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POTENTIAL TRIGONA BEEKEEPING (*Heterotrigona itama* and *Geniotrigona thoracica*) AT SOUTH LABUHANBATU CITY, NORTH SUMATERA PROVINCE, INDONESIA

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ABSTRACT

Study area this research was conducted on November 12th – 21st, 2021, located in Kota Pinang, South Labuhanbatu, North Sumatra, Indonesia. The results of this study can provide a report on the results of the analytical test carried out in the laboratory of the University of Brawijaya. South Labuhanbatu Regency is geographically located at 1°26'00" - 2015'55" North Latitude. 99°40'00" - 100°26'00" East Longitude. Generally, South Labuhanbatu Regency is located at an altitude below 100 meters above sea level. The type of research is exploratory research. The result and discussion gave the best replacement of water content in honey at *Apis dorsata* as an average of 27%. It showed that the higher the water content and acidity of the honey will explain the lower the quality of the honey. The best replacement levels of sucrose in honey at Heterotrigona itama as an average of 68.5%. The percentage level of sucrose showed that honey with a moisture content of more than 17%, with a total sugar content of <83% is susceptible to cosmetological yeast fermentation. The best pH of Honey placed at *Apis dorsata* is an average of 2.350 (Acid). The data showed that the low pH value and high acidity can increase the shelf life of honey because it does not support the growth of microbes.

Keywords: Bees, Honey, Pollen, South Labuhanbatu, Viability.

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INTRODUCTION

South Labuhanbatu is one of the cities in North Sumatra, Indonesia that has high oil palm potential. Coordinating Minister for Maritime Affairs, Luhut Binsar Panjaitan said, Labuhanbatu has 1/5 of oil palm plantations in North Sumatra with a total CPO production of 1 million liters (Hamdani, 2019). Meanwhile, according to BPS data from North Sumatra Province, it shows that the city of South Labuhanbatu has an oil palm plantation area with an area of 43,009 hectares and produced 682,302.73 tons of oil palm production in 2020. The by-product produced by palm oil is coconut oil and is supported by another potential in the form of palm pollen. The palm has the scientific name *Elaeis guineensis*. The presence of pollen can support the life of oil palm plants with pollination assisted by bee colonies (Myint, et al. 2012). Pollen, otherwise known as pollen, is a source of protein for bee colonies to produce honey, propolis.

Bee colonies need nectar and pollen for their survival. Nectar and pollen contain some of the carbohydrates, proteins, vitamins, minerals, and water that bees need. These nutrients are needed to support the growth of honey bees and the quality of productivity produced by honey bees (Sereia, et al. 2013). Bees that collect pollen usually come from the corbiculata group such as bees without a sting, this can be characterized by the presence of basketball pollen on the limbs of worker bees that have a function as pollen carriers. Examples of bees without a sting are *Heterotrigona itama* and *Geniotrigona thoracica*. Not only that, this type of bee belongs to the family *Apidae* and its ability to produce honey is well known. The stingless bee has a morphology consisting of four parts of the body, namely the abdomen, head, legs, and wings (Ali, et al. 2021).

H. itama's body size has a body size ranging from 5-7 mm (Azizi, et al. 2020). The amount of honey produced by *H. itama* bees is very abundant, making this bee widely cultivated (Inoue, et al. 1985). This cultivation is also carried out for bees of the type *G. thoracica*. The body size of *G. thoracica* is larger than that of *H. itama* bees, so the honey production produced is also relatively large. The larger the body possessed by the *G. thoracica* bee, the farther the flight distance will be. The average body size of the *G. thoracica* bee is 5 cm and can fly a distance of 600 m (Amano. 2004). The flight distance of bees is affected by the willingness of natural feed. The natural feed that bees need is nectar and pollen. Nectar is obtained from flower vegetation in the surrounding environment, there are bridal tear plants (AMP), xanthos, coffee, and so on. Meanwhile, many sources of pollen are obtained from oil palm plants.

The quality of the oil palm crop depends on the viability of the pollen produced. The higher the viability of pollen in oil palm plants, the higher the feeding of oil palm products. The protein content of pollen and the viability of palm pollen are also high at 31.11% and have other contents such as water 28.8%, fat 20.74%, carbohydrates 13.41%, and other ingredients (Grains, 2011). This content has the potential to make palm pollen into honey bee feed.

