PHYSICOCHEMICAL CHARACTERISTICS OF STINGLESS BEE HONEY FROM *Tetrigona apicalis*

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Abstract

Each log of stingless bee honey may produce different characteristics of honey due to the different geographical and resources of nectar. The aim of this study is to determine the physicochemical characteristics of stingless bee honey from *Tetrigona apicalis* species (*T. apicalis*) at different production logs in UiTM Pahang. The samples of stingless bee honey were collected from UiTM Pahang, Jengka Campus. Five different logs of stingless bee from *T. apicalis* were selected. There are five different parameters analysed in this study namely pH, total acidity, ash content, colour intensity, and moisture content. The findings showed that the pH for *T. apicalis* honey was acidic in a range of 3.31±0.01 to 3.43±0.02 with a total acidity of 126.67±5.77 to 152.33±6.43 meq/kg. The value of ash content was 0.240±0.03 to 0.490±0.03 g/100g while the moisture content was between 27-34%. The colour intensity of the honey was 0.83033±0.01 to 1.30523±0.01Abs with light amber and extra light amber colour. These findings are important to determine the physicochemical characteristics of stingless bee honey in UiTM Pahang and to measure the quality of honey that was produced.

Keyword: Stingless Bee, Honey, Physicochemical, Characteristics

Introduction

Stingless bee or known as "Kelulut" is a type of bee that comes from *Trigona* and *Maliponine* (Yaacob et al., 2017). There are more than 500 species of stingless bees in the world (Zuccato et al., 2017). *T. apicalis* is one of the species found in Malaysia. It was usually known as a pest due to their activities that cause damage to the plant tissue in order to obtain resin to create the cerumen (Peruquetti et al., 2010). *T. apicalis* has its own characteristics such as black head, frons fully covered with fine yellowish-white hairs, yellowish hairs approaching antennal sockets and clypeus. The total length of *T. apicalis* is around 6.82-7.30 mm in size (Siti Fatimah et al., 2018).

Stingless bee is a well-known pollinator in tropical rainforest and is used as a pollinator for strawberry plantation in Japan. Nectar is known as the main food source for the bees, however, the bees also consume honey produced by aphid as energy resources (Siti Fatimah et al., 2018). The production of honey from stingless bee carries different characteristics in terms of colour, taste, and viscosity due to the different geographical, environment condition, climate, and flower nectar resources (Kuan Wei et al., 2016).

Honey is a natural sweet substance produced by bees from the nectar of a flower or secretion or excretion of plant part. Honey was produced when bees or stingless bee was collected,

transformed, and combined with specific substance and stored in the comb or pot until it reaches the maturity stage. According to Jahan et al. (2015), mixtures of sugar such as fructose (38.3%), glucose (30.3%), maltose (7.1%), and sucrose (1.3%) were examples of specific substances involved in the production of honey. These substances were combined with other compounds such as water, protein, minerals, or other substances. Abu Bakar et al. (2017) stated that honey contained high antioxidant due to the presence of phenolic compounds and carotenoids Maillard reaction products.

The purity of honey from the stingless bee is well known, and it is consumed since long time ago in many communities such as Malay, Arab, Hebrew, Persian, Indian, Roman, and Chinese (Fatima et al., 2017). According to Kuan Wei et al. (2016), the nutrients compound in stingless bee honey consists of sugar, vitamin, mineral, enzyme, organic compounds, and free amino acids.

The physicochemical characteristic of stingless bee honey is important to be analysed since each log may produce different characteristic of honey. Nordin et al. (2018) stated that analysis of the physicochemical characteristics will help to establish a standard quality of stingless bee honey in Malaysia. This study aims to determine the physicochemical characteristics of stingless bee honey of *T. apicalis* from different production logs in UiTM Pahang, Jengka Campus.

Materials and Methods

Sample collection

The samples of stingless bee honey were collected in UiTM Pahang, Jengka Campus. Sample was taken carefully from honey pot by using a syringe. Five different logs of stingless bee from *T. apicalis* were selected randomly in this study.

Parameter of study (Physicochemical characteristic of the honey sample)

pH

pH measurement was conducted following the method previously described by Fatima et al. (2017). 10 g of a honey sample from *T. apicalis* was measured and placed in a clean beaker. The beaker was labelled for each sample. 75mL of distilled water was added into each beaker and mixed with the honey. A standard buffer solution of pH 4 and 7 were used to calibrate the pH meter. The glass electrode was immersed in the beaker containing honey solution and the pH value was recorded. The procedure was replicated three times.

Ash content

The ash content was determined following the method described by Chuttong et al. (2016). All clean crucibles were dried in the oven for 6 hours at 105 °C and left to cool in the desiccator. Empty crucibles were weighed, and data was recorded. Crucibles were filled with 5 g of sample and placed into the muffle furnace at 550 °C for 12 hours. The crucibles were weighed again together with ashes after the cooling process was done in the desiccator. The procedure was replicated three times.

Moisture content

A portable handheld refractometer was used to calculate the moisture content. Only a few drops of the sample was needed. The procedure was replicated three times.

Colour intensity

The colour intensity was determined by following the method described by Fatima et al. (2017). The intensity of the sample colour was measured using Ultraviolet visible

spectrophotometer. 5 g of honey sample was dissolved in 10 mL of deionized water in a clean beaker. The solution was mixed gently by using a vortex. 2 mL of honey solution was transferred into a cuvette. The absorbance at 635 nm was recorded. To determine the colour intensity, Pfund scale was used. The procedure was replicated three times.

