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Honey Purity Analysis of *Trigona* sp. species in Royal Honey Sakah, Bali

Ni Wayan Susilawati ¹, Ni Luh Gede Sudaryati ^{1,*}, I Putu Sudiartawan ¹

¹ Department of Biology, Faculty of Information Technology and Science,
Universitas Hindu Indonesia, Denpasar, Indonesia

*Correspondence email : sudaryati@unhi.ac.id

Abstract

Honey is a sweet liquid produced by bees and derived from the nectar of flowers. The increasing circulation of fake honey has alarmed the public. An analysis of the purity of honey still needs to be reported. This study aimed to analyze the purity of honey from *Trigona* sp. at Royal Honey Sakah. The qualitative design was used during the study in May 2022 at Royal Honey Sakah. Three honey samples from different bees were analyzed to find out how much water, sugar, and viscosity they had. Our findings show that the purity of honey depends on moisture content, sugar content, and viscosity and that these three parameters depend on the quality of nectar produced from flower plants around the place of cultivation. The purity level in sugar, water, and viscosity content in three types of honey, including *Apis dorsata* honey, wild forest honey (*Tetragonula biroii*), and tenganan local honey (*Apis* sp.), all meet the quality requirements of honey according to SNI 8664: 2018. Therefore, the higher the sugar concentration, the less water there is in the honey, and the higher the viscosity, the more pure or authentic the honey is.

Keywords: purity, *Trigona* sp., royal honey sakah, honey, bee cultivation

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1 Introduction

Honey is a naturally sweet liquid made by honey bees from the nectar of flowers [1]. Honey has always been used as a medicine and as part of herbal medicines to help treat diseases like stomach and lung infections and to make people healthier [2]. In addition, honey can accelerate the development of new tissue especially in open wounds [3]. The main components of honey include mineral salts such as calcium, magnesium, aluminum, iron, phosphorus, and potassium needed by the human body to avoid the risk of infection and disease. Also, honey has the B vitamins thiamin, riboflavin, ascorbic acid, pyridoxine (B6), niacin, pantothenic acid, biotin, phosphoric acid, and vitamin K, which can be used as antibacterial agents and antibiotics [4]–[6].

As more people want honey, the price of natural honey's price has increased significantly. As a result, many discoveries of honey circulation that do not meet people's expectations have been made, referred to as "fake honey" [7]. Honey that has been altered is bad for health, especially if it has sucrose, fructose, or glucose syrup. It can increase blood glucose levels and increase the risk of developing diabetes and other disorders that develop over time [8]. Honey makers use different ways to fake honey to make more money without caring about the public's health. People usually use traditional methods to test the quality and authenticity of honey, such as burning honey on a spoon and dragging it to see if it forms a thread, which could be a sign that the honey is fake. Honey can also be dripped onto a newspaper, and if

there is considerable seepage and honey gets onto the newspaper, the honey is considered to be fake. Finally, by putting honey into warm water, if the solubility is fast, it indicates that the honey is not natural [9].

Several studies have reported on attempts to distinguish natural honey from fake honey [7]. Ridoni et al. [10], looked at the amount and quality of *kelulut* honey (*Trigona* sp.) from Mangkauk Village, Pengaron District, Banjar Regency, which met the SNI 8664:2018 standard for sucrose, insoluble solids, lead, copper, and arsenic. However, honey's moisture, sugar, and acidity content still need to meet the requirements that may result from changes in honey's day and shelf life. According to Eteraf-Oskouei research, honey is a hygroscopic substance that quickly absorbs water and is strongly affected by it. His tests showed that honey with a relative humidity of 51% had a moisture content of 16.1%, and honey with a relative humidity of 81% had a moisture content of 33.4%. This showed that honey's higher water content continued to go down [11]. According to the standards set in Indonesian National Standard (SNI) 8664:2018, honey testing includes organoleptic tests (color, taste, aroma) and testing of total moisture content, sugar reduction (glucose), pH value, and metal contamination [12]–[14].

