MALAYSIAN CONSUMER ACCEPTANCE AND PREFERENCE TOWARDS THREE TYPES OF LOCAL HONEY BASED ON SENSORY CHARACTERISTICS

SITI FARHANA BINTI SALUDIN

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By

SITI FARHANA BINTI SALUDIN

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

January 2019

DEDICATION

I dedicate this diamond to my loving parents and my siblings.

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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January 2019

Chairman : Associate Professor Nitty Hirawaty Kamarulzaman, PhD
Faculty : Agriculture

Honey is proven to have a lot of benefits if it is consumed continuously. Usually, honey consumed as foods as well as for medicinal values, cosmetics, etc. Local honey is the most well-known honey in the market and the uniqueness of its characteristics and quality has made it receive a high demand from consumers. As Malaysia can only fulfil 4% of local honey demanded, thus Malaysia needs to import honey from other producer countries to fully fulfil the demand. The most crucial issue that occurred in the honey market is the dominated of artificial honey that has been manipulating the quality and thus confusing the consumers to purchase good quality of pure local honey.

This study was carried out mainly to determine Malaysian consumer acceptance and preference towards three types of local honey (Tualang honey, Stingless bee honey (locally known as Kelulut honey), and Mellifera honey) based on sensory characteristics. Four specific objectives of the study were established; 1) to determine sensory characteristics of three types of local honey, 2) to investigate the association between consumers' preferences towards three types of local honey based on sensory characteristics and socio-demographic profiles, 3) to determine consumers' acceptance towards three types of local honey based on sensory characteristics, and 4) to investigate the most influential factors that influenced consumers' preferences towards three types of local honey.

Purposive sampling was used to select 406 respondents being honey consumers representing Klang Valley, Malaysia. Face-to-face interviews were carried out with the respondents using a structured questionnaire, consisting of closed and open-ended questions. The data was analysed using several statistical analyses such as descriptive analysis, Chi-square analysis, one-way analysis of variance (ANOVA) analysis, factor

analysis, and logistic regression analysis. Further, sensory evaluation was used to analyze the sensory characteristics of three types of local honey among the respondents.

Based on the descriptive analysis, majority of the respondents consumed honey for less than 50 times per year with less than 500ml per year. Medicinal value of the honey was the important reason for the respondents to consume honey. The results of mean ranking analysis showed that most of the respondents preferred honey with sweet in taste and more viscous. Chi-square analysis was carried out and the results revealed that race and marital status were significant with consumers' preferences towards three types of local honey based on sensory characteristics.

The results of one-way analysis of variance (ANOVA) analysis indicated that most of the respondents preferred the moderately light color of Tualang honey and Mellifera honey, and slightly lighter colour of Stingless bee honey. Overall, the respondents were more preferred Mellifera honey compared to other types of honey. Meanwhile, factor analysis revealed that there were nine (9) factors such as granular, colour, bitterness, sweetness, viscosity, spices aroma, sourness, herbal aroma, and fruity aroma influenced the respondents' preferences towards three types of local honey based on sensory characteristics. Finally, the results from logistic regression analysis revealed that viscosity was the most influential factor that influenced consumers' preferences towards three types of local honey when deciding to purchase.

In conclusion, the results from the analyses showed that Mellifera honey was the most preferred honey among the respondents and viscosity attribute was the major attribute that influenced consumers' preferences towards three types of local honey. The findings are beneficial for all local honey producers especially Mellifera honey producers as this study has significantly proved that Mellifera honey was the most preferable honey among the consumers. Thus, the government needs to promote and support the honey industry as there are some unique characteristics of local honey which have significantly attracted consumers for consuming the honey. The government and other agencies also need to establish the local honey standard and publish it for public use. Besides, the government also should organize various programs in order to spread the information on the quality standard of local honey, so that the producers and consumers could improve their knowledge and confident about the local honey.

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PENERIMAAN DAN KEHENDAK PENGGUNA DI MALAYSIA TERHADAP TIGA JENIS MADU TEMPATAN BERDASARKAN CIRI–CIRI DERIA

Oleh

SITI FARHANA BINTI SALUDIN

Januari 2019

Pengerusi : Profesor Madya Nitty Hirawaty Kamarulzaman, PhD
Fakulti : Pertanian

Madu dibuktikan mempunyai banyak manfaat sekiranya diambil secara berterusan. Kebiasaannya, madu diambil sebagai makanan, untuk tujuan nilai perubatan, kosmetik, dan lain-lain. Madu tempatan adalah madu yang amat terkenal dalam pasaran dan keunikan ciri-ciri serta kualiti membuatkan madu tempatan mendapat permintaan yang tinggi daripada pengguna. Oleh kerana Malaysia hanya mampu memenuhi 4% sahaja permintaan terhadap madu tempatan, Malaysia perlu mengimport daripada negara pengeluar madu untuk memenuhi keseluruhan permintaan. Isu utama dalam industri madu adalah madu tiruan yang mendominasi pasaran seterusnya memanipulasi kualiti madu dan menyebabkan kekeliruan pengguna dalam membeli madu tempatan yang mempunyai kualiti yang terbaik.

Tujuan utama kajian ini dilaksanakan adalah untuk mengenalpasti penerimaan dan kehendak pengguna di Malaysia terhadap tiga jenis madu tempatan (madu Tualang, madu Kelulut, dan madu Mellifera) berdasarkan ciri-ciri deria. Empat (4) objektif utama kajian yang di tetapkan adalah: 1) untuk mengenalpasti ciri-ciri deria bagi tiga jenis madu tempatan yang berbeza; 2) untuk mengenalpasti hubungan antara kehendak pengguna di Malaysia terhadap tiga jenis madu tempatan berdasarkan ciri-cire deria dan profil sosio-demografi pengguna; 3) untuk menyiasat penerimaan pengguna terhadap tiga jenis madu tempatan berdasarkan ciri-ciri deria; 4) untuk menyiasat faktor-faktor yang paling mempengaruhi kehendak pengguna terhadap tiga jenis madu tempatan.

