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by Evahelda Evahelda



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Chemical characteristics of kelulut honey (*Trigona sp.*) in Bangka Tengah District, Indonesia

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Abstract. Honey is a natural liquid which generally has a sweet taste produced by honey bees (*Apis sp.*) from floral nectar or other parts of plants (extrafloral). Kelulut honey is the honey produced by kelulut bees (*Trigona sp.*). The kelulut bee is a member of the Meliponidae family (Stingless bee) and has a smaller body size compared to *Apis* bees, making it safe for cultivation. The honey quality cannot be uniformed every time it is harvested. This is because the physical and chemical quality characteristics of honey are very dependent on external and internal factors. External factors that influence it are the source of nectar, season, soil or geographic conditions, processing, and storage conditions. The internal factor that influences it is the type of bee. This study aimed to analyze the chemical characteristics of Bangka kelulut honey based on the Indonesian National Standard (SNI) 3545: 2013. The honey sample used was fresh kelulut honey without processing from the Karomah Forest Farmer Group in Lubuk Lingguk Village, Lubuk Besar District, Central Bangka Regency. The results showed that the chemical quality characteristics of Bangka kelulut honey have not passed the standards set by the Indonesian National Standard (SNI) 3545: 2013, especially on water content, reducing sugar content and acidity, respectively 28.7%, 59.3%, and 74.6 ml NaOH/kg. Kelulut honey also has vitamin C of 24.1 mg/kg.

1. Introduction

Honey is a natural substance that is produced from plant parts secretion or the plant-sucking bees excretion where bees collect, transform by combining with certain substances from within their bodies and store and leave them in the hive [1]. Certain substances found in bees that have a role in the breakdown process of the sugars are bee saliva which contains hydrolase enzymes. The invertase enzyme, which is added by worker bees when drinking and regurgitating honey, serves to convert sucrose to dextrose (glucose) and levulose (fructose).

Another definition according to SNI 3545: 2013[2], honey is a natural liquid that generally has a sweet taste produced by honey bees (*Apis sp.*) From floral nectar or other parts of plants (extrafloral). Flowers extract or nectar is a kind of liquid produced by plant nectar glands, rich in various forms of carbohydrates (3-87%), such as sucrose, fructose, and glucose, contains few nitrogen-containing compounds, such as amino acids, amides, organic acids, vitamins, aromatic compounds, and minerals.



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In Bangka Belitung Province, honey cultivation is generally classified based on the taste, namely sweet honey, and bitter honey from *Apis dorsata* forest bees, which have not been cultivated. Bitter honey comes from the flower of the pelawan tree, which has a distinctive and somewhat bitter taste. Sweet honey comes from the flowers of rubber trees, *leting*, *rempudung*, *egypt*, *mentepong*, *ules*, *qabal*, *mengalak*, *mengketan*, *merapin*, *betur*, *resak*, *black pelem pang* and others [3].

At this time, honey produced in Bangka Belitung Province, especially Central Bangka Regency, is currently not only derived from forest bees, but also kelulut bees (*Trigona sp.*). Kelulut bees (*Trigona sp.*) is a honey-producing bee species. Many terms are used to refer to this bee species. In Java, trigona bees are called klanceng, lanceng or kelulut bees, in Kalimantan and Bangka Belitung they are called kelulut, in Sumatra they are called galo-galo, and in Sundanese people, they are called te'uweul [4],[5].

The kelulut bee is a member of the Meliponidae family (stingless bee) and has a small body size compared to *Apis* bees, making it safe for cultivation. Besides being safe because it doesn't sting, trigona bee cultivation is relatively easy because it does not require intensive maintenance, done permanently, food sources are diverse, relatively resistant to pests and diseases, no famine, easy to adapt to a new environment [6]. In addition, the optimum temperature for better activities is from 26°C to 34°C [7]. The research site, namely Lubuk Lingku Village, has a tropical climate with an average temperature of 24°C to 28°C. Based on these conditions, Lubuk Lingku Village has a suitable climate for kelulut bees to be able to carry out forage activities, so that Lubuk Lingku Village has the potential to be used as a location for kelulut bees cultivation.