The viability of pollen is influenced by the environment so it will also affect the quality of honey produced by bees. (Iovane, et al. 2021) states that environmental conditions such as temperature and humidity will affect pollen viability and protein content in pollen. Until now, there has been no research on the use of palm pollen to produce honey with the help of *H. itama* and G. thoracica, especially in Labuhanbatu Regency.

MATERIAL AND METHODS

Tools and Materials

The materials used in this study include the research sample, 70% alcohol, a*qua dest*, while the tools used in the research include a microscope, dropper, object-glass, cover glass, tweezers, scissors, 100 mL measuring cup, pH meter, *partial counter*, and the brix refractometer.

Study Area

This research was conducted on November 12-21, 2021, located in Pinang City, South Labuhanbatu, North Sumatra, Indonesia. The results of this study can provide a report on the results of the analytical test carried out in the Animal Product Techonology laboratory, Faculty of Animal Science, Universitas Brawijaya. South Labuhanbatu Regency is geographically located at 1°26'00" - 2015'55" North Latitude. 99°40'00" - 100°26'00" East Longitude. Generally, South Labuhanbatu Regency is located at an altitude below 100 meters above sea level. Altitudes between 100-500 meters above sea level are only found in Sungai Kanan District, more precisely in the western part bordering the North Padang Lawas Regency.

As in general, this area is located in North Sumatra, Indonesia is an area with a tropical climate. This area has 2 seasons, namely the rainy season and the dry season.

Types of Research

This research is exploratory research by taking several research samples needed for the analysis test.There are several samples taken including the following:

a. Honey from *Apis dorsata* bees;
b. Honey from *Heterotrigona itama*;
c. Honey from *Genotrigonthoracica*;
d. Bee breed *Heterotrigona itama*;
e. *bee pollen* from the *Apis cerana* bee;
f. Propolis *Genotrigona thoracica*;
g. Bee wax from the *Apis cerana* bee;
h. Male palm pollen;
i. Flower pollen A;
j. Flower pollen B;
k. Flower pollen C;
l. Flower pollen D;
m. Flower pollen E

Meanwhile, the sample above will be analyzed using a microscope and several other tests. The analytical tests tested are in the form of:

a. Test the moisture content of honey samples;
b. Test the level of sucrose on honey samples;
c. Test the pH level on honey samples;
d. Test the analysis of the appearance of micro pollen, bee breed, and bee pollen using a microscope;
e. Viability test on oil palm pollen;

RESULTS AND DISCUSSIONS

The research will be showed Figure 1. *Geniotrigona thoracica* and Figure 2. *Heterotrigona itama*. Not only that, writer will explained about the honey production of both bee below:

Figure 1. *Geniotrigona thoracica*

Figure 2. *Heterotrigona itama*

Honey Sample

Test the moisture content of honey

Research conducted by Pinang City, Labuhanbatu Selatan, North Sumatra, Indonesia showed that the water content value obtained from the table above, we can know that content of water in *G. thoracica* honey minimum at 2nd replications 28,0% and maximum 28,5%, whereas for *H. itama* at 29,5% as maximum and 28,5% as

minimum. Then for A. dorsata honey knows maximum 27,5% at 2nd replications. The water contains in honey greatly affects the quality of honey. Good honey is one that contains a water content of around 17-21 (Sihombing, 2005). The higher the water content and acidity of the honey, the lower quality of the honey, while the lower the sugar content, the lower the quality of the honey (Suranto, 2007).

Table 1. The water content in honey

Kind of Honey	Replications		Average
	1st	2nd	
Geniotrigona thoracica	28.5%	28.0%	28.5%
Heterotrigona itama	29.5%	28.5%	29.0%
Apis dorsata	26.5%	27.5%	27.0%

Test for sucrose content in honey samples

The table above explain about sucrose level, there is two replications each sample. Range sucrose level *G. thoracica* honey between 70-72%, *H. itama* range 68-69%, then *A. dorsata* between 71-72%. Acidity and total sugar levels of honey are also important as parameters of honey quality because their levels can reflect the damage to honey by the activity of osmophilic yeast fermentation *Zygosaccharomyces*. Honey with a moisture content of more than 17%, with a total sugar content of <83% is susceptible to cosmetological yeast fermentation which can cause honey to ferment during the storage process and cause honey to have a sour taste and spoil (Fatma, et al. 2017).

