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The Influence of the Vacuum drying method on the physicochemical properties of Stingless bee Honey

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***Abstract*—** Purpose: The aim of this research was to preliminary study the influence of the reducing moisture method on the physicochemical properties of honey stingless bees. Research Method: By using a vacuum pump combined with a desiccator for 0, 1, 3, and 5 hours. After reducing moisture content, the honey of stingless bees was determined physicochemical properties, moisture content, pH, conductivity, Hydroxymethylfurfural (HMF) content, °Brix, total reducing sugar content, and color according to AOAC and International Honey Commission. Findings: The results showed that at 5 hours displayed the moisture content lower than others. Additionally, their physicochemical properties were nearly the raw honey stingless bee before reducing moisture content and accordingly to stingless bee honey standard. Originality/value: Research findings could be used in the agricultural or food industries for honey storage and quality control.

***Keywords*—** Honey stingless bee; Physicochemical properties; Vacuum drying method

I. INTRODUCTION

The Stingless bee plays a significant part in plants' pollination process and an insect belongs to the order Hymenoptera of the family Apidae (Meliponini). it was found in 10 genera with 31 species in Thailand [1],[2],[3]. Honey of stingless bees is including of a diverse component of carbohydrates, such as glucose and fructose, amino acids, organic acids, vitamins, minerals, and enzymes from nature. Additionally, various bioactive and phytochemical contents for example phenolic and flavonoids [4],[5]. In the same way, it also has biological activity consisting of cardioprotective, antiinflammatory, antihelmintic, neuromodulatory action, and antioxidant activity [4]. However, honey stingless bees have a high moisture content, which results in a fermentation process and can decrease honey quality [6]. As previously reported, reducing honey's moisture by heating method might cause loss or change of components in honey [7,8]. Besides, in Thailand, the quality of honey required by the Thai Agricultural Standard of moisture content with less than 21% [9]. Therefore, finding a method that is free from heat may help with the effect of altering the honey quality.

II. RELATED WORK

In the previous research work, Kunjet et al. studied the effect of reducing moisture to maintain the honey quality of stingless bee by using the drying oven method. The data showed that the drying of honey stingless at 40 and 60 degrees Celsius was able to maintain the hydroxymethyl furfural (HMF) and moisture content of less than 80 mg/kg and 22%, respectively [9]. However, this method was used for about 6 hrs. to reduce the moisture content to 20-21%. Moreover, the microwave vacuum drying method has been reported that obtained quality dried honey after drying and a short time process (0-2 min) at low power [10]. However, low-cost entrepreneurs or farmers may not be able to prepare with this method. Thus, we are interested in a preliminary study of the effect of the reducing moisture method on the physicochemical properties by using a vacuum pump combined with a desiccator, the basic equipment in the general laboratory.

III. METHODOLOGY

Collection and Preparation of Honey of Stingless Bee

The honey of stingless bee (*Tetragonula laeviceps*was) collected stingless bee farm in Pase Yawo sub-district, Sai Buri district, Pattani, Thailand, on February 2020. Honey was filtrated with thin whites and kept in a glass bottom at 4°C for further study.

Experimental Study

Briefly, 100 g of stingless bee honey was added into the stainless-steel chamber and taken into the desiccator, which was connected with a vacuum pump (LAX®, S LX 115 Model, 1.5 CFM, 5 Pa, 220V~50Hz, ¼ HP), and decreasing the moisture content for 0, 1, 3 and 5 hrs.

After decreasing moisture content, stingless bee honey was analyzed for its physicochemical properties. Moisture content and °Brix were conducted by using a portable refractometer. HMF content and total reducing sugar content followed the white method [11]. In brief, the pH value is determined with pH meter METTLER TOLEDO.

