The effectiveness of portable honey thickener machine to improve the quality of *Trigona incisa* honey

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Abstract. This study aims to determine the effectiveness of a portable honey thickener machine on several qualities of *Trigona incisa* bee honey. The research was conducted in Tamalanrea, Makassar City, South Sulawesi, and the process of testing the quality of honey was carried out at the Makassar Health Laboratory Center and PT. SUCOFINDO Makassar. The data analysis used is quantitative by calculating each of the observed variables, then the data obtained from each variable is compared with the SNI Standard 01-3545:2013. The variables observed in this study were Hydroxymethylfurfural (HMF), water content, reducing sugars (glucose and fructose), Sucrose, Acidity (ml NaOH 1 N/kg), water insoluble solids, and ash content. The results showed that the portable honey thickener machine was very effective in improving the quality of *Trigona incisa* honey after being added to the portable honey thickener machine when compared to SNI 2018, but when compared with the SNI 01-3545-2013 standard, some of the honey quality variables did not meet the standards. Honey quality standards are water content, reducing sugars (Glucose and Fructose), acidity, insoluble solids in water, and ash content, while those that meet SNI Standard 01-3545-2013 are reducing sugars Glucose and Sucrose.

1. Introduction

One of the non-timber forest products that have become a priority for the development of the Ministry of Environment and Forestry, which has become a leading commodity, is honey. Honey is a natural liquid that generally has a sweet taste produced by honey bees from plant flower extracts, extranutfial nectar, or the excretion of insects called sooty dew. In addition, honey bees can also produce products such as beeswax, beebread, royal jelly, bee venom, bee pollen, and propolis which have high economic value [1]. The use of products produced by honey bees and the need for the use of honey bee products are increasingly consumed by individuals, and honey is widely used in the food, beverage, pharmaceutical, and beauty industries [2].

There are around 500 species of *Trigona* spp. in the world, and in Indonesia, there are approximately 150 species spread across various islands. For example, on the island of Java, 9 species are known, 18 species in Sumatra, 31 species in Kalimantan, and 6 species in Sulawesi. This number can be found even more because each region has a different diversity of species. The most widely distributed species was *Trigona indipennis* or *T. Laeviceps*, followed by other species, namely *T. apicalis, T. fusco-balteata, T. valdesi, T. collina, and T. terminata*. *Trigona* bees were first discovered in India, inhabiting forests in Asia and extending eastward to the Solomon Islands [2]. Honey bees can be divided into 2, namely...
stingless bees and stingless bees. One type of stingless honey bee is *Trigona incisa* which has the potential to produce large amounts of honey, propolis, and bee bread [3].

The *Trigona incisa* bee is an endemic bee that can produce honey with a sour taste but is resistant to fermentation. The specialty of this bee is that it is docile, does not sting, and its size is larger than other *Trigona* bees [4]. *T. incisa* colonies can be harvested four times a year, two major harvests and two intermediate harvests. At harvest time, the potential for colony production in producing honey is around 5-15 liters, bee bread 1-2 kg, and propolis 0.5-1 kg [5].

In the market, it is very difficult for the senses to know whether the honey circulating in the market is of high or low quality; therefore, it must be tested in the laboratory. Honey quality is a very important consideration for honey consumers, industry, and importers; therefore, it is very important to note that honey must be pure, free from other impurities. There are several honey quality variables recognized by the Ministry of Health of the Republic of Indonesia and required to pass the test for the purity and specifications of honey products, namely diastase enzyme activity, hydroxymethylfurfural (HMF), water content, reducing sugar, sucrose, acidity, insoluble solids in water, ash content. Metal contamination (Pb and Cu) and Arsenic [6].

Portable Honey Thickener Machine is a machine that is used to reduce the water content of a liquid material, including honey, with this tool it is expected to help improve the quality of honey. The working principle of this machine is to reduce the water content in honey and not cause heat so that honey is maintained and does not change the quality of honey [7].

Based on the previous description, the *T. incisa* bee has enormous potential to be developed, but until now, the quality of the honey it produces is not known, so it is necessary to conduct research on the effectiveness of the portable honey thickener machine to improve the quality of the *T. incisa* bee honey so that it can be used. Increase its selling price in domestic and international markets.

