra Malaysia (UPM) and graduated in year 2007. After working for few years, he decided to further his study under the supervision of Prof. Dr. Tan Chin Ping and is currently working on edible bird's nest product development.



LIST OF PUBLICATIONS

Journal Submitted

Yap, K. C., Tan, C. P., & Chong, G. H. (2020). Edible Bird Nests Quality Identification using HPAEC-PAD. *International Food Research Journal*.





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