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Influence of Storage Temperature on the Quality of *Geniotrigona thoracica* Honey

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Abstract

Stingless bee honey is well-known for its high content of moisture compared to Apis mellifera honey. This study aimed to investigate the influence of different temperatures used to reduce moisture content in honey using clay pots. The Geniotrigona thoracica honey was kept in clay pots for 10 days at 25 °C and 35 °C, and the changes in its properties were evaluated on the moisture content, total soluble solids, viscosity, pH, free acidity, and colour. Honey stored at 35 °C reduced moisture content by <20% in 3 days while honey at 25 °C took 7 days. Free acidity was found higher (113 meq/kg) in the sample stored at 35 °C for 3 days compared to honey stored at 25 °C for 7 days (106 meq/kg). From this study, the suitable temperature and the use of clay pots was proved to reduce the moisture content in honey.

Keywords: *clay pots, Geniotrigona thoracica, moisture content, physicochemical, stingless bee honey*

INTRODUCTION

The sting bees or stingless bees produced a natural product called honey, and it is well-known for its rich nutritional content and medicinal properties (Rao, Krishnan, Salleh, & Gan, 2016). By owing to the fact that stingless bee honey contained more health benefits than honey bees honey (Amin et al., 2018), many opportunities in research field available.

The distinctive characteristics of stingless bee honey from ordinary honey was it contained higher moisture and acidity (De Almeida-Muradian et al., 2013; Alvarez-Suarez et al., 2018), which were feared to cause rapid fermentation that can deteriorate the honey quality (Nordin et al., 2018; Silva et al., 2016; Subramanian et al., 2007). The International Honey Commissions (IHC) had set the limit for moisture content of a good quality of honey must <20%. Therefore, several methods had been used by the bee farmer to lessen the level of moisture in honey such as the use of a dehumidifier, conventional heating, and open tray drying. Previous studies also discovered several methods for reducing the moisture content in stingless bee honey but found that the thermal treatment caused the increase in hydroxymethylfurfural (HMF) content (Yap, Chin, Yusof, & Chong, 2019; Zarei, Fazlara, & Tulabifard, 2019).

In this present study, the use of clay pots was implemented to store the stingless bee honey to reduce its moisture content. The moisture from the honey diffused through the clay pots' wall and

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evaporated to the surrounding air due to the porosity of the clay pots. The aim of this work was to evaluate the physicochemical properties of Geniotrigona thoracica honey after storing in clay pots at different temperatures.

RESEARCH METHODOLOGY

Material and sampling

The G. thoracica honey was freshly harvested from Orchard 10, UPM, Malaysia in October 2018 and immediately transported to the laboratory. About 50 g of honey were filled into 40 cylindrical clay pots (Figure 1) and divided into half to be placed in an incubator at 25 ± 2 °C (room temperature; RT) and 35 ± 2 °C (elevated temperature; ET), respectively, until the moisture reduced to <20 %.

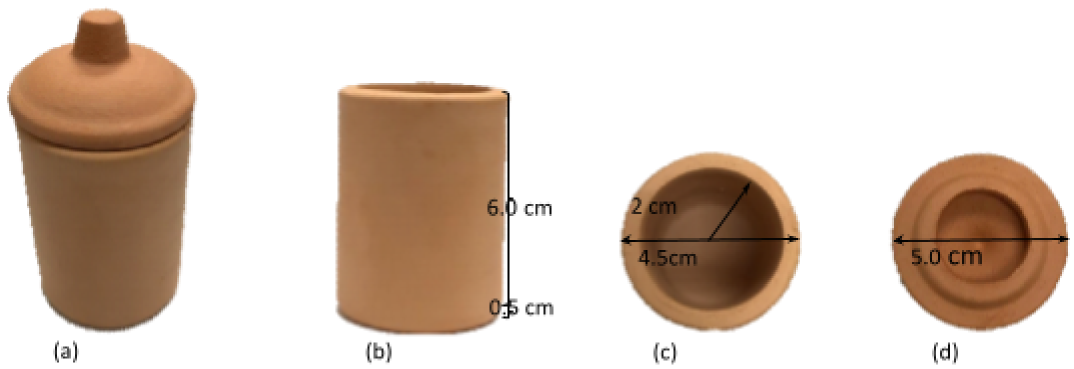

Figure 1. The dimension of the cylindrical-shaped clay pot

Physicochemical determinations

1. Moisture content and total soluble solids (TSS) content

The moisture content and TSS content of honey samples were measured using an Abbe refractometer by obtaining the refractive index for moisture content calculation to the method mentioned in (Ghazali et al., 2019), while for TSS content obtained in term of °Brix value from the refractometer.