### 2. Materials and methods

#### 2.1. Sampling research procedure

a) Samples are taken directly from the harvest from the *Trigona incisa* bee box

b) The sample is put into a bottle container

c) The sample is divided into two, namely breeder 1 and breeder 2

d) Samples were tested at the Makassar Health Laboratory Center and PT. SUCOFINDO Makassar

e) After three days, the honey sample was taken, then tested at the Makassar Health Laboratory Center and PT SUCOFINDO Makassar.

#### 2.2. Laboratory sample testing procedures

Laboratory sample testing procedures are tested with standards and test procedures according to SNI 01-3545:2013 with the quality variables tested as follows:

a) Hydroxymethylfurfural (HMF)

b) Moisture Content (Refractometer Method)

c) Reducing Sugar Level

d) Sucrose Level

e) Acidity

f) Solids that are insoluble in water

g) Ash content

#### 2.3. Data analysis

Analysis of the data used is quantitative. Counting each observed variable, then the data obtained from each variable is compared with the SNI Standard 01-3545:2013. The requirements for honey quality can be seen in Table 1.
Table 1. Honey quality requirements based on SNI 01-3545:2013.

| Unit Test                                      | Unit               | Un Requirements |
|------------------------------------------------|--------------------|-----------------|
| Hydroxymethylfurfural Water                   | Mg/kg              | Max 50          |
| Content                                        | % b/b              | Max 22          |
| Reducing sugar                                 | % b/b              | Min 65          |
| Sucrose                                        | % b/b              | Max 5           |
| Acidity Solid insoluble in water               | ml NaOH (1 N/kg)   | Max 50          |
| Ash content                                    | % b/b              | Max 0.5         |

3. Results and discussion

3.1. Hydroxymethylfurfural (HMF)

Hydroxymethylfurfural is a product of the breakdown of monosaccharides (glucose and fructose) by enzymes in the honey. HMF is also known as a neurotoxin which, if found in a lot of honey, causes honey to be bad [5]. The addition of sugar can increase the HMF value; besides that excessive heating will also cause the HMF value of honey to increase. This heating is usually done to reduce the water content [1]. The results showed that the amount of HMF that was not treated was 36.70, while the treatment was 1.93 mg/kg; this value met the quality standard of SNI 01-3545-2013 honey (Figure 1), namely the maximum value of HMF in honey, up to 50 mg/kg. The HMF value was very low in the *T. incisa* honey test, namely the honey sample that was treated (Figure 1). This is an indicator that the honey tested is fresh or has been heated, or has been stored too long. This is also in accordance with the opinion of Eva Crene (1975), which states that fresh or undamaged honey contains small or low amounts of HMF [7].

![Figure 1. Hydroxymethylfurfural (HMF)](image)

3.2. Water content

The water content obtained in the *T. Incisa* honey test with that which was not treated was 30.01%, while the treated 26.74%. This value did not meet SNI 01-3545-2013, namely the water content of honey which required maximum water content of 22%, but if compared to SNI 2018, the quality standard of this honey still meets the standard (Figure 2).
Figure 2. Moisture content

The high water content can be caused by the high humidity level of the tropics (around 60 – 80%). In contrast to the subtropical areas where the humidity level is very low (below 50%). The high quality of honey is strongly influenced by climate, and the wetter an area, the higher the water content.

3.3. Reducing sugar
The presence of reducing sugars is very important, especially to facilitate the digestion of honey by the human digestive system and provides high energy with calories produced per 100 g on average 294 - 328 calories [6].

Figure 3. Reducing sugar

The results showed that the amount of reducing sugar that was not treated was 35.61%, while the treated sugar was 60.29%. This value did not meet SNI 01-3545-2013, namely the value of reducing
sugar in honey which required reducing sugar in honey to be at least 65% (Figure 3). Viviena (1998) explained that one of the quality standards of honey is based on the content of reducing sugars (glucose and fructose) [6]. The low, reducing sugar in the tested honey was due to the very high water content of honey (30.01%). This is in accordance with the opinion of Eva Crene (1975), who stated that the higher the water content of honey, the lower the sugar content (reducing sugar) [7].

