Composition and nutritional content of Honey *Trigona* sp in the Tikep forest management unit (KPH) North Moluccas

A S Nurdin¹, E Saelan², I N Nurdin³ and Dusjat⁴

¹Department of Forestry, Faculty of Agriculture, University of Khairun, Ternate, North Moluccas, Indonesia
²Department of Animal Science, Faculty of Agriculture, University of Khairun, Ternate, North Moluccas, Indonesia
³Department of Fisheries Product Technology, Faculty of Fisheries and Marine Sciences, Muhammadiyah University of Kendari, Kendari, Southeast Sulawesi
⁴Department of Biology Faculty of Sains and Technology, Institut Teknologi dan Kesehatan Avicenna Kendari, South East Sulawesi

E-mail: aqshanshadikin@ymail.com

Abstract. One of the non-timber forest products among them is honey bees which have high economic value. Honey is flower nectar that is absorbed by a honey bee into a honey bag inside its body. The flower nectar that has been sucked is processed in the bee body with a mixture of certain enzymes and then released back to the honey storage area in the beehive. This enzyme is the most important element in honey, which functions as a continuation of biological, chemical reactions and the metabolic system in the body. The purpose of this study was to determine the composition and nutrient content of *Trigona* sp. honey located in the Tikep forest management unit (KPH). The sampling method used in this study is using purposive sampling. Analysis of the sample through a proximate test included analysis of water content, ash content, fat content, protein content, and carbohydrates. Based on the results of the study, the water content in both samples was very high. The test results showed that forest honey (37.22%) and cultivated honey (35.18%), these values exceed the categories stipulated by Indonesian National Standard (SNI) No. 01-3545-2004 maximum 22%. The ash content analysis in both samples ranged from 0.79 to 1.12%. According to SNI, the maximum ash content in honey is 0.5%, which means that the sample of forest and cultivation honey has exceeded the maximum SNI limit. The analysis showed the highest levels of protein and fat in forest honey with a value of 1.72% and 10.76%. Unlike the carbohydrate content, the cultivation honey sample is greater than forest honey, with a value of 23.26%.

1. Introduction
Honey is a non-timber forest product that is utilized by the community surrounding the forest [1]. Honey is easy to use and does not require any complicated technology. It is very easy and has high economic values [2]. Honey is fluid nectar of flowers that is smoked by honey bees into a bag of honey in his body [3]. Smoked flower nectar is processed in a bee’s body with the help of an enzyme then reissued to the honeycomb’s honeycomb [4]. In general, honey contains 60-70% monosaccharides, disaccharides, Trisaccharides, and oligosaccharides and approximately 200 organic compounds, including amino acids, enzymes, proteins, vitamins, organic acids, pigments, phenolates, Maillard (MRP) reaction products,
and volatile compounds. The main composition of honey consists of 75-80% carbohydrates, 17-20% water, 1-2% minerals and organic compounds [5,6].

Nectar is a substance that has a very complex arrangement produced by the plant nectar glands in the form of sugar solution with varying concentrations. The main components of nectar (honey) are sugar (sucrose, glucose, and fructose) and other components such as proteins, organic acids, vitamins, pigments, enzymes, minerals and aroma substances [7].

Honeybees are social insects that live in the form of colonies. One of the terms of living honey bees is the presence of plants as feed sources. In the woods, honeybee colonies live on hollow trees. Many benefits can be drawn from honeybees. Honeybees can be differentiated into 2, which are stingless honey bees. One type of unsting honey bees is Trigona sp. [8]. Besides producing honey, Trigona sp. can produce propolis and bee pollen by consuming nectar from flowers and producing propolis from consuming sap from flower pollen [9]. The feed that is consumed Trigona sp. is also one of the factors that need to be considered in its cultivation efforts because the feed can determine the quality of the products [10].

Kususinopa Village is a region that produces Trigona honey from the Itama and Biroit types. This area has a large enough potential for plantation crops such as coconut, mango and other plantations, making it very suitable for Trigona sp’s honeybee habitat in looking for food.

2. Materials and methods

2.1. Research methods
For the research, Honey from Trigona sp. collected using purposive sampling was analyzed. The samples were collected from the farmers’ groups in and around the KPH Tikep through general observations made in terms of the forest areas and the type of cultivation adopted.

2.2. Research variables
The variables analyzed in this study were proximate content (moisture content, ash content, protein content, fat content, and carbohydrates).

2.3. Data analysis techniques
The analysis used in this research is quantitative descriptive using SPSS. Quantitative descriptive research is a research method used to examine specific populations or samples by taking samples and collecting data with quantitative research instruments. Quantitative descriptive research aims to explain the figures in the form of percentages and averages that are displayed in tables and graphs [11].

3. Results and discussion
The analysis of the content of comprehensive nutrients includes not only moisture content, ash content but also protein levels, fat levels, and carbohydrate levels [12]. Carbohydrates are usually analyzed by difference. This analysis is important to know the nutrient composition of food that can later be used to compose the nutrition fact that is included in the Food packaging label [13,14]. The table below shows the results of the analysis of several biochemical tests (proximate) on forest honey and cultivation.