In addition, based on observations in the field, this kelulut honey has a specific taste characteristic, namely sweet and sour. The sour taste of honey is indicated by its high antioxidant content [8]. The honey quality cannot be uninformed every time it is harvested. This is because the physical and chemical quality characteristics of honey are very dependent on external and internal factors. External factors that influence it are the source of nectar, season, soil or geographic conditions, processing, and storage conditions. The internal factor that influences it is the type of bee [3].

At this time, kelulut honey bees are starting to be widely cultivated since it can be used as a source of family income. Apart from the price of honey, which is relatively more expensive than the honey produced from forest bees (*Apis dorsata*). The kelulut bee also produces propolis, bee pollen, and royal jelly. The price of kelulut honey in Bangka Belitung is relatively more expensive than the sweet honey. Kelulut honey costs IDR 75,000, per 250 ml while sweet honey is IDR 50,000. This is due to the fact that the production is still small, this honey is also believed by the local community to cure various diseases, including canker sores. The selling price of Kelulut honey is higher than forest bee honey (*Apis sp.*) and its easy maintenance makes people interested in cultivating it [9].

In addition, based on observations in the field, this kelulut honey has a specific taste characteristic, namely sweet and sour. The sour taste of honey is indicated by its high antioxidant content [8]. The honey quality cannot be uninformed every time it is harvested. This is because the physical and chemical quality characteristics of honey are very dependent on external and internal factors. External factors that influence it are the source of nectar, season, soil or geographic conditions, processing, and storage conditions. The internal factor that influences it is the type of bee [3]. The sweetness of natural honey exceeds the sweetness of sugar because the sweetness of natural honey has a sweetness level of one and a half times the sweetness of sugar. The sweetness of natural honey does not have bad effects such as granulated sugar, because in natural honey the sweetness level is influenced by simple carbohydrates in the form of 79.8% monosaccharides and 17% water so that it is easily absorbed by the body [9].

Based on [10], that kelulut honey quality owned by farmers from Mangkauk Village [5] at storages for 1 month still passed SNI 01-3545-2004, are sucrose content, water-insoluble solids, lead [5] copper, and arsenic. Meanwhile, the analysis results of honey that do not pass the standards set by SNI (01-3545-2004) are water quality, reducing sugar quality, and acidity quality. Some research studies showed that kelulut honey bee has greater nutritional content than an ordinary bee (*Apis dorsata*). For instance, Propolis produced by *Trigona sp.* Has microbial activity against salmonella bacteria [11].

The quality of Kelulut honey is also as good as forest honey (*Apis dorsata*) in controlling blood cholesterol levels [12].

This study aimed to analyze the chemical characteristics of Bangka kelulut honey based on the Indonesian National Standard (SNI) 3545: 2013, and to find out which chemical quality requirements of Bangka kelulut honey have not passed the standards set by the Indonesian National Standard (SNI) 3545: 2013, and to analyze the vitamin C level.

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2. Methods

2.1. Place and time of research

This research was conducted in Lubuk Lingkok Village, Lubuk Besar District, Central Bangka Regency. The research site determination was carried out purposive with the consideration that in Lubuk Besar Subdistrict there is a Karomah Forest Farmer Group, which is the only farmer group conducting kelulut bee cultivation. This research was conducted from March to December 2019.

Analysis of chemical characteristics based on the quality requirements of Indonesian honey (SNI 3545: 2013) (diastase enzyme activity, hydroxymethylfurfural content, water content, reducing sugars, sucrose, acidity, insoluble solids, ash, metal contaminants (Pb, Cd, Hg, As), chloramphenicol, microbial contamination, and vitamin C; which was held at the Bogor Agro-Industry Center (BBIA).

2.2. Materials and Tools

The honey sample used was freshly harvested kelulut honey from the Karomah Forest Farmers Group in Lubuk Lingkok Village, Lubuk Besar District, Central Bangka Regency.