3.4. Sucrose

Tests for sucrose levels were carried out because most adulteration of honey, such as the addition of simple sugars, could increase the sucrose content of honey by more than 8%.

![Figure 4. Sucrose](image-url)

The results showed that the amount of sucrose that was not given treatment was 0.78%, while those who were given treatment were 1.58%. This value meets SNI 01-3545-2013, namely the value of sucrose content in honey which requires sucrose in honey to be a maximum of 5% (Figure 4). This value indicates that the honey tested has not received added sugar or is still original. This is in accordance with the opinion of Eva Crene (1975), who stated that high-quality honey must also contain not too high sucrose sugar [7]. Sucrose levels in honey occur due to honey harvested young or cooked after harvesting. This causes the invertase enzyme present in honey to die. In fact, it is this invertase enzyme that functions to convert long chain sugars (sucrose) into monosaccharides. Honey is different from sugar; honey is a nutritious natural food supplement containing monosaccharides consisting of glucose and fructose. While sugar only contains a disaccharide called sucrose [3].

3.5. Acidity

The results showed that the acidity value obtained from the untreated was 200.34%, while the acidity value was 196.34% ml NaOH (1 N/kg); this value did not meet SNI 01-3545-2013 concerning honey which requires acidity. In honey, a maximum of 50 ml NaOH/kg (Figure 5), but when compared to SNI 2018, it still meets honey quality standards. The high acidity value in the honey test was caused by the honey being tested from *T. inciso* honey, which is honey that has specific characteristics with an acidic taste but is resistant to fermentation [7]. In addition, the water content of honey is also very high (30.01%).
The type of acid that is quite influential on honey is gluconic acid (which was discovered in 1960) which is the result of the breakdown of glucose by the enzyme glucose oxidase, in addition to other types of acids [3]. While the organic acids in honey include glycolic acid, formic acid, lactic acid, citric acid, acetic acid, oxalic acid, malic acid, and tartaric acid. Some of these acids are very beneficial for health, which are useful for the body's metabolism, including oxalic acid, tartaric acid, lactic acid, and malic acid. Even in lactic acid, there is a content of lactobacilli substances that can inhibit the growth of cancer cells and tumors. Free amino acids in honey are able to help cure diseases, as well as materials for the formation of neurotransmitters or compounds that play a role in optimizing brain function [7].

3.6. Solids that are not soluble in water
The results showed that the value of solids that were not soluble in water obtained that were not treated was 0.4%, while those who were given treatment were 0.81% (Figure 6).
Values that meet SNI 01-3545-2013 are those that are not given treatment, namely solids that are insoluble in honey that is not soluble in water in honey a maximum of 0.5%. This value indicates that the honey tested is clear and has a lower percentage of solids that are insoluble in water. The lower the content of materials that are not soluble in water, the cleaner the honey [7].

3.7. Ash level

The ash content of honey is determined by the types of materials that bees collect while foraging for food. The results showed that the value of ash content that was not given treatment was 0.015 %, while that which was given treatment was 0.78% (Figure 7).

![Figure 7. Ash content](image)

Values that meet SNI 01-3545-2013 are honey that is not treated. In this case, the standard value of honey ash content of SNI 01-3545-2013 requires a maximum of 0.5%. The ash content in the tested honey is quite high; this is because the honey contains inorganic compounds. This is in accordance with the opinion of Nuraeni (2007), which suggests that honey containing inorganic compounds such as calcium, potassium, magnesium, phosphorus, aluminum remains in honey after high combustion occurs in conditions of abundant oxygen [5]. There are several inorganic compounds that decompose faster at high temperatures. This kind of residue is referred to as ash. The ash content in honey depends on the type and material collected by worker bees while searching for food.

4. Conclusion

Based on the research that has been done can be concluded that:

1. The portable honey thickener machine is very effective in improving the quality of *Trigona incisa* honey after being added to the portable honey thickener machine when compared to SNI 2018.
2. Quality of *T. incisa* honey that does not meet honey quality standards according to SNI 01-3545-2013 standards, namely water content, reducing sugars (Glucose and Fructose), acidity, insoluble solids in water, and ash content, while those that meet Standard SNI 01-3545-2013, namely reducing sugars Glucose and Sucrose.

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