eISBN 978-967-16145-1-8

Konvensyen Kebangsaan Kejuruteraan Pertanian Dan Makanan 2019
21 Mac 2019, Wisma Tani, Kementerian Pertanian Malaysia, Putrajaya

MSAE2019-PFE13

Effects of Conventional Storage Method on *Geniotrigona thoracica* Stingless Bee Honey Properties

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Abstract

Most of stingless bee honey contains high moisture content that can easily lead to honey fermentation. This study aims to investigate the applicable of conventional storage method on stingless bee (Geniotrigona thoracica) honey and its effect on storage stability. The Geniotrigona thoracica honeys were stored in a glass bottle at 25˚C for 21 days. The samples were subjected to physicochemical analysis such as moisture content, water activity, viscosity, pH, free acidity, electrical conductivity, colour (L, a* and b*) and colour intensity. The results obtained indicated that the honey stored in glass bottle slowly reduced the moisture content. The moisture content of honey stored at 25˚C in a glass bottle was reduced from 28.03% to 27.25%. The free acidity of honey increase significantly from106.7 meq/kg to146.3 meq/kg. In conclusion, the amount of water content of honey stored in glass bottle was not largely reduced and consequently changes the physicochemical properties of honey.*

Keywords: Honey, stingless bee, *Geniotrigona thoracica*, moisture content, physicochemical analysis

Introduction

Geniotrigona thoracica (*G. thoracica*) is a species of stingless bees found in Malaysia that have commercial value. *G. thoracica* stingless bee produced honey that naturally acidic and varies according to the geographical and botanical origins (Abdul Aziz, Giribabu, & Rao, 2017)**.** Stingless bee honey chemically consist of carbohydrates, especially glucose and fructose, organic acids, amino acids, minerals, vitamins, enzymes, pollen and pigments (Carvalho, Fonseca, Souza, & Clarton, 2009). Some of the vitamins found in honey include ascorbic acid, pantothenic acid, niacin and riboflavin; along with minerals such as calcium, copper, iron, magnesium, manganese, phosphorus, potassium and zinc that are important for health and nutritional value (Ajibola, Chamunorwa, & Erlwanger, 2012). Stingless bee honey acts as wound healing agent and has a lot of similarities with other honeys in terms of its bioactive components (Abd Jalil, Kasmuri, & Hadi, 2017).

However, the moisture content of stingless bee honey is well-known to be higher that the moisture of other honeys such as *Apis mellifera* honey that can lead to unwanted fermentation (Oddo et al., 2008; Chuttong et al., 2016). Honey has the ability to absorb and hold moisture from surrounding which is known as hygroscopicity. The environmental factors during production such as weather and humidity inside the hives also plays important role to final moisture content of honey (Olaitan, Adeleke, & Ola, 2007). For good quality *Apis mellifera* honey, the International Honey Commission (IHC) has set the threshold in term of moisture which is 20 g/100 g but most of stingless bee honey exceeds the limit.

Therefore, this study is to investigate the effect of conventional storage method in Malaysia which the honey stored in glass bottle on physicochemical properties of *G. thoracica* stingless bee honey during storage time.

Materials and methods

1) Materials:

Geniotrogona thoracica stingless bee honey was obtained from Faculty of Forestry, Universiti Putra Malaysia. The clay pots are custom-made and obtained from Belipot Craft Sdn Bhd, Kota Bharu, Kelantan.

2) Sampling

1.05kg of *G. Thoracica* honey was divided in 21 identical glass bottles. Each bottle filled with 50g of *G. Thoracica* honey. Then, the glass bottles were divided to 7 testing days for storage period of 0, 1, 3, 5, 7, 14 and 21 days. The samples were stored at 25˚C.