Kaedah persampelan secara bertujuan digunakan untuk memilih 406 responden yang merupakan pengguna madu yang mewakili Klang Valley, Malaysia. Temuramah

secara bersemuka dijalankan dengan menggunakan soalan berstruktur yang mengandungi soalan terbuka dan tertutup. Data daripada temuramah dianalisis dengan menggunakan analisis diskriptif, analisis kedudukan min, analisis Khi-kuasa dua, analisis varian (satu-hala ANOVA), analisis faktor dan analisis regrasi logistik. Selanjutnya, penilaian deria di gunakan untuk menganalisis ciri-ciri deria tiga jenis madu tempatan antara pengguna.

Berdasarkan analisis diskriptif, kebanyakan pengguna mengambil madu kurang daripada 50 kali setahun dan kurang daripada 500ml setahun. Nilai perubatan adalah penyebab utama responden untuk mengambil madu. Hasil dapatan analisis kedudukan min menunjukkan kebanyakan responden lebih suka madu yang mempunyai rasa manis and lebih pekat. Dapatan kajian daripada analisis Khi kuasa dua menunjukkan bahawa bangsa dan status perkahwinan adalah signifikan dengan kehendak pengguna terhadap ciri deria madu.

Hasil dapatan kajian untuk analisis varian (satu-hala ANOVA) menunjukkan bahawa kebanyakan responden lebih suka warna madu Tualang dan Mellifera yang sederhana cerah dan madu Kelulut yang berwarna sedikit cerah. Keseluruhannya, responden lebih suka madu Mellifera berbanding madu yang lain. Sementara itu, analisis faktor mengenalpasti terdapat Sembilan (9) faktor yang mempengaruhi persepsi pengguna terhadap tiga jenis madu tempatan berdasarkan ciri-ciri deria iaitu berbutir, warna, rasa pahit, rasa manis, kepekatan, aroma rempah, rasa masam, aroma herba dan aroma buah-buahan. Akhir sekali, dapatan daripada analisis regrasi logistik mengenalpasti bahawa kepekatan adalah faktor penting yang mempengaruhi kehendak pengguna terhadap tiga jenis madu tempatan apabila membuat keputusan untuk pembelian.

Kesimpulannya, keputusan daripada analisis menunjukkan bahawa madu Mellifera adalah madu yang menjadi pilihan responden and kepekatan adalah ciri utama yang mempengaruhi kehendak kualiti pengguna terhadap madu tempatan. Hasil kajian ini berguna untuk semua pengeluar madu terutama pengeluar madu Mellifera kerana madu Mellifera dibuktikan menjadi pilihan utama pengguna. Oleh yang demikian, kerajaan perlu mempromosikan dan menyokong industri madu kerana terdapat ciri-ciri unik yang menarik pengguna untuk mengambil madu tempatan. Agensi kerajaan juga perlu menubuhkan standard madu tempatan dan diterbitkan untuk kegunaan awam. Di samping itu, kerajaan juga harus menganjurkan pelbagai program untuk menyebarkan maklumat berkenaan standard kualiti madu tempatan untuk membantu pengeluar dan pengguna memperoleh pengetahuan dan keyakinan terhadap madu tempatan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Nitty Hirawaty Kamarulzaman, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Mohd Mansor Ismail, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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Signature: _____
Name of
Chairman of
Supervisory
Committee: Associate Professor Dr. Nitty Hirawaty Kamarulzaman

Signature: _____
Name of
Member of
Supervisory
Committee: Professor Dr. Mohd Mansor Ismail

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LIST OF ABBREVIATIONS

AFB	American Foulbrood
ANOVA	One-Way Analysis of Variance
BOT	Balance of Trade
CCD	Colony Collapse Disorder
CLT	Central Location Test
CODEX STAN	Codex Alimentarius Standard
DOA	Department of Agriculture
EFB	European Foulbrood
FAO	Food and Agriculture Organisation
FCP	Free Choice Profiling
HMF	Hydroxymethylfurfural
HSD	Honsetly Significance Difference
H_0	Null Hypothesis
$H_{1, 2, 3}$	Alternative Hypothesis
IDRC	International Development Research Centre
IFT	Institute of Food Technology,
IHC	International Honey Commission
ISO	International Organization for Standardization
ITC	International Trade Centre
JAR	Just About Right Scale
KMO	Kaiser-Meyer-Olkin
KPD	Koperasi Pembangunan Desa
MARDI	Malaysian Agricultural Research and Development Institute
MBRDT	Malaysian Beekeeping Research and Development Team
MOA	Ministry of Agriculture and Agro-Based Industry
MOH	Ministry of Health
RISDA	Rubber Industry Small Holders Development Authority
RRIM	Rubber Research Institute Malaysia
TFQ	Total Food Quality
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UM	Universiti Malaya
USFDA	US Food and Drugs Administration
UPM	Universiti Putra Malaysia
USA	United States of America
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

The first chapter of this thesis gives a brief description of the beekeeping industry in Malaysia and its contribution to the nations. The issues and challenges related to the industry are discussed with reference to the local honey. Specifically, the chapter focuses on three types of local honey and its' characteristics. The chapter also consists of the problem statement, research questions, research objectives, significance of the study, and organization of the thesis.