Total acidity

A titrimetric method was applied to determine the acidity of the sample. 10 g of sample was dissolved in a beaker containing 75 mL of distilled water. Titration was done using 0.05M sodium hydroxide solution until the pH reached 8.5. 10 mL of 0.05M of sodium hydroxide solution was immediately added in the titrated solution. The solution was back titrated using 0.05M of hydrochloric acid solution until the pH reached 8.3. The procedure was replicated three times.

Results and Discussion

The results of the physicochemical characteristic of stingless bee honey on the pH, ash content, moisture content, colour intensity, and total acidity are tabulated in **Table 1** until **Table 5**. **Table 1** presents the pH value of *T. apicalis* honey. From the table, the range pH value is from 3.26±0.01 to 3.43±0.02. The highest pH value was recorded from log 3 with 3.43±0.02 whereas log 5 indicates the lowest pH value at 3.26±0.01. The result showed that *T. apicalis* honey was considered as acidic honey. According to Chuttong et al. (2016), the pH value of stingless bee honey originated from Thailand was at the range of 3.1 until 3.9. Fatima et al. (2017) stated that the lower pH value in the honey helps to prevent the growth of microorganism.

Table 1 The pH value of *T. apicalis* honey

T. apicalis **(Honey)**	**pH value**
Log 1	3.31±0.01
Log 2	3.34±0.02
Log 3	3.43±0.02
Log 4	3.32±0.01
Log 5	3.26±0.01

From the analysis, the ash content of stingless bee honey from *T. apicalis* was less than 1 g/100 g with the range of 0.240±0.03 to 0.490±0.02 g/100g. Log 2 has the highest value (0.490±0.02g/100g) whereas Log 4 shows the lowest ash content (0.240±0.03 g/100g) (**Table 2).** According to Chuttong et al. (2016), the ash content of stingless bee honey from Thailand was only 0.05g/100 g. The ash content identifies the value of mineral content. It can be related to the composition of plant nectar sources (Nordin et al., 2018).

Table 2 The ash content of *T. apicalis* honey

T. apicalis **(Honey)**	**Ash content (g/100 g)**
Log 1	0.424±0.05
Log 2	0.490±0.02
Log 3	0.324±0.01
Log 4	0.240±0.03
Log 5	0.311±0.02

The colour intensity for all stingless bee honey sample was determined by comparing the absorbance with Pfund scale. UV-Vis spectrophotometer was used in this analysis to determine the absorbance. **Table 3** shows that the range scale of Pfund readings is between 51-85mm. Although the absorbance's value of each honey is different, all logs showed Pfund scale within the range of 51-85mm, which was classified as light amber in colour. According to Nascimento et al. (2015), the darker the colour of the honey, the higher the content of the ash. The variation in the absorbance value of stingless bee honey may also be affected by multiple factors such as the exposure of sunlight, heat, storage, and enzymatic reactions (de Sousa et al., 2016).

Table 3 Colour Intensity of *T. apicalis* honey

T. apicalis **(Honey)**	**Absorbance**	**Pfund scale (mm)**	**Colour of honey**
Log 1	1.12457±0.002	51 – 85	Light amber
Log 2	1.30523±0.014	51 – 85	Light amber
Log 3	1.01950±0.007	51 – 85	Light amber
Log 4	0.83033±0.012	51 – 85	Light amber
Log 5	0.92437±0.024	51 – 85	Light amber

The total acidity indicates the sum of free and lactonic acidities of the honey (Lage et al., 2012). **Table 4** presents the total acidity of *T. apicalis* honey. The range for the total acidity was 126.67meq/kg to 152.33meq/kg. Log 2 recorded with the highest total acidity at 152.33±6.43meq/kg whereas Log 3 shows the lowest value at 126.67±5.77meq/kg. The acidity of the honey was determined by the maturity stage and the fermentation rate process in the honey (Nascimento et al., 2015).

Table 4 Total acidity of *T. apicalis* honey

T. apicalis **(Honey)**	**Total acidity (meq/kg)**
Log 1	136.67±10.41
Log 2	152.33±6.43
Log 3	126.67±5.77
Log 4	128.33±5.77
Log 5	131.67±2.89

The moisture content for *T. apicalis* was observed by using a handheld refractometer. **Table 5** shows that moisture content for *T. apicalis* honey is between 27% - 34%. Log 4 recorded with the highest moisture content at 34.20% whereas Log 1 recorded with the lowest moisture content at 27%. Fatima et al. (2017) stated that the moisture content of the stingless bee was between 28.3 % - 33.7%. The moisture content can differ due to the relative humidity and the place of honey storage (Nascimento et al., 2015). Higher moisture content indicates a higher probability of honey fermentation during storage (El Sohaimy et al., 2015).

Table 5 Moisture content of *T. apicalis* honey

T. apicalis **(Honey)**	**Moisture content (%)**
Log 1	27.00±0.00
Log 2	28.53±0.29
Log 3	31.03±0.29
Log 4	34.20±0.00
Log 5	31.03±0.29

Conclusion

Based on this study, it can be concluded that the physicochemical characteristic of stingless bee honey can be determined by pH analysis, ash content, colour intensity, total acidity, and moisture content. From the result of the pH and the total acidity, stingless bee honey from the species of *T. apicalis* is suggested to be acidic. Meanwhile, the ash content value tallies with the absorbance value. Each analysis result obtained from different logs showed similar reading with slight differences.

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Conflict of interests

Authors hereby declares that there is no conflict of interests with any organization or financial body for supporting this research.

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