Honey authenticity testing has yet to be done on a large scale, but it is said to be in Royal Honey Sakah. This study used a refractometer to test the honey's moisture, sugar reduction, and viscosity, based on the SNI 8664:2018 standard for honey purity. The honey analyzed came from Royal Honey Sakah, where *Trigona* sp. bees were raised. This study aimed to analyze the purity of honey from *Trigona* sp. at Royal Honey Sakah. Through this research, the public will have more information about how to test the purity of honey, and fake honey will not be sold.

2 Method

This study used a qualitative and descriptive research design [15]. In May 2022, the identification procedure will last for one month. At Royal Honey Sakah in Batuan Kaler Village, Sukawati District, Gianyar Regency, identification and research were made. Royal Honey Sakah location are presented in Figure 1.

The honey in question is made by the *Trigona* sp. species and grown in Royal Honey Sakah. Sampling by aspirating (1-3 cc) with a modified vacuum device and then placing it on a bottle for analysis. The honey analyzed was of three types, including *Apis dorsata* honey, wild forest honey (*Tetragonula biroï*), and Tenganan local honey (*Apis* sp.).

Identification of the purity of honey is carried out by analyzing the substance's moisture content, sugar content, and viscosity with a refractometer. The test flow consists of several stages, including: a) ensuring that the hand refractometer is clean, particularly in the prism; b) calibrating with a few drops of aqua dest or NaCl solution on the prism; c) then the solution is removed, and the prism part is cleaned again using tissue; d) honey samples to be tested are dripped in as much as 2-3 drops; and e) transferring a hand refractometer that already exists [16].

The data were looked at descriptively by calculating how much water, sugar, and viscosity each honey sample had on average. These numbers were then compared with the reference SNI 8664:2018. The moisture and sugar content are presented in percentages (%), while the viscosity is expressed as °C^(b) or refractive index [14].



Figure 1 Royal Honey Sakah Location.

3 Result and Discussion

Overview of the study location

Royal Honey Sakah is an agrotourism spot in Banjar Sakah, Batuan Kaler Village, Sukawati District, and Gianyar Regency that raises honey bees. Royal Honey Sakah is a business with four official branches: Royal Honey Sakah, Royal Honey Bongkasa, Royal Honey Taro, and Royal Honey Sibetan. At least seventy young farmers in Bali work with Royal Honey Sakah to keep honey bees alive and grow them. Royal Honey Sakah was founded by Mr. **Dr. I Wayan Wahyudi, S.Si., M.Si.** At Royal Honey Sakah, raising honey bees is done with a focus on zoological and botanical conservation. Five species of bee live in this agrotourism, and around 150 colonies have been collected, including *Heterotrigona itama*, *Apis cerana* (*Nyawan Bali*), *Trigona* bee (*Kele-Kele*), *Tetragonula biroi*, and *Trigona thoracica*. In this study, we tried to analyze the purity of honey produced by *Trigona* sp. bees.

Honey purity Analysis

The results of the honey purity test reviewed from the analysis of moisture content, sugar content, and viscosity using a refractometer are presented in Table 1. The types of honey for which the analysis was carried out are presented in Figure 2.

Table 1 The results of the analysis of the purity of honey of the species *Trigona* sp.

Characteristic	Deuteronomy	Local honey Tenganan <i>Apis</i> sp.	Wild forest honey <i>Tetragonula biroi</i>	<i>Apis dorsata</i>	Reference Value of SNI 8664:2018
Moisture Content (%)	1	24	>27	23,5	Maximum 27.5% w/w
	2	24	>27	24	
	3	24,5	>27	23	
		24,7	>27	23,5	
Sugar content (%)	1	75	67	75	Minimum 65% w/w
	2	74,5	68	74	
	3	74,5	68,5	75	
		74,67	67,83	74,67	
Viscosity (T °C)	1	39,5	<38	39	-
	2	40	<38	39,5	
	3	40	<38	39	
		39,83	<38	39,17	



Figure 1 The type of honey for which the purity analysis is carried out. Description: left, honey *Apis dorsata*; middle, wild forest fight (*Tetragonula biroi*); right, madu local Tenganan (*Apis* sp.).

