A simple reducing water content technique for stingless bee honey (*Heterotrigona itama*) in South Kalimantan

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Abstract. Water content is one of the parameters of the honey product quality. Unlike Apis honey product, honey from stingless bee (*Heterotrigona itama*) have higher water content. To meet the required standard, reducing water content of stingless bee honey need to be done. Therefore, in this study we aim to find out the effect of using honey water content reduce device to water content and quality of stingless bee honey. We modified simple drying cupboard with heat pad to reduce honey water content. Moreover, nutrient analysis was carried out to know whether the drying process affect its nutrient quality. Six sample of stingless bee honey which was placed in a container (thickness=0.5 cm) and the temperature was set at 40°C. According to the study, to reach the recommended honey water content (21-22%) it takes approximately 3 hours with a value of R=0.848 in addition, drying treatment (40°C) did not affect the nutritional quality of stingless bee honey.

1. Introduction

The demand for honey continues to increase along with the increase in population and public awareness of honey consuming [1]. The types of honey in Indonesia have a variety of products. The diversity of honey is influenced by differences in regional origin [2], climate [3], bee species [3,4], nectar source plant species [5], cultivated bees or wild bees, how to harvest and how to handle post-harvest [1,3]. The honey standard in Indonesia was developed into three categories namely forest honey, cultivated honey and stingless bee honey [1].

Stingless bee has great potential to be used in medicine and has a higher drug value than other types of honey [6,7]. One of the advantages of stingless bee honey is that there are antioxidants that can break the chain of free radicals [8]; antimicrobial properties can overcome bacterial contamination; abundant potassium, calcium, sodium, magnesium and manganese content [9], wound healing, anti-diabetes, anti-bacterial and anti-inflammatory [7,10].

However, the weakness of this stingless bee honey is high water content [11-13]. Honey with high water content tends to do fermentation and crystallization [12,14,15]. This will cause a decrease in the quality of honey [16,17]. Decreasing quality in terms of sour taste and undesirable appearance as the presence of osmophilic yeast and fungus in honey is inevitable [16]. Therefore, it is necessary to reduce the water content of honey in order extending the shelf life. The purpose of this research is to find out the effect of using modified honey water content reducer device to water content and quality of honey.
2. Materials and Methods

2.1. Materials

Sampling was carried out in July 2019 (during the dry season). The honey sample that was tested came from honey bee farmer which located in Layuh Village, Batu Benawa Subdistrict, Hulu Sungai Tengah District (115°28’37.7” East; 2°36’30.1” South) Barabai, South Kalimantan with a height of 27 meters above sea level. The bee species on site is *Heterotrigona itama*. The temperature at the time of honey sampling ranged between 27.8°C-28.5°C. Harvested honey was put in a clean, sealed plastic bottle and then stored in the refrigerator at 4°C.

The activity of reducing water content was carried out done less than a month after harvesting kelulut honey. This experiment was carried out at the Banjarbaru Environment and Forestry Research and Development Institute Laboratory.

2.2. Methods

2.2.1. Designing a simple honey water content reducer device

The design of the simple honey water content reducer device (SHWCRD) was carried out by designing and making water content reducing equipment that was easy, affordable and applicable but did not damage the quality of honey. The honey water content reduction was a modified tool that has been developed by the community of South Kalimantan kelulut honey farmers. Materials and equipment needed were closed glass cabinets (used showcases) with size of 50 x 50 x 100 cm, mini dehumidifiers of 0.5 L of capacity, mini/exhaust fans, heat pads, digital thermo hygrometer, and reflectometer, a gauge for measuring moisture content (Figure 1). Exhaust fan mounted on the topside inside of the glass cabinet. The heat pad was mounted on the left and right side of the inside of the glass cabinet. Dehumidifier was placed at the bottom inside the cupboard. Honey samples were placed on cabinet shelves.

The working principle of the device made was evaporation technique to reduce water content by using dehumidifier. A closed glass cabinet used in this device was functioning to keep the honey from contamination with outside air. Heat pad was added to this tool to reduce air humidity inside the air-tight glass cabinet that resulted a faster water content reduction. Heat pad was set on temperature below 40°C to minimize honey quality decrease. Temperature and humidity inside the glass cabinet can be read from thermo hygrometer that installed in the device. Reduced water content process was focused on contact area between honey with drying air inside air-tight glass cabinet. Mini fan was set to ensure drying air circulated evenly inside the glass cabinet, so each honey shelf exposed to drying air flow. The specification of mini fan is AC200V/240V 50/60Hz 0.14A21W 2P.