Table 2. The levels of sucrose in honey

Kind of Honey	Replications		Average
	1st	2nd	
Geniotrigona thoracica	70.0%	72.0%	71.0%
Heterotrigona itama	69.0%	68.0%	68.5.0%
Apis dorsata	72.0%	71.0%	71.5%

Test the pH level on honey samples

Research on pH showed that the levels of honey produced by *Geniotrigona thoracica, Heterotrigona itama*, and *Apis dorsata* explained above. The pH measurement shows that all the honey produced is acidic. The low pH value and high acidity can increase the shelf life of honey because it does not support the growth of microbes (Lage, et al. 2012) in line with those mentioned by (Alves, et al. 2013) that the low pH value supports the extraction and storage of honey. However, this pH value is still relatively low and is not stable if processed into royal jelly. According to (Murean and Buttstedt. 2019) explain that pH value of honey that can be processed into royal jelly is pH 4-4.5.

Table 3. The pH levels in honey

Kind of Honey	Replications		Average
	1st	2nd	
Geniotrigona thoracica	2.77 (Acid)	2.81 (Acid)	2.79 (Acid)
Heterotrigona itama	2.57 (Acid)	2.62 (Acid)	2.59 (Acid)
Apis dorsata	2.24 (Acid)	2.46 (Acid)	2.359 (Acid)

Analysis of Micro Pollen, Bee Breed, and Bee Pollen Appearance Forms Using a Microscope

The micro appearance of pollen, bee breed and bee pollen is seen from a microscope with a magnification of 400x.