The concentration of the honey solution was prepared as 10% (w/v) in DI water. The conductivity value is measured with a Conductivity meter HACH Sension 378. The concentration of the honey solution was prepared as a 20% (w/v) in DI, and it was expressed in microSiemens per centimeter (S/cm) [12], [13], [14]. The color of honey was analyzed with Jasco V-730 Spectrophotometry at 560 nm. The absorbance of the sample was multiplied by a factor of 3.15. It was expressed in mm Pfund scale by compared color designations of honey in Table 1 [15].

Table : 1 Color designations of honey

USDA color standard designation	Color range Pfund scale (mm)	Sample result range
Water White	≤8	0 - 0.094
Extra White	> 8 and ≤ 17	0.094 – 0.189
White	> 17 and ≤ 34	0.189 – 0.378
Extra Light Amber	> 34 and ≤ 50	0.378 – 0.595
Light Amber	> 50 and ≤ 85	0.595 – 1.389
Amber	> 85 and ≤ 114	1.389 – 3.008
Dark Amber	>114	> 3.008

Statistical Analysis

The values were the mean of three replicates and presented as mean ± standard deviation (n=3). One-way ANOVA used the analysis of the significant differences between values. The differences were considered significant when $p<0.05$.

IV. Results and Discussion

This work evaluated the physicochemical properties at different times (1, 3, and 5 hours) for decreasing moisture content by using a vacuum pump combined with a desiccator. The influence of the method on the physicochemical properties showed that the lowest moisture content was five hrs. with 21% which takes less time than the method of Kunjet et al. [9] and also without heating. In contrast, all parameters were increased following decreasing times, except the pH value (Table 2 and 3). The data represented that the loss of moisture content increased the value of conductivity, °Brix, color, HMF content, and reducing sugar content [16] And also found that honey has a thicker and more viscous appearance with increasing time. Whereas pH values were decreased due to the relation of acidic compounds having increased concentrations [16]. In addition, the moisture content of honey with a vacuum system for 5 hours to affect the honey quality meets the standards of Thai Agricultural Standard (TAS 8003-2013).

Table 2: Physical properties of honey before and after reducing the moisture content

Time (hrs.)	pH	Moisture content (%)	Conductivity (μS/cm)	°Brix	Color
0	3.99±0.00^{a}	26.33±0.58^{a}	704.67±14.47^{a}	71.0±0.0^{a}	1.58±0.00^{a}
1	3.99±0.01^{a}	24.00±0.00^{b}	697.33±14.74^{a}	74.0±0.0^{b}	1.74±0.02^{b}
3	3.98±0.02^{a}	22.00±0.00^{c}	685.00±8.54^{a}	74.0±0.0^{b}	1.83±0.00^{c}
5	3.94±0.02^{b}	21.00±0.00^{d}	683.00±10.82^{a}	75.0±0.0c	1.89±0.00^{d}

Note: $^{a-d}$Means within each column followed by different letters are significantly different ($p<0.05$).

Table 3: Chemical properties of honey before and after reducing the moisture content

Times (hrs.)	HMF content (mg/100g)	Reducing sugar content (mg/100g)
0	28.30±1.20^{a}	50.30±2.08^{a}
1	30.30±0.60^{b}	52.00±0.02^{a}
3	32.30±0.60^{c}	58.00±0.03^{b}
5	35.30±1.50^{d}	65.00±0.02^{c}

Note: $^{a-d}$Means within each column followed by different letters are significantly different ($p<0.05$).

V. Conclusion and Future Scope

The drying method of honey stingless bees by vacuum pump combined with a desiccator can reduce moisture content within five hrs., which honey quality was followed to Thai Agricultural Standard (TAS 8003-2013). This method showed a short time than previously reported [9] which uses heating and six hrs. Moreover, this method is also easy to set up and low cost when compared with microwave vacuum drying [10]. Currently, In Thailand, there are many areas of stingless bee cultivation. It may also be considered for its benefit in reducing humidity and helping preserve honey to maintain its quality. However, a vacuum pump combined with a desiccator reduces the moisture content of honey and may be required further studies in conditions of larger sample volumes in order for future industrial use.

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