2. Viscosity

Honey viscosity was determined using a rheometer (AR-G2, TA Instruments, New Castle, USA) equipped with a 60-mm diameter cone and plate geometry (30 mm truncation gap, 1° cone angle). The analysis were performed as a steady-state flow with a shear rate range of 1–1000 s-1.

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3. pH and free acidity

AOAC method 962.19 was used in determination of pH and free acidity of honey. Honey solution of 10 g of honey mixed with 75 mL distilled water was prepared and the pH meter (Sartorius, PB-10) was used to measure the pH value. Titration of the solution using 0.1 M NaOH until pH 8.30 was carried out and the volume of the NaOh used was noted. To obtain the free acidity value which expressed as miliequivalent acid per kg of honey (meq/kg), the volume (mL) of 0.1 M NaOH used to titrate the solution was multiplied by 10.

4. Colour

An UltraScan Pro spectrophometer (HunterLab, Reston, VA, USA) was used to measure the colour parameters (L*, a*, and b*). The Pfund method was used to measure the colour intensity of the honey (Sousa et al., 2016). About 5 g of honey was diluted in 10 mL of ultrapure water to prepare the honey solution and a UV-VIS spectrophotometer (Ultrospec 3100 pro, Amersham Biosciences, Piscataway, NJ, USA) was used to the determine the solution absorbance at 636 nm. The value in the Pfund scale was obtained by inserting the absorbance value in equation 1.

$mmPfund = \; -38.7 + 371.4 \times Abs$ (1) (Where Abs is absorbance).

Statistical analysis

Microsoft Excel was used to analyse all the collected data which were repeated three time. The data were expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

The moisture content of the honey stored at RT and ET were shown in Figure 2. Initially, the honey contained 26.03 ± 0.09 % of moisture which fell in the range of the moisture content of stingless bee honey in Malaysia (Jibril, Abu Bakar, Ismail, & Manivannan, 2016). At ET, the moisture content of the honey decreased drastically and reached moisture level <20% on day 3 while for the honey sample in RT the moisture content reduced to <20% on day 7. The results indicated that the temperature influenced the rate of evaporation of moisture from the clay pots wall. Meanwhile, the TSS content of the honey samples (Table 1) increased when the moisture content decreased. The initial value of the TSS content of the honey was 72.5 ± 0 °Brix. Samples in ET had the highest TSS content on day 3.

The honey initial viscosity was 0.238 ± 0.012 (Table 1). The value of the viscosity increased after storage for both conditions and the values corresponding with the moisture content decrement (Yanniotis et al., 2006). The honey viscosity stored in ET had the highest increment with a value of 2.64 ± 0.29 Pa.s on day 3 compared to honey in RT which had the viscosity of 1.1 ± 0.1 Pa.s on day 7.

On day 0, the value of honey acidic pH (3.42 ± 0.01) was shown in Table 1. Samples in RT showed a slight decrease in pH value after 7 days of storage. Honey free acidity on day 0 (96 ± 2 meq/kg) was lower than the reported value for Thailand stingless bee honey (164 ± 162 meq/kg) (Chuttong et al., 2016). The free acidity of honey samples in ET increased rapidly until day 3 and

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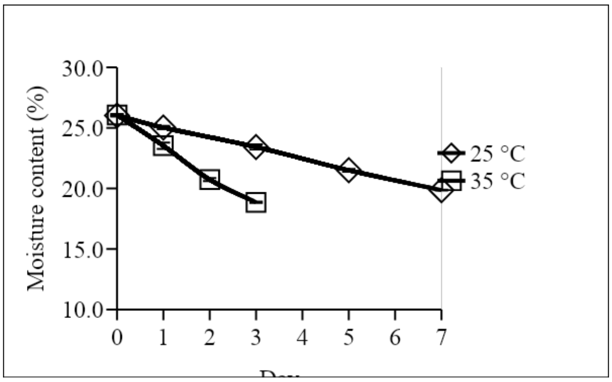
had the highest free acidity value compared to the samples stored at RT after 7 days. The higher value of free acidity in ET samples might due to the higher temperature than RT that could influence the chemical reactions between sugars and amino acids (Samira, 2016).