1.1 Overview of the Beekeeping Industry in Malaysia

Malaysia is one of the countries that is blessed with varieties of flora and fauna. One of them is the bee. There are great varieties of bee species in Malaysia and the two types of bees usually reared by the beekeepers are a honey bee (sting bee) and stingless bee that is also known as Kelulut among Malaysians. According to Hassan and Omar (2003), beekeeping activity in Malaysia has been documented since Malacca Sultanate. Nevertheless, it is believed that the beekeeping activity was practiced for a very long time ago. The villagers were known to be the honey hunters as they harvest the honey directly from the beehive. Based on Mardan, Hamid, Emby, Marasidi, and Ismail, (1988), the honey harvested by a hunter is from the hives of the wild bee, *Apis dorsata*, nested in a Tualang tree in the deep forest. This is how the Tualang honey got its' name. Honey produced by *Apis dorsata* is also known as wild honey. The honey hunters use several traditional tools such as a bamboo ladder, cow-bone knife and cow-skin container to perform a special ceremony while harvesting honey which usually takes place in the middle of the night (GNE HMP, 2014; Mardan *et al.*, 1988; Mardan, 2008). This activity will be performed once a year, which is usually between January and April.

The beginning of modern beekeeping in Malaysia was in the 1970s when the beekeeper set up an apiary in Johor by using the imported commercial bees (*Apis mellifera*) from Taiwan (Ismail, 2016). Mardan (2008) stated that in 1981, the establishment of Malaysian Beekeeping Research and Development Team (MBRDT) that was funded by the International Development Research Centre (IDRC) and led by Dato' Prof. Dr. Makhdzir Mardan from Universiti Putra Malaysia were objectively concerned to develop the systematic beekeeping in Malaysia. Furthermore, in the 1980s also, the Malaysian Ministry of Agriculture through the Department of Agriculture (DOA) now known as Ministry of Agriculture and Agro-Based Industry (MOA) in Johor had sent an officer to Australia for the beekeeping training. In October 1988, a National Apiary Centre was established at Parit Botak by MOA that was aimed to plan, develop, and organize training in modern beekeeping. Nevertheless, this centre is less exposed to the public (Ismail, 2014; Ismail, 2016). Modern beekeeping

in Malaysia involved the domesticated bees such as *Apis mellifera, Apis cerana*, and several species of stingless bee like *Geniotrigona thoracica, Heterotrigona itama, Lepidotrigona terminata,* and *Tetragonula leaviceps* (DOA, 2012; Jaafar, 2012). The tools or apparatus that were used is more developed compared to previously, for instance, a built hive, frame, and centrifuge which assists in the management and development of beekeeping for a rapid growth (DOA, 2012; Jaafar, 2012).

Malaysia is a country with an abundance of a variety of bee species, such as honey bee, orchid bee, sweat bee, alkali bee, stingless bee, and others (Ismail, 2014). Malaysia is also a country that contains diverse plant species which some of it are fruit tree planted by the farmers and some of it are forest tree. This diverse species of plants are able to produce the favourable nectar for the bees. As a tropical country, Malaysia allows for luxuriant plant growth and produce a wide array of edible fruits, and this makes Malaysia is very well-known as a paradise of fruit enthusiasts. There are seasonal and non-seasonal fruits in Malaysia. Non-seasonal fruits such as coconut, pineapple, star fruit, papaya, guava, and watermelon are simply available throughout the year in Malaysia. Table 1.1 shows the potential monthly revenue generated from beekeeping industry with respect to the area of the crop or plant in Malaysia.

Table 1.1: Monthly Revenue of Beekeeping Industry

No	Types of Crop/Plant	Area (ha)	Capacity of Colony (unit)	Labour Capacity (person/ 200 colony)	Potential Yield (kg/month)	Potential Revenue (RM 30/kg)
1	Acacia Mangium	655,000	163,750 @ 4ha/colony	818	786,000 @ 6kg/colony	23,580,000.00
2	Pineapple	12,800	3200 @ 4ha/colony	16	9600 @ 3kg/colony	288,000.00
3	Coconut	123,000	30,750 @ 4ha/colony	153	30,750 @ 1kg/colony	922,500.00
4	Fruit	54,840	6855 @ 8ha/colony	34	3427 @ 0.5kg/colony	102,810.00
5	Starfruit	2,550	2550 @ 1ha/colony	12	10,200 @ 4kg/colony	306,000.00
	Total	848,190	207,105	1,033	839,977	25,199,310.00

Source: Department of Agriculture (2013)

Based on Table 1.1, it shows that a total of 193,190 ha of land are occupied by farms of coconut, pineapple, star fruit, and other fruit. According to Ismail (2014), *Melaleuca cajuputi* (Malay language: gelam) and *Acacia mangium* (Malay language: akasia) are the common plants that are easily found in the tropical forest of Malaysia that produce nectars and pollen for the bees. Based on Table 1.1, *Acacia mangium* occupying about 655,000 ha of lands in Malaysia, thus it plays a vital role in the development of Malaysians' beekeeping industry. This plant would influenced the sensory characteristics of the honey through its nectar that is collected by honey bees, processed and stored in the honey comb until it ripens. According to Hagler *et al.* (2011), that honey bee can travel from 45 m the minimum to 5,983 m the maximum,

in fact, could be as long as 10 km to collect pollen and nectar. *Acacia mangium* is the plant that has high potential of yield which is 786,000 kg per month with 163,750 colonies of honey bee.

At the early days, the beekeeping industry in Malaysia was at a slow stage for almost last 10 years before it could slowly recover. In 1996 and 1997, the colony collapse disorder (CCD) occurred and destroyed almost all the bees in Malaysia. A species of mite, *Varroa destructor*, carried by the imported *A. Mellifera* bee, spread and killed the other bee colonies. The effect of the CCD made the production of honey to decrease throughout Malaysia from 1996 up to 2008 (Ismail, 2014). Based on the Ministry of Agriculture and Agro-Based Industry (MOA), in 2010, there was a total of 417 beekeepers that have registered with a total of 5,916 colonies. This number is way too low when compared with 1988 whereby during that year, there were 946 bee breeders with over 7,000 colonies. There were 600 to 700 of beekeepers that have been registered in the MOA in 2015 from all the states in Malaysia with total hive count of 23,189 hives and the highest beekeepers were from Sabah with 625 beekeepers, followed by Kedah with 20 beekeepers and Kelantan with 17 beekeepers. Sabah has the highest number of beekeepers in Malaysia as it is the largest area of virgin Acacia forest in the country (See, 2016). In Sabah, beekeeping on local bees is one of the main projects in poverty eradication programmes under the auspices of *"Koperasi Pembangunan Desa"* (KPD), Sabah and in 2010, KPD managed to have 200 trained beekeepers with 40,000 colonies of *A. cerana*. The annual production of natural honey in Sabah is also expected to increase to 360 tonnes from 20 tonnes currently. This will at least contribute to the 5,000 tonnes of natural honey stipulated in the Balance of Trade (BOT) Plan, 2000.