Table 1 shows that the honey samples used in this study's honey purity analysis were from three different types: local honey from Tenganan (*Apis* sp.), honey from wild forest bees (*Tetragonula biroi*), and honey from *Apis dorsata*. The honey with the lowest moisture content is that of the type *Apis dorsata* (23.5%), followed by local honey Tenganan *Apis* sp. (24.7%), and the honey with the highest moisture content is that of the wild forest bee *Tetragonula biroi* (>27%). The sugar content in the honey sample, from the lowest to the highest, was wild forest bee honey (*Tetragonula biroi*), which was 67.83%, followed by tenganan local honey (*Apis* sp.) and *Apis dorsata* with sugar contents of 74.67% each. Also, regarding honey's viscosity, *Tetragonula biroi* honey from wild forest bees has the lowest viscosity, at <38 °C^(b). *Apis dorsata* honey has the highest viscosity, at 39.17 °C^(b), and Tenganan local honey from *Apis* sp. bees has the lowest viscosity, at 38 °C^(b). The type of nectar that honey bees get and eat determines how much water, sugar, and viscosity the honey has [13], [17], [18].

Honey has several substances that are good for human health and have been shown to help prevent and heal diseases [11], [19], [20]. Honey's main content is minerals, salts, calcium, magnesium, aluminum, iron, phosphorus, and potassium [6], [21]. Also, honey's thiamin (B1), riboflavin (B2), ascorbic acid (C), pyridoxine (B6), niacin, pantothenic acid, biotin, folic acid, and vitamin K could be used to improve health, such as by making it easier for the body to fight off pathogens [22]–[25]. After sugar and carbohydrates, our research showed that honey needs air, the third most important part of honey. The purity of honey is determined by its moisture and sugar content [6], [26], [27].

The moisture content in honey is crucial in determining its freshness and protecting it from the dangers associated with fermentation [2], [28]. Research by Ridoni et al. [10] reported an analysis of the quality of *kelulut* honey (*Trigona* sp.) from Mangkauk Village, Pengaron District, Banjar Regency, which obtained the lowest water content of *Apis dorsata* honey, namely 23.5%. Honey collected during the dry season has less water than honey collected during the rainy season. This is because the weather and air around the place where the honey is grown have an effect, and the dry season is long. This happens when honey absorbs water from the surrounding air [3], [17], [29]. The lower the moisture level of honey, the higher it is quality and commercial viability [30]–[32]. In addition, the age of the harvest can affect the honey-water mixture. Honey that has been stored for a long time has less water than honey that has been stored for a short time. The longer the honey stays in the honeycomb, the more moisture is lost to evaporation [33].

Furthermore, Amanto et al. [28] discovered that high moisture content honey is of lower quality because it cannot withstand storage, reducing honey's water to improve its quality. In addition, a decrease in moisture content increases the viscosity of honey, making fermentation more difficult [34]. Long-term fermentation of honey in packaging can cause damage to the packaging as well as sensory changes and a reduction in the nutritional value of honey, resulting in a decrease in the quality of honey [21], [34]. According to SNI 8664:2018, the more it meets the requirements for water, sugar, and viscosity content, the honey is declared to have high purity or authenticity [14].

Research by Ridoni et al. [10] found samples of velvet honey (*Trigona* sp.) producing at least 54.13% reducing sugar. Unlike the findings on honey samples at Royal Honey Sakah, Tenganan *Apis* sp. and *Apis dorsata* have the highest sugar content at 74.67%. The amount of fructose and glucose in a sample of honey is what is meant by "total honey-reducing sugar" [35], [36]. Compared to SNI 8664:2018, the results show that the honey made by *Trigona* sp. bees in Royal Honey Sakah has a relatively high purity level. The results also show that the local honey Tenganan *Apis* sp., wild forest honey *Tetragonula biroi*, and *Apis dorsata* meet moisture content, sugar content, and viscosity requirements [14]. This study is different from Wulandari's research, which stated that the honey samples tested did not meet the quality requirements set with an average water content of > 28.59% w/w, which indicates high water levels and honey viscosity is relatively low, as a result of which honey is easy to ferment as a result of honey quickly absorbing water. It is highly recommended to store honey at cold temperatures rather than at room temperature [37].