2.3. Research methods

This research was conducted in Lubuk Lingkok Village, Lubuk Besar District, Central Bangka Regency. The research site determination was carried out purposive with the consideration that in Lubuk Besar Subdistrict there is a Karomah Forest Farmer Group, which is the only farmer group conducting kelulut bee cultivation. In this study, the honey sample used was fresh kelulut (*Trigona sp*) honey without processing which was directly harvested from farmers in Lubuk Village, Bangka Tengah regency. The packaging used after harvesting is a pre-sterilized five-liter plastic package. Furthermore, the honey sample put into a cool box to keep the temperature constant and avoid direct sunlight. After that, the kelulut honey is analyzed for its chemical quality characteristics.

3. Results and discussion

Kelulut honey is the honey produced by kelulut bees (*Trigona sp*). Characteristics of Bangka kelulut honey based on the quality requirements of SNI 3545: 2013 honey (Table 1.). Based on the table, it indicated that kelulut honey has several different characteristics from other types of honey in general. According to [13], honey derived from stingless bees (*Trigona sp*), has several differences in its chemical-physical characteristics. Based on the analysis results, Bangka kelulut honey has differences, especially on water content, reducing sugar, and acidity, exceeding the honey quality standard. This is because kelulut honey has a specific sour taste compared to honey in general. Besides, kelulut honey has a high water content compared to other types of *Apis* honey [14]. The honey quality cannot be uninformed every time it is harvested. This is because the physical and chemical quality characteristics of honey are very dependent on external and internal factors. External factors influencing it are the source of nectar, season, soil or geographic conditions, processing, and storage conditions. The internal factor that influences it is the type of bee [3]. Based on [15], the kelulut honey quality owned by farmers from Mangkawk Village that saved for 1-month still passed SNI 01-3545-2004, are sucrose content, water-insoluble solids, lead, copper, and arsenic. Meanwhile, the analysis results of honey that do not pass the standards set by SNI (01-3545-2004) are water quality, reducing sugar quality, and acidity quality.

Based on Table 1, the water content of Kelulut Bangka honey is 28.7%, while the water content quality requirement required in SNI for honey is a maximum of 22%. This water content is higher than required. However, the water content of kelulut honey is in contrast to the research of [16] which stated that the water content of kelulut honey was above 30%, similar to the research of [15], that the water content of kelulut honey originating from Banjar Regency is 25%. Furthermore, according to [14], the water content of kelulut honey in Malaysia was 33.24%. The high water content in Bangka kelulut honey is caused by the harvesting process carried out in an open space, so the honey absorbs a lot of moisture from the air because honey has hygroscopic properties. The process of harvesting kelulut honey, which is generally carried out on Bangka Island (Figure 1.). The high moisture content in Bangka Kelulut honey can be caused by the harvesting process which is done in an open space so that much honey absorbs moisture from the air because it has hygroscopic properties. The process of harvesting honey that is common by the forest Farmer group Karomah can be seen in Figure 1.

Table 1. The quality of Bangka Kelulut Honey Compared to Indonesian National Standard 3545: 2013

No.	Test type	Unit	SNI requirement 3545:2013	Bangka kelulut honey
A.	Organoleptic			
1.	Smell		Typical honey	Typical honey
2.	Taste		Typical honey	Typical honey
B.	Laboratory test			
1.	Diastase enzyme activity	DN	min 3*	1.64
2.	Hydroxymethylfurfural (HMF)	mg/kg	maks 50	0
3.	Moisture content	% b/b	max 22	28.7
4.	Reducing sugar (calculated as glucose)	% b/b	min 65	59.3
5.	Sucrose	% b/b	max 5	0
6.	Acidity	ml NaOH/kg	max 50	74.6
7.	Water insoluble solids	% b/b	max 0.5	0.16
8.	Ash	% b/b	max 0.5	0.23
9.	Metal contamination			
9.1.	Timbale (Pb)	mg/kg	max 2.0	0.16
9.2.	Cadmium (Cd)	mg/kg	max 0.2	<0.007
9.3.	Mercury (Hg)	mg/kg	max 0.03	<0.005
10.	Arsenic contamination (As)	mg/kg	max 1.0	<0.013
11.	Chloramphenicol		Undetected	-
12.	Microbial contamination			
12.1.	Total plate figures (ALT)	coloni/g	< 5 x 10 ³	30
12.2.	Most likely number (APM) coliform	APM/g	< 3	< 3
12.3.	Mold and yeast	coloni/g	< 1 x 10 ¹	<10
13.	Vitamin	mg/kg	-	24.1