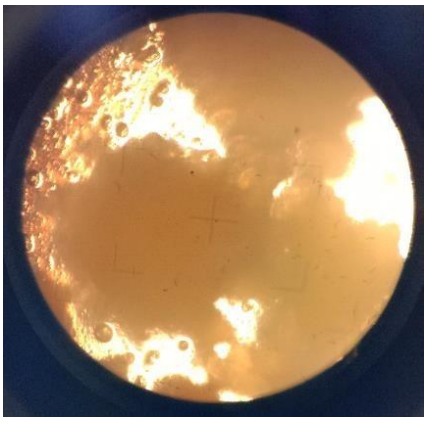

Figure 3. Bee Breed *Heterotrigona itama*

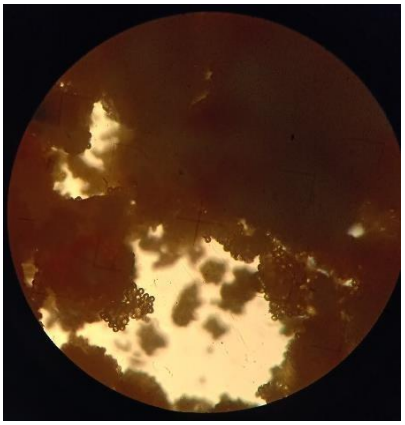

Figure 4. Bee pollen *Apis cerana*

Figure 5. Male Palm Pollen

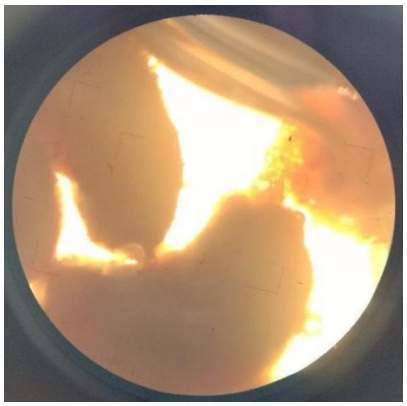

Figure 6. Flower Pollen A

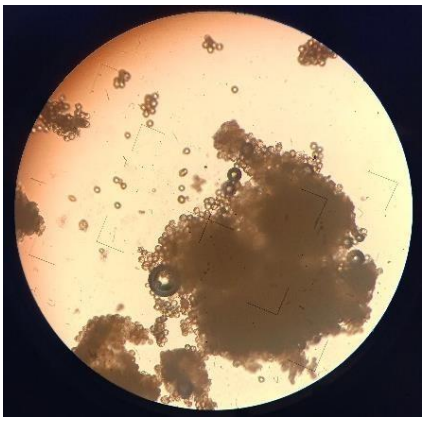

Figure 7. Flower Pollen B

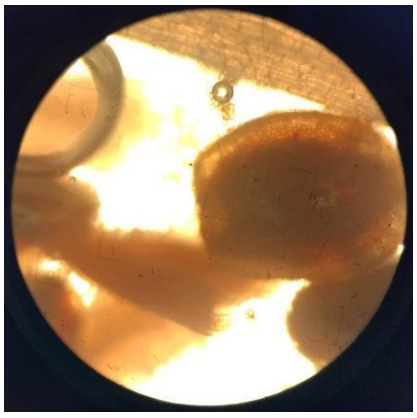

Figure 8. Flower Pollen C

Figure 9. Flower Pollen D

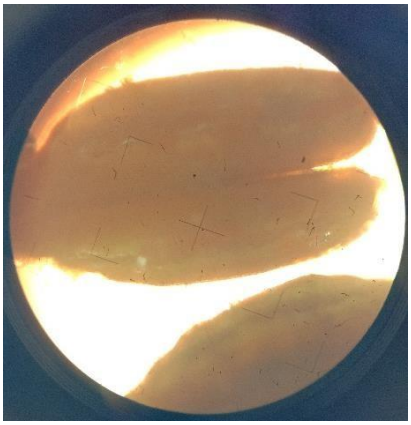

Figure 10. Flower Pollen E

Viability Test on Palm Pollen

Pollen viability is an important parameter, because pollen must be alive and able to germinate after pollination for fertilization to occur. The availability of pollen with high viability is one of the components that determine the success of plant crosses (Widiastuti and Palupi, 2008). Furthermore (Bot and Mariani, 2005) explained that pollen is a critical stage in the plant life cycle, pollen viability is very important for efficient sexual reproduction of plants. Pollen is declared viable if it is able to demonstrate its ability or function to deliver sperm to the institution's bladder (*embryo sac*), after pollination occurs. Pollen can lose its viability over a period of time. The loss of viability is strongly influenced by environmental conditions, especially temperature and relative humidity (Shivanna, et al. 1991).

A pollen grain is a living cell and has a nucleus and protoplasm, which is enclosed by a cell wall. The cell wall consists of two layers, namely the inner layer (*intine*) which is thin and soft like a membrane and the outer layer (*axine*) which is thick and hard to protect the entire contents of the pollen grain (Darjanto and Satifah, 1982). If the pollen is compatible, it will germinate on the stigma and form a pollen tube that will carry male gametes to the female gametophyte. The protein compounds found at the beginning of the formation of pollen are called lectins, located in the outer layer (axine) and the inner layer (intine). Lectin plays an important role in the recognition mechanism between pollen and pistil. However, if the pollen is incompatible, pollen germination will be inhibited or the growth of the pollen tube will be retained in the transfer tissue (Anjelina, 2009).

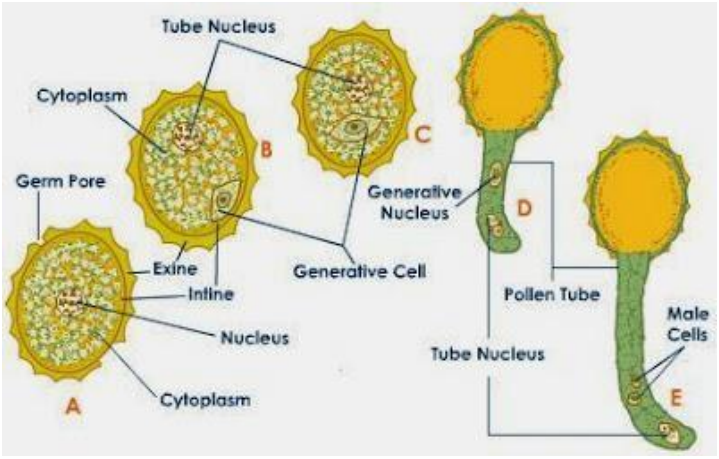

Figure 11. Stages of Pollen Tube Formation (Source : https://qsstudy.com/describe-formation-structure-pollen-grain)

To form a fruit must go through pollination and fertilization. Pollination can only occur when viable pollen falls onto the stigma which can release biochemical (receptive) compounds. Pollen viability indicates the state of pollen that is ripe and ready to pollinate the stigma. The pollen will germinate to form a pollen tube and deliver the sperm to fertilize the egg so that fertilization can be successful. By inhibiting the formation of the pollen tube, fertilization does not occur because sperm cannot reach the ovary.

Thus the fruit cannot be formed (Wahyuningsih, et al. 2009). Fertilization is a continuation of pollination. In this fertilization process, the pollen attached to the stigma with the help of the liquid in the stigma will germinate or elongate (Hanum, 2008).