3) Physicochemical Analysis

i) Moisture content and total soluble solid

Moisture content of honey was obtained with a digital refractometer (Digital ABBE Refractometer AR2008, A.Kruss, Germany) at 20°C determining the corresponding moisture percentage by means of equation 1 (Sesta et al., 2008):

Moisture content (%) =
[-0.2681 –log (RI-1)]/0.002243
(1)

Where RI is the refractive index. The total soluble solids content in the honey samples is expressed in °Brix (Amin, Safwat, & El-Iraki, 1999)

ii) pH and free acidity

pH and free acidity was determined according to the method described by Bogdanov, (2009). The pH is measured by using pH meter (Milwaukee, Mi 805, USA). The pH meter was calibrated with pH 4.00 and pH 7.00 buffer solutions. 10g of honey was dissolved in 75ml deionized water for the analysis. pH electrode was immersed in the solution and pH value was recorded. Then, the solution was titrated with 0.1M NaOH solution until the pH reach 8.3 (end-point of phenolphthalein) to determine the free acidity in the sample.

iii) Water activity

Water activity (aw) was measured by using water activity meter (Aqualab CX2, Decagon Devices Inc, WA, USA). 2g of honey was placed in the sample dishes and measured at room temperature (25˚C).

iv) Viscosity measurement using rheometer

Steady state measurements of honey was measured by using a rheometer (AR-G2, TA Instrument, New Castle, USA) and equipped with a software (TA Instrument Advantage TM software). 60mm diameter plate geometry and 1° steel cone angle was used to determine the viscosity of the honey. Steady state measurements was conducted at 1-1000 s-1 shear rate and plate gap of 1000µm at temperature 20°C. Circulated water system was used to control the temperature. 2g of honey was placed onto the sample plate. Data was obtained by calculating the average of 30 points. The experiment was measured twice for each sample and test was conducted at room temperature (25°C) (Chong, Chin, & Yusof, 2017).

v) Colour intensity

An UV-VIS spectrophotometer was used to determine the colour of honey according to the method described by Maria et al., (2016). Honey is diluted to 50 g/100 ml. About 2 ml of sample is placed in quartz cell and read at 636 nm and the white (or reference cell) was provided by ultrapure water. The colours were classified in the Pfund scale by using the formula:

mm Pfund = -38.7 + 371.39 x Abs

vi) Colour difference

Visual or optical colour was measured by using an Ultrascan PRO Spectrophotometer (Hunterlab, Reston, Virginia) in three aspects L* (lightness), a* (redness and greenness) and b* (yellowness or blueness). The instrument was calibrated with light trap and white tile prior to the measurement of the samples. Port plate of 0.780 inches was used. 30g of honey sample was poured into optically clear glass cell (20mm depth x 55 mm width x 57 mm height). Glass cell with samples was placed on the reflectance sample shelf and covered with light cover before being measured with EasyMatch QC software (Quek et al., 2012). Colour difference was measured using the formula as in equation 2:

$$\Delta E=\sqrt{\left(L^*-L_0{}^*\right)^2+(a^*-a_0{}^*)^2+\left(b^*-b_0{}^*\right)^2}$$
(2)

Where L*, a* and b* denoted as colour of the stingless bee honey after treatment and L_0*, a_0* and b_0* indicated the colour of honey before treatment.

Results and discussion

Physicochemical Properties

The moisture content of fresh honey on day 0 was 28.03%±0.18 and decreased to 27.25%±0.15 on day 21. There was only 0.77% of moisture loss during the storage of 21 days. This result showed that honey stored in glass bottle will maintain the moisture content and slowly reduced it in time. Glass bottle is a non-porous material that cause moisture cannot be evaporated or loss to environment. Total soluble solid of honey is related with moisture content so it also showed the same trend. The total soluble solid increased from 70.5%±0.1 on day 0 to 71.3%±0.1 on day 21.

The result for pH value of honey indicates its acidity which 3.43±0.01 on day 0 and 3.16±0.01 on day 21. The Malaysian Standard has set an acceptable pH range of 2.5 to 3.8 for stingless bee honey which shows that honey stored in glass bottle after 21 days was still in a good quality. The free acidity of honey increased rapidly from 106.7meq/kg ±0.6 on day 0 to 146.3meq/kg±1.5. This result indicates that honey undergo fermentation process which convert the sugar into organic acids. The water activity of honey showed to remain the same from 0.779±0.001 on day 0 to 0.774±0 on day 21.

The changes of colour parameters of *G. thoracica* honey during 21 days of storage time are shown in Figure 3. All parameters showed the decreasing value from day 0 to day 21 of storage period. The a* value decreased from 2.25±0.02 to 1.86±0.05 on day 0 and day 21, respectively. The b* value decreased from 2.93±0.08 on day 0 to 0.90±0.15 on day 21. The L value decreased from 26.48±0.03 to 24.98±0.07. This indicates that the *G. thoracica* honey was darker throughout the storage period. The colour difference, ∆E showed an increasing trend from day 0 to day 21. The colour intensity of stingless bee honey increased steadily during storage from 121.6±1.2 on day 0 to 146.3±1.0 on day 21. The viscosity of stingless bee honey increased slightly during the storage period.