^{*)} These requirements are based on test after the honey is harvested; DN = Diastase Number

- = Non-mandatory requirement

In addition, geographical conditions can also affect the high water content of kelulut honey. According to [17], stated that a tropical climate environment that generally has above-average rainfall can affect the water content of honey. According to [15], the dry air in the dry season may cause the low quality of nectar. This will make nectar sugar content also increase. Honey harvested or taken in the dry season can produce a lower water content than the honey taken in the rainy season due to the

dry surrounding air, this is influenced by honey which absorbs water from the surrounding air. Besides that, according to [18], which states that the storage place for kelulut bee honey is in the form of a pot which is a propolis and wax combination. In the fields of cultivated kelulut bees, the honey pots are gathered in a hive or box which is only closed with transparent plastic, so that it is easier for farmers to open and close the hive/box to check whether the honey is ready to be harvested. Unlike the case with Apis bee honey storage, which is in the form of hexagonal combs covered by a layer of wax and then surrounded by large bees.



Figure 1. (a) Honey bag/pot using wooden sticks, (b) The process of harvesting Kelulut honey using a pump machine

Apart from water content, other components that are different from other SNI quality requirements are reducing sugar content and acidity. Quality requirements for honey-based on SNI are at least 65%, while the reducing sugar content of Bangka kelulut honey is 59.3%. Likewise, the condition for honey-acidity based on SNI is a maximum of 50 ml NaOH / kg, but Bangka kelulut honey acidity is 74.6 ml NaOH / kg (Table 1). The low levels of reducing sugars and high acidity in Bangka kelulut honey are similar to the research of Ridoni et al. (2020), which states that the levels of reducing sugar and acidity of kelulut honey from Banjar Regency are 54.13% and 146.79 ml NaOH 1 / N kg, respectively. This is under the characteristic taste of kelulut honey which is sourer than other types of honey from other Apis bees. The acidity in honey is determined by hydrogen ions dissociation present in aqueous solution, while most of it also contains various minerals (including Ca, Na, K). Honey with more minerals has, a higher pH [15].

According to [19], which states that kelulut honey has a sweet and sour taste. The sour taste of kelulut honey can indicate the high level of antioxidants found in kelulut honey. Based on [8], that the origin of honey from trigona bees (bees that don't have a sting) contains antioxidants, anticancer, antimicrobials so that it is very beneficial for human health.

Antioxidants in kelulut honey can be seen from the level of vitamin C. The level of vitamin C in honey is not a mandatory requirement stipulated in SNI 3545: 2013. However, the analysis of vitamin C levels was carried out as supporting data to see the antioxidant content in Bangka kelulut honey. The level of vitamin C in Bangka kelulut honey is 24.1 mg/kg. Vitamin C contained in kelulut honey can also contribute to a sour taste in kelulut honey because vitamin C is ascorbic acid. However, the sour taste in kelulut honey causes the honey to be less attractive to consumers. Besides the aspect of taste, another difference is that honey from forest bees tends to be thicker and sweeter than Kelulut honey which is more dilute and sour [9].

4. Conclusion

The chemical characteristics of Bangka kelulut honey have not passed the standards set by the Indonesian National Standard (SNI) 3545: 2013, namely the parameters of moisture content, reducing sugar content and acidity, respectively 28.7%, 59.3%, and 74.6 ml NaOH/kg, and vitamin C levels of 24.1 mg/kg.

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