![Figure 1. Water content reducer device of stingless bee honey](image-url)
2.2.2. Test for reducing water content of honey

The honey sample was put into a container /petri dish with a thickness of honey liquid in the container was 0.5 cm. In this study, the sample used were 6 samples. The temperature set at 40°C.

Before honey was put into the glass cabinet, the honey's initial moisture content was measured. Observations were made every one hour of observation. The experiments were carried out until honey levels were as expected (21-22%).

2.2.3. Stingless bee honey quality

Laboratory analysis was performed to find out whether the stingless bee honey quality change before and after the treatment using simple honey water content reducer device. The honey quality parameter analysed were diatase enzyme, reducing sugar (glucose), acidity, and metal pollutant Lead (Pb).

2.3. Data analysis

Data were analysed using simple regression analysis with OLS (Ordinary Least Square) method. The analysis uses the Microsoft Excel 2010 program.

3. Results and Discussion

3.1. Water Content

The result of reducing the honey water content with a simple honey water content reducer device (SHWCRD) showed that the water content decreases with the length of drying duration on temperature of 40°C. Decreasing the water content required less than 3 hours (Figure 2). The results of the regression analysis showed that the water content of honey was closely related to the duration of drying.

![Graph showing decreased water content of stingless bee honey on some drying duration](image)

\[
MC(\%) = -1.9907\times(T) + 27.79
\]

\[R^2 = 0.8483\]

**Figure 2.** Decreased water content of stingless bee honey on some drying duration

Honey water content reducer device which used by some stingless bee honey farmers in South Kalimantan usually made of glass cabinet (used showcase), dehumidifier and fan. Water content of stingless bee honey of *Heterotrigona itama* in South Kalimantan ranged from 25% to 29%. Likewise, water content of stingless bee honey of *Heterotrigona itama* in Malaysia as 26.53% to 28.87% [18]. Honey with water content of more than 22% tends to be easily fermented and decrease honey quality [16,19].

Modification a simple honey water content reducer device commonly used by honey farmers by adding heat pad that attached inside of the device. Heat pad was functioning to increase temperature inside the device. Temperature was set on 40°C as stated by [14] that dehydrating stingless bee honey on 40°C and 55°C did not damage the nutrient content. Based on test results, it needed about 3 hours of treatment to get recommended honey water content (21-22%). Decreasing water content of stingless bee honey was expected to maintain its quality.

3.2 Honey quality
The honey quality analyses results after shwcrd treatment on temperature of 40°C showed decreasing on the four of honey quality parameters measured (Table 1). In diastase enzyme, acidity and Lead (Pb) metal pollutant was still fit with the honey quality standard requirements based on SNI 8664: 2018. In reducing sugar parameter, its value was below the requirement standard whether before or after the treatment.

| parameter                        | IHC Standard | SNI 8664 : 2018 | Before treatment | After treatment |
|----------------------------------|--------------|-----------------|------------------|----------------|
| Diastase Activity (DN)           | Min 8        | Min 1           | 3.411            | 3.141          |
| Sum of Fructose and Glucose (g/100 g) | Min 60    | Min 55 (Glucose) | 22.48            | 11.44          |
| Free Acidity (meq/100 g)         | Max 50       | Max 200         | 203.93           | 107.27         |
| Lead (Pb) metal pollutant (mg/kg) | -            | Max 1           | 0.897            | < 0.001        |

Heating on honey was done to reduce its water content. Based on some references, water content can accelerate phytochemical changes of honey. In general, heating process on temperature of 40°C does not degrade the honey quality. Reducing water content in stingless bee honey is needed to maintain the quality and extend shelf life so that its storage and marketing will be easier [15].

Diastase enzyme content is one of quality and originality validity parameter of honey [1]. Laboratory analyses showed that diastase enzyme DN value declined after the heating (reducing water content) but still fit the quality requirement standard.

Reducing sugar of stingless bee honey of *Heterotrigona itama* sample value was below the honey quality requirement standard. Low reducing sugar content in kelulut honey happened because the honey harvested when it was not matured enough (honey cell was not fully closed) so that inversion by amylase enzyme that break complex sugar to simple sugar (reduction) on honey was not complete [20].

Acidity of stingless bee honey was decreasing along with reducing honey water content. It was confirmed with honey reviewed by [4] that showed stingless bee honey that had a high water content also had a high acidity.

Lead (Pb) metal pollutant in stingless bee honey before and after heating was still meets the honey quality requirement standard. In addition, heating stingless bee honey can reduce Lead content in honey.

4. Conclusion
Using modified simple honey water content reducer device (SHWCRD) on temperature of 40°C in 3 hours can reduce water content of stingless bee honey (*Heterotrigona itama*) up to 6% of initial water content. Honey with lower water content can be stored longer that can help the farmer to distribute their honey product.

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