There are several companies that rear honey bees in Malaysia that contribute to the honey production of the country. B-B Town Sdn. Bhd. is one of the companies that rear honey bee who owns 5,000 hives that can produce 98,000 kg of honey per year. This company operates in Kg Pangkalan Badak and Kg Bukit Katil, Melaka that rears a bee species of *Apis mellifera* with an open culture system since year 1978. Summer Pacific Sdn. Bhd. is also one of the companies that own 2,850 hives at Samarahan, Tatau, and Bintulu, Sarawak that also rears *Apis mellifera* species. There is another company that rears honey bee at Sungai Lembu, Pulau Pinang that owns 1,200 hives of *Apis mellifera* in orchards and bushes nearby. These three (3) companies represent 38.7% of total bee hives in Malaysia with honey production of 192,000 kg per year (62.8% of national honey production) in 2015. Though Malaysia produces its own local honey, at the same time, Malaysia needs to import honey from other countries to fulfil the demand of honey from the local consumers. Honey importing countries of Malaysia are Australia, China, New Zealand, and Thailand. Table 1.2 shows the selected countries that export natural honey to Malaysia in terms of quantity (in tonnes) and value (in RM) for 2015 and 2016.

Table 1.2: Quantity and Value Imports of Natural Honey

Country		2015	2016
Australia	Quantity (in Tonnes)	357	400
	Value (in RM)	8,091	9,600
China	Quantity (in Tonnes)	2,690	1,184
	Value (in RM)	19,400	12,044
New Zealand	Quantity (in Tonnes)	126	134
	Value (in RM)	7,699	9,649
Thailand	Quantity (in Tonnes)	264	348
	Value (in RM)	4,158	5,165
Total	**Quantity (Tonnes)**	**3,437**	**2,066**
	Value (RM)	**39,348**	**36,458**

Source: International Trade Centre (2017)

Based on Table 1.2, there are four (4) selected countries that export honey to Malaysia. Total quantities of natural honey that have been imported to Malaysia by four selected countries for the past two years showed the declination in quantities which were from 3,437 tonnes in 2015 to 2,066 tons in 2016. The declination also applied to the total value of the imported honey which was from RM39,348 in 2015 to RM36,458 in 2016. For the past two years, China is the leading country that exports natural honey to Malaysia with 41% of the total value (RM19, 400) in 2015 with the quantity of 2,690 tonnes of natural honey. In 2016, Australia, Thailand, and New Zealand shows a slight increase in the quantities of honey that have been imported.

Honey is a natural product that is sweet in taste, produced by honeybees that are collected from the sugary secretion of plants, process it through regurgitation and stored in honeycomb to ripen. Usually honey is in form of a viscous liquid such as syrup, colour in pale yellow to yellowish brown, typical sweet taste with a delicious aroma and fresh. It is made up by bees that become one of the pollination agents of the plants. Based on US Food and Drugs Administration (USFDA), honey is a combination made up of the nectar and sweets deposit from plants, modified and stored in honeycomb by honeybees. Encyclopaedia Britannica also stated that honey is a sweet, viscous liquid food and dark golden in colour that is produced in the honey sacs of various bees from the nectar of the flowers. The flavour and colour of honey are influenced by the flowers from which the nectar is gathered. The nectar that is collected by the bees is ripened into honey by inversion of the major portion of its sucrose sugar into the sugars levulose (fructose) and dextrose (glucose) and by the removal of excess moisture. Honey stored in a honeycomb that is double layered of uniform hexagonal cells constructed of beeswax (secreted by the worker bees) and propolis (a plant resin that collected by the worker).

Malaysia is one of the countries that become the epicentre of biodiversity for bees and honeybees. There are thousands of bee species that can be found in Malaysia and also their natural enemies are aplenty and they thrive well in rainforest ecosystem. In the context of sustainable development, the rainforest assumes a critical or important role in carbon sequestration or global carbon sink in the climate change era. In regards to

that, it can be considered that bees are important to the conservation of genetic biodiversity of the rainforest flora species (Mardan *et al.,* 1988). The genus Apis has been greatly associated with a human because of its main by-products from the honeybees - honey. The ecosystem of the rainforest is teeming and well-endowed with great diversity of flora-fauna interaction of species that it yields tremendous fractal niches and habitats that enable five (5) (*A. dorsata, A. andreniformis, A. cerana, A. koschevnikovi, and A. nuluensis*) out of the eight (8) world's honeybee species to co-exist in the tropical rainforest of Malaysia (Mardan *et al*., 1988).

Honey produced by honey bees using the nectar from flowers through a process of regurgitation and evaporation. Based on Nordqvist (2018), honey has high levels of monosaccharides, fructose, and glucose, containing about 70% to 80% of sugar, which gives it its sweet taste. Usually, honey is used as a sweetener, as well as a natural beauty agent and it is also stated that honey has been used in a few societies for its' medicinal values. According to Mandal and Mandal (2011), in world's oldest medical literature, the importance of honey in terms of medicinal value has been documented and it has been known to possess antimicrobial property as well as wound-healing activity.