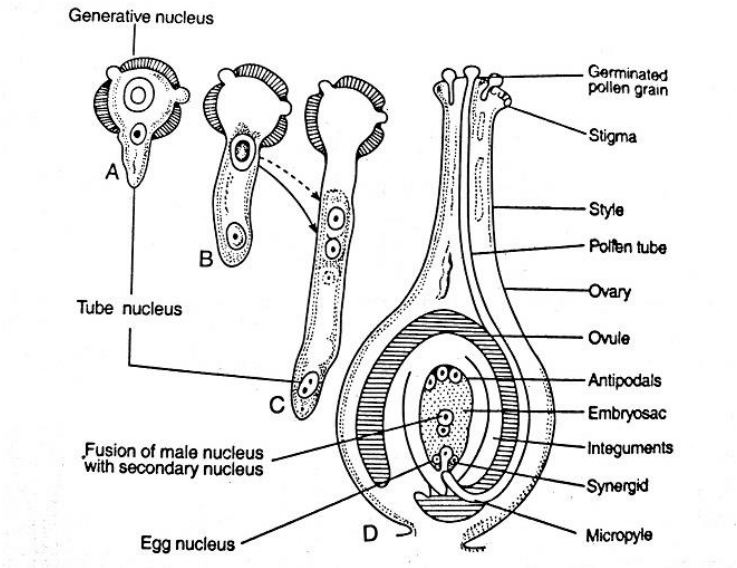

Figure 12. Stages of the Fertilization Process (Source: Humagain, 2021)

The size of the pollen in the field is obtained using a particle counter on oil palm pollen as follows:

- 0.3 microns as much as 15,166 grains
- 0.5 microns as much as 2,564 grains
- 1.0 micron as much as 615 grains
- 3.0 microns as much as 221 grains
- 5.0 microns as much as 179 grains
- 10.0 microns as much as 111 grains

This means that the highest amount of palm pollen is 0.3 microns in size.

Propolis (*Geniotrigona thoracica*)

Organoleptic Test

Propolis samples were extracted using the maceration method. The solid propolis sample was crushed into several chunks, the chunks were then crushed on a mortar with a pestle. After the sample is finely powdered, it will be sieved using an 80 mesh sieve. Then it will be macerated with 300 ml of 70% ethanol solvent, then soaked for approximately 24 hours while shaking occasionally. After 24 hours, it was allowed to stand and then filtered using a funnel that had been lined with sterile gauze. Filtered again using filter paper that has been sterilized to obtain the filtrate. The dregs obtained will be macerated with the same solvent, namely 70%, twice to obtain an almost clear filtrate.

Ethanol 70% was used for sample maceration because it can filter with a wide polarity, starting from non-polar compounds to polar compounds (Saifudin, et al. 2011). The results of the macerated propolis

samples were then carried out by organoleptic tests and obtained the physical quality of being sticky, dark brown in color, not distinctive in smell, bitter in taste and slightly sour, and sticky and chewy in texture.

CONCLUSIONS

- Water content of *Honey Genotrigona thoracica as big as*28.5%, Heterotrigona itama honey 29.5%, and Apis dorsata honey 26.5%. It is necessary to standardize the water content in honey according to SNI of 17-20% so as not to create gas in honey. The presence of honey that has good water content, then the honey is declared safe for consumption.
- Image result obtained from Micro view of pollen, bee breed and bee pollen viewed under a microscope at 400x magnification. The picture clearly can be concluded that the shape of the sample above is very varied. Suggestions for further research, the sample is examined in detail the smallest parts and the samples taken must also be stored in closed containers, so as not to be contaminated with the surrounding environment.
- The availability of pollen is very important for the efficient sexual reproduction of plants. Pollen can lose its viability over some time. The loss of viability is strongly influenced by environmental conditions, especially temperature and humidity. When measuring the size of pollen in the field using a partial counter on palm pollen, it was found that more than 15,000 palm pollen grains were 0.3 microns in size. That is, in that place, it is stated that the palm pollen that is produced is 0.3 microns in size. Suggestions for further research are that adequate tools are needed and there is a need for detailed detection of pollen which is measured whether the original type of palm pollen is or not, so that accurate and precise results are obtained.
- The macerated propolis samples obtained organoleptic test results, namely the quality of the physical form that is sticky, dark brown in color, has a distinctive odor, tastes bitter and slightly sour, and has a sticky and chewy texture. Suggestions for further research, the sample is investigated more deeply about the content of micro substances in the sample. In order to obtain detailed and accurate results.

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