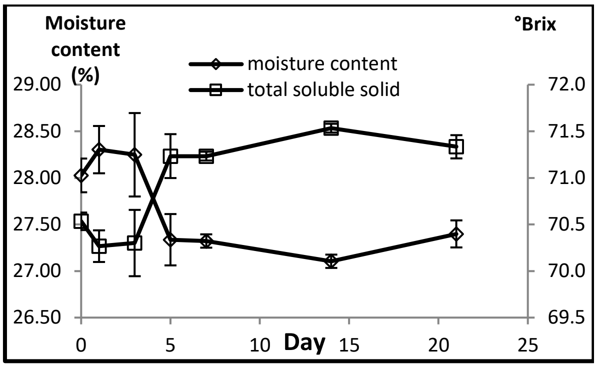

Figure 1: Profile of water reduction and total soluble solid during storage period

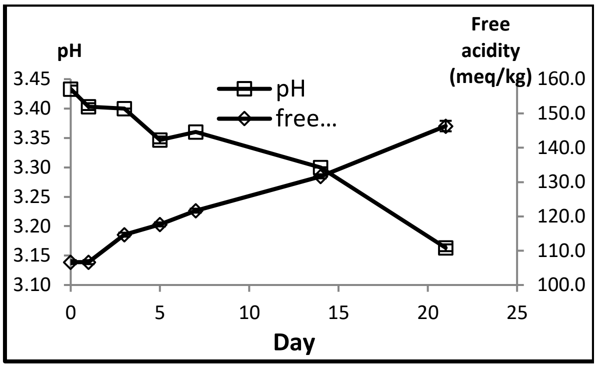

Figure 2: pH and free acidity during storage period

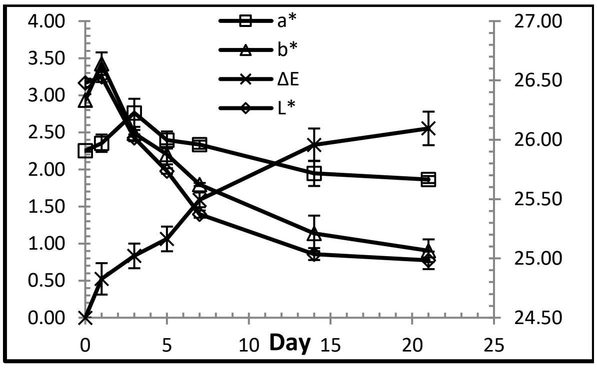

Figure 3: Colour parameter of stingless bee honey during storage period

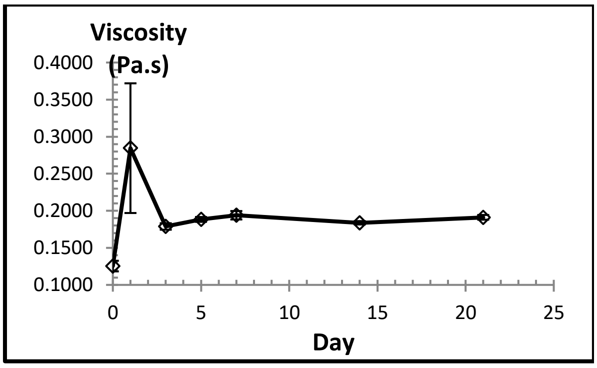

Figure 4: Viscosity of stingless bee honey during storage period

Conclusion:

Storage of stingless bee honey in glass bottle does not make any significant reduction of moisture content. Some physicochemical characteristic of *G. thoracica* changed; free acidity increases significantly during storage period that indicates fermentation of honey. For a better storage of honey, it is suggested to store at low humidity condition and the glass sealed tightly. Therefore, honey will not absorb the water at surrounding since it has the hydroscopic properties.

Acknowledgement:

The authors thank to Ministry of Education Malaysia for the Transdisciplinary Research Grant Scheme with Vote number: 5535708 for the research funding.

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