The healing property of honey is well-known due to the fact that honey offers antibacterial activity, maintains a moist wound healing, and high viscosity of honey help to provide a protective barrier to prevent infection. Its immunomodulatory property is relevant to wound repair too. The antimicrobial activity in most honey is due to the enzymatic production of hydrogen peroxide. Eteraf-Oskouei and Najafi (2012) stated that honey has an inhibitory effect on around 60 species of bacteria, some species of fungi and viruses. In many disease conditions, the antioxidant capacity of honey is important due to a wide range of compounds including phenolics, peptides, organic acids, enzymes, and Maillard reaction products. Honey has also been used in some gastrointestinal, cardiovascular, inflammatory and neoplastic states.

The current price of honey in this country varies depending on the location, type of bees and type of nectar sources. As reported, Selangor shows the highest price of honey as compared those sold in Sabah and Sarawak. The most expensive honey is from Trigona species and the one from tropical forest. It also stated that the price of honey offered by the wholesalers is between RM25.00 and RM100.00 per kilogram, whereas, the price sold by retailers to consumers is between RM50.00 and RM140.00 (Ismail, 2014). It can be concluded that the local honey sold at a premium price, thus enabling the beekeepers to obtain high income if they increase their production.

Malaysia is one of the honey producers that produced honey with unique characteristics and honey is become a well-known natural product among consumers in Malaysia. The uniqueness characteristics of honey usually describe through its authentic sensory characteristics such as taste, aroma, colour, and texture. These authentic sensory characteristics are influenced by the climate and also the conditions of the environment around the foraging areas of the honey bees (Chua, Rahman, Sarmidi, and Aziz, 2012). Besides, this authenticity of local honey has attracted

consumers to consume local honey (Ismail, 2014) and thus, increased demand for local honey in the market. Honey not only consumed in the form of its original form, but it also used as value adding for several products such as beverages product, cereals products, bakery, supplement, and cosmetics. According to Ismail (2014), average production of honey in Malaysia for each year is 64 metric tonnes and the average consumption of honey among the Malaysian consumers are 1,622 metric tonnes. These figures showed that honey production in the country only accommodates 4% of the total honey consumption. Besides, Ismail (2014) stated that the consumption of honey increased up to 5,780 metric tonnes with consumption per capita at 210g. In order to support the increased consumption per capita, the production of local honey needs to be increased to 5,000 metric tonnes annually. Thus, due to this scenario, Malaysia needs to import honey from other countries to fulfil the demand of honey among consumers.

1.2 Types of Honey

1.2.1 Stingless Bee Honey

Stingless bee honey is one of the precious bee products that produced by stingless bee (locally known as Kelulut). The honey that is produced by Stingless bee is different from honey that is produced by the bees of the genus *Apis* (*i.e.* the honey bee) in terms of its colour, taste and viscosity (Almeida-Muradian, Stramm, and Estevinho, 2014: Guerrini, Bruni, Maietti, Poli, Rossi, Paganetto, Muzzoli, Scalvenzi, and Sacchetti, 2009). According to Rasmussen and Cameron (2010), there are approximately 500 species of stingless bee genus and majority of these species located in Latin America, the mainland of Australia, Africa, and Eastern and Southern Asia. Stingless bees can be grouped into two genera, namely Melipona and Trigona. The Melipona genus is usually large in size, even larger than that of the common honey bee (*Apis Mellifera Linnaeus*) (Michener, 2013). Trigona has a smaller size as compared to Melipona. Based on Roubik and Aluja (1983), the size of Melipona genus is between 6 to 15 millimetre and size of Trigona genus is from 2 to 12 millimetre in length. Stingless bees play important roles in the ecology, economy, and culture. These bees act as the main pollinators for many wild and cultivated tropical plants (Slaa, Chaves, Malagodi-Braga, and Hofstede, 2006). The products of this bee such as honey, pollen, and cerumen have been used as a source of income for generations. According to Malaysian Agricultural Research and Development Institute (MARDI), one of the specialities of stingless bees is their capability to pollinate the small-sized flowers due to their size that they are quite small. Stingless bees are easier to handle and these bees do not sting and thus it is easier to extract the honey, pollen and the propolis frequently. Stingless bee honey differs from the other honey in many aspects. In terms of taste, the Stingless bee honey is less sweet compared to the other honey and it has a higher moisture content which favours the fermentation. This type of honey also needs high levels of care during harvesting and needs to be stored under refrigeration (Bijlsma, Brujin, Martens, and Sommeijer, 2006; Souza, Roubik, Barth, Heard, Enriques, Caryalho, Villas-bo, Marchini, Locatelli, Oddo, Almeida-Muradian, Bogdanov, and Vit, 2006; and Almeida-Muradian, Matsuda, and Bastos, 2007). Besides, Stingless bee honey is less viscous due to the high moisture content and this makes it easy to flow as compared to the other types of honey.

1.2.2 Tualang Honey

Tualang honey is a multifloral jungle honey that is found in Malaysia recently attracting attention. There are three (3) subspecies of *Apis dorsata* that have been recognized namely *Apis dorsata dorsata*, *Apis dorsata binghami* and *Apis dorsata breviligula* (Jack, Lucky, and Ellis, 2015). Tualang honey produced by the wild honey bees (*Apis dorsata*) or locally known as Tualang bees that build their hives high up in the branches of Tualang tree (*Kompassia excels*). This tree that commonly known as *Mengaris* is found mainly in tropical rain forest and can reach up to 250 feet in height. (Erejuwa, Sulaiman, Wahab, Sirajudeen, Salleh, and Gurtu, 2010a; Erejuwa, Sulaiman, Wahab, Sirajudeen, Salleh, and Gurtu, 2010b; Erejuwa, Sulaiman, Wahab, Sirajudeen, Salleh, and Gurtu, 2011; Mohamed, Sirajudeen, Swamy, Yaacob, and Sulaiman, 2010). In Malaysia, usually, this tree can be found in the north-eastern region in the state of Kedah. The honeycomb of Tualang bees can be up to 6 feet across, and the hive can contain as many as 30,000 bees. Tualang bees have an exposed honeycomb and thus an effective defence system have been built by Tualang bees in order to protect their comb. In a Tualang tree, there are more than 100 nests of honeycomb that can be found and from this tree, the yield can reach 450 kg (about 1,000 pounds) of honey (Mohamed *et al.*, 2010). The professional honey hunters harvest Tualang honey seasonally from the colonies in spite of the effective defend by the colony and location that is difficult to reach which is, high up on the trees or on cliffs. Generally, honey is composed of fructose, glucose and other sugars. It contains more than 180 substances that include the amino acids, vitamins, minerals, and enzymes (Perez, Sanchez-Brunette, Calvo, and Tadeo, 2002; Al-Jabri, Al-Hosni, Nzeako, Al-Mahrooqi, and Nsanze, 2005). Tualang honey is dark brown in colour and contains 3.55 - 4.00 of pH value (Ghazali, 2009) and it shows that the Tualang honey is more acidic as compared to any other local Malaysian honey.