The colour parameter of L* indicates the lightness of the honey samples increased for both samples in different storage temperatures. The a* (redness/ greenness) and b* (yellowness/blueness) for both samples in different storage temperatures also showing the increasing trend. For colour intensity, the colour of the honey was dark (>114 mmPfund) according to the USDA. Both honey samples stored in RT and ET showed increasing values in colour intensity based on the Pfund scale and these results correspond to the decrease in moisture content. Colour intensity of the honey is related to pigments presented in honey which has antioxidant activities such as flavonoids and carotenoids, therefore the honey in our studies contained high antioxidants due to its high colour intensity (Kek, Chin, Yusof, Tan, & Chua, 2014).



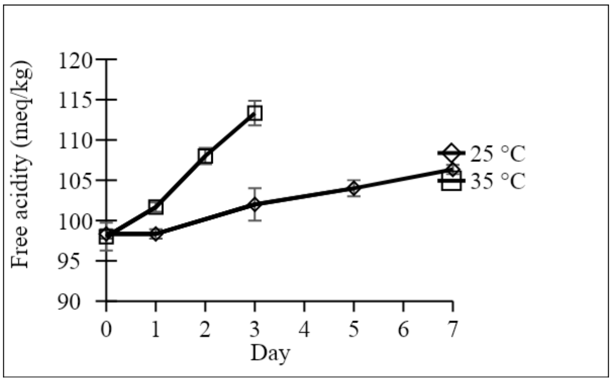


Figure 2. Moisture content of G. thoracica honey at 25 and 35 °C Figure 3. Free acidity of G. thoracica honey at 25 and 35 °C

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Table 1. Physicochemical properties of G. thoracica honey at 25 and 35 °C

Storage temperature (°C)	Day	TSS	Viscosity (Pa.s)	pH	L*	a*	b*	Colour intensity (mmPfund)
25	0	72.5 ± 0	0.238 ± 0.012	3.42 ± 0.01	29.6 ± 0.1	0.58 ± 0.02	4.57 ± 0.12	150 ± 2
	1	73.5 ± 0.1	0.465 ± 0.028	3.4 ± 0	28.4 ± 0	1.01 ± 0.07	5.09 ± 0.03	150 ± 1
	3	74.8 ± 0.1	0.636 ± 0.01	3.42 ± 0	29.3 ± 0	0.80 ± 0.01	5.01 ± 0.05	155 ± 1
	5	77 ± 0.2	0.782 ± 0.04	3.43 ± 0	29.8 ± 0	0.78 ± 0.05	4.82 ± 0.12	158 ± 1
	7	78.6 ± 0	1.1 ± 0.1	3.39 ± 0	30.1 ± 0	0.70 ± 0.06	5.07 ± 0.11	162 ± 1
35	0	72.5 ± 0	0.238 ± 0.012	3.42 ± 0.01	29.6 ± 0.1	0.58 ± 0.02	4.57 ± 0.12	150 ± 2
	1	75.0 ± 0.2	0.465 ± 0.028	3.44 ± 0	28.4 ± 0.0	0.49 ± 0.13	3.81 ± 0.12	156 ± 1
	2	77.7 ± 0.1	1.1 ± 0.1	3.42 ± 0	31.8 ± 0	0.92 ± 0.06	6.27 ± 0.07	157 ± 1
	3	79.5 ± 0	2.64 ± 0.29	3.43 ± 0	34.2 ± 0	1.31 ± 0.1	8.14 ± 0.15	160 ± 1

CONCLUSIONS

The clay pots did help in lowering the level of moisture content of honey and the difference in storage temperature influenced the rate of moisture reduction through the clay pots' wall. Although the honey that kept in clay pots at room temperature (RT) had reduced the moisture content slower (7 days) compared to ET (3 days), the honey in RT showed better honey quality even though stored at a longer period than in ET. Therefore, honey stored in RT was a better condition to store honey in clay pots to reduce its moisture which is also easier for the bee farmer to handle and cost-effective.

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