The use of honey has been widely adopted [38], [39]. Honey, in addition to a therapeutic effect, also provides a comprehensive recovery effect for several diseases [40], [41]. The moisture, sugar, and viscosity of honey depend on the nectar of flowers bees obtain. In Royal Honey Sakah, plants that produce good nectar and honey are *Anthostemon chrysanthus* (Xanthos), *Jatropha integerrima* (Batavia), *Porana*, and *Antigonon* (Bridal Tears). The three kinds of honey identified are most sought after by the public for medicine [26], [42], [43]. It

is known that it contains many active chemicals, such as protein, carbohydrates, fiber, calcium, phosphorus, iron, salt, potassium, copper, zinc, riboflavin (vitamin B2), niacin (vitamin B3), and vitamin C in 100 g of honey [13], [44]. Research Simona explains that honey can be used in the medical world, especially for wound management [1]. The content of bioactive compounds in honey can have a medicinal effect on skin regeneration and tissue remodeling [3]. Furthermore, Bouacha found results showing that Algerian honey has the potential to be used as an antibiotic in the treatment of urinary tract infections in pregnant women [45]. In addition, honey has antibacterial potential and activity [5], [19], [22], [46].

Mama's research showed that honey has antibacterial effects on *methicillin-resistant Staphylococcus aureus* (MRSA), with the most considerable effect stopping 75% of the bacteria's growth [22]. Nayaka also said that the *Apis cerana* bees in Indonesia that make multiflora honey extract have antioxidant and antibacterial properties [43]. *Bacillus subtilis* and *Escherichia coli* cannot grow in *Apis cerana* honey because it has a lot of phenols and flavonoids [46]–[49]. This is in line with Abedi research, which revealed that honey contains high amounts of flavonoids such as safranal, crocin, crocetin, catechin, resveratrol, and calebin A [50]. His research found that honey and its main ingredients stop the virus from getting into the host cell and copying itself. They also change the way inflammatory cascades like COVID-19 work [50], [51].

Zaidi proved that honey's phenolic acids and flavonoid compounds kill bacteria, fungi, and viruses [52]. Honey can help with diseases like diabetes mellitus, cough, wound healing, ophthalmology, and cancer if eaten daily for a long time [8]. Nikhat said that forest honey and foods grown on farms have phenolics, proteins, vitamins, carbohydrates, and organic acids that have biological functions as antimicrobial compounds, wound healers, immunomodulators, antitoxins, and antioxidants [27], [53], [54]. Thus, the cultivation of honey deserves serious attention to meet human needs. By protecting and preserving the habitat and knowing what is needed for bee farming, agro-tourism selectors must put environmental conservation at the top of their list to produce honey that meets the established food tally.

4 Conclusion

The purity of honey depends on its moisture content, sugar content, and viscosity. The quality of the honey made by the *Trigona* sp. species depends significantly on the quality of the nectar made by flowering plants near where it is grown. In Royal Honey Sakah, plants that are widely taken as nectar by *Trigona* sp. bees include *Anthostemon chrysanthus*, *Jatropha integerrima*, *Porana*, and *Antigonon*. The purity of honey in terms of sugar content, moisture content, and viscosity in three types of honey, including honey *Apis dorsata*, wild forest honey (*Tetragonula biroii*), and local honey Tenganan (*Apis* sp.), all of which meet the Indonesian National Standard (SNI) 8664:2018, needs more research in the future to find out how honey made by *Trigona* sp. can help treat diseases.

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6 Author contribution

Ni Wayan Susilawati, conceptualization, data collection, data analysis, and writing manuscripts; Ni Luh Gede Sudaryati, supervisor, data analysis and manuscript validation; I Putu Sudiartawan, reviewed and approved the final manuscript.

7 Etic

Not applicable

8 Conflict of Interest

All authors declare there is no conflict of interest.

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