1.2.3 Apis Mellifera Honey

Apis mellifera originated from Europe, Western Asia and Africa. *Apis mellifera* was introduced to other continents during the 17th century. Now these bees are found all around the world, such as East Asia, Australia and North and South America (Sammataro and Avitabile, 1998; Winston, Dropkin, and Taylor, 1981). Usually, the habitat that is preferred by *Apis Mellifera* is that which has an abundant supply of suitable flowering plants, such as meadows open wooded areas and gardens. As there is sufficient water, food and shelter, *Apis Mellifera* can survive in grasslands, deserts and wetlands. According to Milne and Milne (2000), *Apis Mellifera* needs cavities (e.g. in hollow trees) to nest in. Generally, the colour of *Apis mellifera* is red/brown with black bands and orange yellow rings on abdomen. Besides, this bee have hair on their thorax and less hair on abdomen. *Apis mellifera* also has a pollen basket on their hind legs and mostly their legs are dark brown/black. Currently, there are 29 subspecies of *Apis mellifera* that have been recognized with differences based on the morphology and molecular characteristics (Ruttner, 1988; Engel, 1999; Sheppard, Meixner, Hepparda, and Eixnera, 2003). *Apis mellifera* usually feed on the pollen and nectar that was collected from the blooming flowers from the surroundings. These bees also eat the honey that have been stored or the concentrated nectar and the secretions which was produced by other members of their colony.

In Malaysia, the modern beekeeping activity began in the 1970s where the beekeepers used *Apis mellifera* that was imported from Taiwan in order to set apiary in Johor (Ismail, 2016). Honey that comes from different botanical sources have different taste and aroma characteristics that influence the acceptance and preference of products by the consumers. The aroma and taste of honey are related to the volatile compounds (Piana, Oddo, Bentabol, Bruneau, Bogdanov, and Declerck, 2004), as well as to sugars, acids, amino acids, tannins and phenolics (White, 1979). Aroma of honey was influenced by the botanical sources, the physiology of the honey bee, and the climatic conditions (Bianchi, Careri, and Musci, 2005; Serra-Bonvehı´ and Ventura-Coll, 2003; Soria, Martı´nez-Castro, and Sanz, 2003). According to Kaakeh and Gadelhak (2005), *Apis mellifera* honey is sweet in taste and strongly preferred by consumers. The colour of *Apis mellifera* honey usually ranges from amber to dark amber, whereas, the moisture content of Apis *mellifera* honey is lower as compared to stingless bee honey.

1.3 Issues in Honey Industry

Unlike the other countries such as Thailand and Vietnam, Malaysians' apiculture is still far underdeveloped although the government has promoted this industry since 1980s (Ismail, 2016). The rising importance of beekeeping has increased the responsibilities of the extension services in the bee-project areas. These services were intensified and strengthened due to the tremendous demand at the state levels as early as 1984. There are several agencies that carry out the special-area extension services such as the Rubber Research Institute Malaysia (RRIM), Rubber Industry Small Holders Development Authority (RISDA), Malaysian Agricultural Research and Development Institute (MARDI) and Universiti Putra Malaysia (UPM).

Generally, beekeeping activity in Malaysia is running in a small scale, scattered in suburbs and rural areas throughout the country. Most beekeeping activities' survival depends on tourism where the income is generated from the entrance fee collection and sales of bee products to visitors. In Malaysia, the migratory or mobile beekeeping is less commonly approached although it generates income from honey and pollen collections. It also helps in achieving the fundamental aim of having strong and healthy hives, at the commencement of the nectar flow (Wah and Baharun, 2009). In Malaysia, besides *Apis mellifera*, honey is also obtained from species of *Apis cerana*. The amount of production of honey in Malaysia is very low as compared to the world major producers. As a result, Malaysia still imports large quantities of honey from China, Australia, Thailand, and New Zealand.

In 2001 to 2002, the quality of honey from China faced controversy due to high contamination of antibiotics in the product (Ismail, 2016). Based on US Food and Drugs Administration (USFDA) (2009), that honey from China are found to be contaminated with Chloramphenicol which has been linked to aplastic anaemia, a serious disease with symptoms similar to some cancers. The same goes for honey from Australia and the United States. Issues in Australia emerged as they import the honey from China due to widespread drought that dropped the production of honey in the

country. Australia's processors re-export honey that was imported from China in order to fulfil the export contracts to the United States.
Total honey produced in 2002 was 118,802 kg. The average of honey production per hive for various projects was 25.15kg for *Apis mellifera*, whereas *Apis Cerana* only produced 2.5kg per hive per year. In Malaysia, there is another honey source collected from feral honeybee, *Apis Dorsata*. Like any other tropical countries, Malaysia's forest honey is an important non-timber forest product, both as a source of food, tonic, and medicine for local communities and it is also an important economic resource for the local economy. Unfortunately, the dynamic deforestation of the rain forest in Malaysia disturbs the lives of the giant bees, and of course, the activities of forest honey gatherers, hence the yield may decline (Bachmann and Nabhan, 1996).