3.1. Moisture
The test results showed the moisture content of forest honey, and honey cultivation exceeds the value set by Indonesian National Standard (SNI) No. 01-3545-2004 maximum 22% [15]. The amount of water in honey determines the durability of honey. This causes honey to ferment quickly and loses its quality. According to International Honey Commission, the normal water content of honey ranges from 14-25% [16]. Moisture content is influenced by several factors such as climate, temperature, and long storage. In addition, the moisture content in honey also greatly affects the quality of honey (table 1).
Table 1. Moisture Testing Results.

| Sample                | Test result (%) |
|-----------------------|-----------------|
| Forest honey          | 37.22           |
| Honey cultivation     | 35.18           |

The water content of honey is influenced by the humidity of the environment. This is because honey has hygroscopic properties, which is easy to absorb water. The higher the environmental humidity, the higher the water content of the honey. The water content of honey in Indonesia is high due to the high relative humidity (Rh) of the air in Indonesia [3,17].

3.2. Ash
The results of the analysis of ash content in honey from KPH Tikep ranged from 0.79 to 1.12%. The highest ash content is 1.12% is a sample of honey from cultivation and is a very significant difference with the forest sample that has the lowest ash content of 0.79% (table 2). According to SNI, the maximum content for honey ash is 0.5%, which means that the sample of forest and cultivation honey has exceeded the maximum SNI limit [18].

Table 2. Test results for ash content.

| Sample                | Test result (%) |
|-----------------------|-----------------|
| Forest honey          | 0.79            |
| Honey cultivation     | 1.12            |

According to the International Honey Commission, honey content of ash ≤ 1.2 g / 100g, which means that both honey samples from KPH Tikep have ash content that meets international standards. Ash content represents the total inorganic residue in the honey carbonization process. The difference in ash content in honey can be caused by several factors, one of which is the geographical condition of honey nectar. Ash content in honey is influenced by the presence of mineral content from nectar and food sources of bees, namely pollen or pollen [19].

3.3. Protein
The results of the analysis of protein content in honey samples showed that forest honey samples had a higher protein content (1.72%) compared to the cultivation samples (table 3). The difference in protein content in honey can be caused by differences in the origin of the nectar consumed by bees [20]. Honey bees, besides requiring high protein from pollen, also need ten types of essential amino acids.

Table 3. Results of testing protein levels.

| Sample                | Test result (%) |
|-----------------------|-----------------|
| Forest honey          | 1.72            |
| Honey cultivation     | 0.36            |

Pollen is the only source of protein for honey bees which turns out to have a protein content of pollen per flower that varies [21]. To meet the needs of protein and essential amino acids, honey bees must visit all types of flowering plants (forest plants, plantations, agriculture, horticulture, and wild plants) [22]. Protein from pollen is needed by young worker bees in physiological changes such as maturation of the flying muscles, maximizing the thoracic period, the development of the queen’s ovaries, and extending the life of the honey bee. to reach adulthood and colony productivity [23].
3.4. Fat
The results of the analysis of honey fat content from KPHTikep ranged from 2.66 - 10.76%. Some food ingredients in Indonesia can contain 10% or more extracts of ether (fat), the effect of storage will cause rancidity and can reduce the value of these ingredients (table 4). Honey has a low-fat content. Therefore rarely found sources and references that state the range of fat content in honey [12].

| Sample           | Test result (%) |
|------------------|-----------------|
| Forest honey     | 10.76           |
| Honey cultivation| 2.66            |

High or low-fat content is influenced by the diversity of plant species. The more various types of plants, the easier it is for the bees to collect pollen as a source of feed. The fat content of the pollen is around 1-20% [22]. Honey bees need fat in small amounts compared to protein and carbohydrates. The fat content of pollen varies from 0.8-18.9%. The pollen brought into the hive is mixed with the nectar and bee saliva [24].

3.5. Carbohydrate
Honey carbohydrate from KPH Tikep has a range between 19.02 – 23.26%. The highest Total carbohydrate is found in the sample honey cultivation (23.26%) (table 5). Carbohydrates are the most compositions in honey. Monosaccharides (fructose and glucose) reach 85-90% of carbohydrates contained in honey, while disaccharides, Oligosaccharides, and polysaccharides are only a small part [3]. Fructose and glucose during the digestive process can be quickly transported into the blood so that the body is quickly utilized as a source of energy [25].

| Sample           | Test result (%) |
|------------------|-----------------|
| Forest honey     | 19.02           |
| Honey cultivation| 23.26           |

The main function of carbohydrates is as an energy producer in the body. This indicates that honey can be used as an energy-supplying food because the Karbohidratnya content is quite large [12]. The distinctive flavor of honey is determined by the content of organic acids and carbohydrates, also influenced by the source of the nectar. The Randu honey has a sweet flavor. The sweetness of honey is determined by the ratio of carbohydrates contained in the nectar of the plant to the source of honey. Honey flavor can change when stored in unsuitable conditions and high temperatures, which results in the sense of honey turning into a rather sour [26].

Overall the test results of nutrient content (proximate analysis) on both samples can be seen in the figure 1 below.
4. Conclusions
Analysis of the content of comprehensive nutrients not only includes moisture content, and ash content, but also protein levels, fats, and carbohydrates. The composition and nutrient content of honey *Trigona* sp. in KPH Tikep shows moisture content in both samples is very high. The test results showed the moisture content of forest honey (37.22%) and honey cultivation (35.18%), exceeding the value stipulated by SNI No. 01-3545-2004, a maximum of 22%.

The results of ash content analysis on both samples ranged from 0.79 – 1.12%. According to SNI, the maximum rate for honey ash content is 0.5% which means that the sample of forest honey and cultivation has exceeded the maximum limit of SNI. The results of the analysis showed protein and fat levels in the largest forest honey with a value of 1.72% and 10.76%. Unlike the carbohydrate content, the sample of honey cultivation is greater than the honey, with a value of 23.26%.

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