The weather is one of the biggest influencing factors of bee nutrition, and hence bee productivity in the world. Rainfall is the most important aspect of the weather that affects the beekeeping activities. In other words, honey production and rainfall are strongly correlated. Heavy downpour drains away nectars, causing the bee colonies to be unable to secure sufficient food, hence no honey storage. High humidity causes the thin nectar to have difficulty to ripen and yeasts may develop in humid weather, spoiling the quality of the honey and causing a serious reduction in hive population. Malaysia is endowed with various bee plants. Based on a survey research conducted by Mardan *et al.* (1985), of the 46 species of bee plants monitored at Selangor, 21 species were major bee plants, 3 were minor bee plants and 12 were pollen plants. 33 of these species were found to flower continuously throughout the year.

Based on Wah and Baharun (2009), the development of Malaysians' apiculture is limited by the following micro environmental factors:
a) **Bee disease**. American Foulbrood (AFB) and European Foulbrood (EFB) are common diseases that attack *Apis Mellifera* caused by bacterium *Paenibacillus* larvae. AFB brings threats to bee colonies if treatment is not carried out because the spore of *Paenibacillus* larvae can initiate the disease and spores can remain viable on beekeeping equipment for an indefinite period of time. AFB may recur in a few weeks if the remaining spores are not destroyed.
b) **Parasite problem**. The Asiatic mite, *Varroa destructor* is a major concern for local beekeepers due to the reason that this mite can cause the formation of deformed wings and legs in drone bees. These drones failed to emerge from the cells. Seriously infested colony would be absconded or dismissed.
c) **Wasps.** Wasps are commonly found in most areas foraging for nectar from flowers and feeding on rotten fruits. In the beekeeping, wasps were not observed to be nuisance during dry periods when food is abundantly available. However, during the rainy period and after fruit season usually, in September and October month of the year, wasps are more commonly observed attacking colonies in large numbers. Continuous attack by wasps could weaken the colony and cause it to abscond.
d) **The red ant**, *Oecophylla smaragdina*, is a serious pest of honey bees Malaysia. They build their nests on the trees. Usually, this red ant attack and carry the bee away to their nests and will eventually cause the bee colony to abscond.

It also stated that the seasoning bird attack is another major threat to Mellifera bees. Unlike *Apis Cerana* and *Apis Dorsata*, *Apis Meliffera* flies slower and higher, therefore, it is easier for the birds to pick the bees when the bees are out foraging for food. Majority of local beekeepers are keeping *Apis Cerana*, an Asiatic species. *Apis Mellifera* is found in more established apiaries located in West Coast particularly in Melaka, Johor, Selangor, Negeri Sembilan, and Perak.

The honey production in Malaysia still lower than in the 1980's because the number of beekeepers declined over the years. The production in Malaysia is largely in the area of Johor (Pontian and Batu Pahat), Perak (Bagan Datuk) and Selangor (Kuala Langat and Kuala Selangor) (Ismail, 2014). Malaysia could only produce 4% to meet its local honey requirements. As the local production could only produce 4% of honey, it cannot supply the high domestic demand for natural honey, therefore it requires increased import resources from overseas such as Australia, China, New Zealand, and Thailand, and unfortunately, the quality of honey is low in grade.

Based on the International Trade Centre (2017), Malaysia was ranked at 26th as a honey importer country in the world. Most of honey in Malaysia are imported mainly from countries such as New Zealand, Thailand, Australia, and China. The aims for importing honey from these countries are to support the honey production in the country and to fulfil the high consumption per capita among the Malaysians. According to Ismail (2014), the consumption of local honey among consumers has increased every year which led to increase demand for honey. Instead of consuming honey in its original form, honey can also be used as value adding in several products such as cosmetics, bakery, and health supplement (Ediriweera & Premarathna, 2012). According to Magnusson, Arvola, Koivisto, Åberg, and Sjödén (2001), consumers concern about their healthy lifestyle, and thus encouraged them to consume honey to gain several benefits on the nutritional and medicinal values. However, honey that are available in the Malaysian markets mostly imported which are cheap and low quality (Ismail, 2014).

In the meantime, the high nutritional value and unique characteristics of natural bee honey have caused the price to be relatively higher compared to imported honey. Therefore, there is a need to produce in mass production as a substitute of natural honey that have nutritional value and benefits for health, tasty as well as cheaper than imported honey. One of the most important issues in the local honey industry in Malaysia is the artificial honey.

The cases of artificial honey are frequently reported in the market almost every year. In 2006, an expert from Universiti Malaya (UM) has carried out an experiment according to the local honey and the results revealed that majority of the honey samples were artificial honey which was synthetic and adulterated honey. According to Kamaruddin, Joesima, and Nuruddin (2006), there were only 23% of honey in Malaysia claimed as pure honey, whereas, 77% were either adulterated or synthetic (toxic). In 2017, the researchers from MARDI have found that five samples of honey that have been bought from different merchants have high sugar content that can affect

consumers' health when consumed. Nowadays, it has increased to 80% of honey which is adulterated or synthetic honey in the market. This adulterated or synthetic honey is very harmful for the consumers' wellbeing as it can lead to diseases such as diabetes, heart disease, and cancer.

1.4 Problem Statement

Honey is one of the substances that is secreted from honeybees' body which contains thousands of benefits, especially for a human. Honey acts as an energizer for workers and athletes to regain energy, prevent osteoporosis as well as helping in curing asthma patients. Wound healing can also be faster by using honey. These benefits can be applied by using pure honey which contains high nutrition, enzymes, and traces of minerals and vitamins. However, honey industry in Malaysia is shocked by artificial honey that is produced and sold widely in the market. Almost every year the cases of artificial honey are reported occurring in the market. Research showed that almost 77% of the honey that is available in the Malaysian market is an artificial honey which can cause diseases and death. In 2017, significant reported cases on artificial honey have increased to 80%, which indicate the seriousness of the issue. This shows that the artificial honey has dominated the honey industry and thus, making consumers inaccessible to the pure local honey. According to the Ministry of Health (MOH), artificial honey is divided into two categories which is adulterated honey (small amount of pure honey mixed with sugar syrup) and synthetic honey (a sugar syrup). These types of honey are usually added with dangerous substances such as antibiotics that cause diseases such as diabetes and cancer. Thus, to ensure the quality of the local honey, local honey sold in the Malaysian market must be approved by the Malaysian Honey Standard under Malaysian Agricultural Research and Development Institute (MARDI) and International Honey Commission. These references are made to ensure the quality of local honey can be upheld and preserved.

Each consumers has different acceptance and preferences towards different products, particularly in local honey products. The price, medicinal value, brand reputation and quality of the local honey products are the factors that influenced consumers' acceptance and preferences. Price is one of the factors that influenced consumers' acceptance towards local honey product. Generally, local honey is sold at a higher price in the market because some consumers have strange belief that high price will have a better quality of local honey. The medicinal value also influences consumers' acceptance as well as preferences towards the local honey products. Consumers nowadays choose to go for a healthier lifestyle and honey has become one of their choices as honey contains nutrition and minerals that help to maintain a good health. Brand reputation is also one of the factors that influenced the acceptance and preferences of the consumers towards local honey products as well as an important factor for a company to stay competitive in the market (Yeow, Chin, Yeow, and Tan, 2013). Usually, consumers preferred a brand of local honey that offers good quality products and services as well as information availability that makes the consumers easier to communicate with the producers. Quality has influenced the acceptance and preferences of the consumers towards local honey product as it determines the nutrition that benefits the consumers. For honey products, the sensory characteristics

of the honey such as taste, aroma, appearance, and texture are the quality that consumers usually recognize when purchasing honey products.

Acceptance and preferences towards local honey among consumers are rather subjective especially when it is dealing with sensory characteristics. Usually, consumers who are familiar with common sensory characteristics prefer local honey which is sweet in taste and viscous in appearance. Besides, consumers also accept and preferred honey due to its benefits especially for the health which has nutrition and minerals that helps to prevent diseases and maintain a healthy living. However, as the artificial honey is dominant in the Malaysian market, the acceptance of the consumers towards local honey has decreased as they are insecure about the quality of the honey. Besides, consumers tend to question the quality of the local honey and do not prefer to purchase it due to its' low quality.

Local honey has their own unique sensory characteristics with several attributes namely taste (sweetness, sourness, bitterness), aroma (fruity aroma, herbal aroma, spice aroma), appearance (colour, viscosity) and texture (granularity). These sensory characteristics act as the benchmark for good quality honey as well as the factors that local honey receives a high demand from the consumers. As reported, common sensory attributes of honey that have been widely spread were yellowish in colour, with a sweet taste, fruity aroma, and viscous structure as well as very fine in texture. Some of these widely spread attributes are inconsistence with the pure local honey attributes. Based on the previous studies, most of the local honey have less sweet taste with amber to slightly dark in colour, less viscous and have granules in the texture as well as varieties of aroma.

The differences on sensory characteristics of the local honey make it difficult to determine the standard taste, aroma, appearance, and texture of the local honey which occurred due to the varieties of nectar that were collected by the bees from varieties of plants. Besides, cases on the artificial honey become one of the factors that make the sensory characteristics of local honey difficult to determine. As reported, sensory characteristics of artificial honey are absolutely the same as the pure local honey in terms of the taste, aroma, appearance, and texture and only by carrying out experiments in the labs that it will determine the actual quality of the local honey. Hence, understanding sensory characteristics for three types of local honey based on consumers' acceptance and preferences could provide further information on the market value of local honey.

1.5 Research Questions

In this study four (4) research questions were addressed as follows:

i. Are there any differences in sensory characteristics among three types of local honey?

ii. Is there any associations between consumers' preferences based on sensory characteristics towards three types of local honey and their socio-demographic profiles?
iii. Are there any differences in consumers' acceptance among three types of local honey based on sensory characteristics?
iv. What are the important factors that influenced consumers' preferences towards three types of local honey?

1.6 Objectives of the Study

The general objective of this study was to determine consumer acceptance and preference towards three types of local honey based on sensory characteristics.

The specific objectives of this study were as follows:-

i. To determine sensory characteristics of three types of local honey.
ii. To investigate the associations between consumers' preferences towards three types of local honey based on sensory characteristics and consumers' socio-demographic profiles.
iii. To determine consumers' acceptance towards three types of local honey.
iv. To investigate the influential factors that have influenced consumers' preferences towards three types of local honey.

1.7 Significance of the Study

This study helps beekeepers to better understand the preferences by consumers towards local honey based on sensory characteristics and the factors that influenced their acceptance and preferences towards local honey. This study will also contribute to the understanding of the producers and entrepreneurs towards the requirements, wants and needs of consumers with respect to the three types of local honey. Not forgetting it will also identify the influential factors of consumers purchasing behaviour thus it could also improve their marketing and sales strategies. Besides, the government agencies could also use this information in order to improve the quality standards of local honey produce as the quality is one of the important variables that influenced the consumers' acceptance and preferences towards local honey. This study is valuable to the extension services in order to develop the industry especially the beekeeping industry by understanding the consumers' behaviour based on their preferences towards local honey.

1.8 Organization of Thesis

This thesis is organized into five (5) chapters. The first (1) chapter begins with the introduction that includes the overview of the beekeeping industry in Malaysia, issues in honey industry in Malaysia, problem statements, research questions and objectives of the study. The second (2) chapter consists of the reviews of the literatures on the

past studies and information that are pertinent to the study. The third (3) chapter includes the explanation about the research methodology, including the sampling techniques, method of data collection, description of the study areas and statistical analysis for the data. The fourth (4) chapter provides an in-depth discussion on the findings of the study. The last chapter, chapter five (5) consists of summary of the study, recommendations, limitations of the study, suggestions for further study and the overall conclusion of the study.

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