The effect of moisture content in Nusa Tenggara Timur Forest honey on viscosity, pH and total dissolved solids

E P Primandasari¹, A Susilo² and D Masyithoh³

¹Student of Faculty of Animal Science, Brawijaya University, Malang, Indonesia
²Lecturer of Faculty of Animal Science, Brawijaya University, Malang, Indonesia
³Lecturer of Faculty of Animal Science, University of Islam Malang, Indonesia

Email: elmaputri@student.ub.ac.id

Abstract. This study to determine the physicochemical properties of Nusa Tenggara Timur (NTT) forest honey from Apis Dorsata based on differences in moisture content. The method used was an experimental method with a completely randomized design of four treatments and four replications. The treatment given to NTT forest honey with a moisture content of 23% was reduced with a vacuum evaporator to 22%, 21% and 20%. The variables observed were viscosity, pH and Total Dissolved Solids (TDS). The results showed that the decrease in moisture content in NTT forest honey using a vacuum evaporator had a very significant effect (P<0.01) on viscosity. The results of the study had a very significant effect on the TDS (P<0.01) and had no effect on the pH value. The viscosity value of NTT forest honey has an average of 747.25–953 poise. The average TDS value was 331.25–322.75 ppm and had an average pH value of 3.77–3.79. The conclusion of the study was that the reduction in moisture content in NTT forest honey had a very significant effect on viscosity and TDS in honey, but did not affect the pH value.

1. Introduction
Honey is a natural liquid which generally has a sweet taste produced by honey bees from plant flower extract. One of the locations that are potential honey producers in NTT is the landscape. Honey production in NTT reaches 104 tons per year. The quality of honey can be affected by the surrounding environment, as can moisture content. The moisture content is because honey has hygroscopic properties, which is easy to absorb moisture content in the surrounding environment. The problem faced by Indonesian is that most of its areas have high relative humidity (RH) reaching 60–90%, so the honey produced has a high moisture content. Honey with high moisture content is of low quality. The maximum moisture content of honey according to the (SNI 8664:2018 Madu) Standard National Indonesian is 22% [1].

Honey that has a high moisture content is prone to damage, which shortens storage time. Damage to honey is caused by the fermentation process by microorganisms in honey. Honey with high moisture content is easily fermented by yeast cells. Honey that has undergone fermentation has a non-fresh smell, it turns very sour and feels hot in the throat. The solution to the problem that can be done is to reduce the moisture content of honey. Honey that has a low moisture content will avoid fermentation, so it can be stored for a longer period of time.

The decrease in the moisture content of honey can slow down the fermentation process. Reducing the moisture content of honey can be done by evaporation at medium temperature (60°C), so that it does
not damage the quality of the honey. Efforts that can be done to minimize the damage during the decrease in the moisture content of honey is to use a vacuum evaporator.

2. Method
The research was conducted at the Laboratory of Animal Products Technology, Faculty of Animal Husbandry, Brawijaya University and PT. Kembang Joyo Sriwijaya. The study was conducted from 15th June to 23rd August 2020. The method used in this study was an experimental method with a completely randomized design consisting of 4 treatments and 4 replications. The data obtained were analyzed using Analysis of Variance (ANOVA) and followed by the Multiple Range Test (DMRT) test if a significant difference is produced (P<0.05). The experimental placement used can be seen in Table 1. The treatment is given as follows:

- P0: Pure honey with 23% moisture content without decreasing.
- P1: Decrease the moisture content of honey by 22%.
- P2: Decrease the moisture content of honey by 21%.
- P3: Decrease the moisture content of honey by 20%.

| Treatment | Replications |
|-----------|--------------|
|           | U1 | U2 | U3 | U4 |
| P0        | P0 U1 | P0 U2 | P0 U3 | P0 U4 |
| P1        | P1 U1 | P1 U2 | P1 U3 | P1 U4 |
| P2        | P2 U1 | P2 U2 | P2 U3 | P2 U4 |
| P3        | P3 U1 | P3 U2 | P3 U3 | P3 U4 |

The data observed were viscosity, pH and total dissolved solids. The reduction in moisture content of the sample was carried out using a vacuum evaporator. The honey used is 50 kg using a temperature of 60°C with a pressure of 60 atm. Honey with 23% moisture content is reduced to 20% and the moisture content is checked every 10 minutes continuously. Check the water content using a refractometer [2].

Viscosity test using a Brookfield NJD-5S viscometer [3] with poise units. PH testing using a pH meter [4] with a 2 in 1 pH meter and EC meter sensor, and the TDS testing using the TDS Meter [5] with the TDS-3 type which has units of ppm.

Viscosity test used a Brookfield NJD-5S viscometer by pouring honey so that it covered the bend on the viscometer. The spindle will rotate until it shows a stable number. The pH value of honey was determined by weighing a sample of 5 grams (10% weight/volume) [6] using digital scales. The honey sample was dissolved with 50 ml of distilled water in a beaker glass and homogenized. Measurement of honey pH is carried out by dipping the pH meter electrode into the honey sample solution [7] The measurement of the total dissolved solids of honey is carried out by immersing the TDS meter electrode into the honey sample solution [8] with a ratio of 1 gram: 5 ml of honey and distilled water in a beaker glass and homogenized.

3. Results and discussion
The results of the viscosity value can be seen in table 2. The data showed that the moisture content had a very significant effect on the viscosity of honey (P<0.01). Honey with moisture content of 23% has the lowest viscosity value compared to moisture content of 22%, 21% and 20%. Honey with moisture content of 21% and 20% did not have a difference in viscosity values. Viscosity is a measure of the thickness of a liquid. The viscosity of honey depends on moisture content and temperature [9]. High-quality honey is usually thick. The viscosity of honey is also affected by rain. If the moisture content increases, the honey becomes less viscous [9].

The data model used in the study.

Table 1: The data model used in the study.

| Treatment | Replications |
|-----------|--------------|
|           | U1 | U2 | U3 | U4 |
| P0        | P0 U1 | P0 U2 | P0 U3 | P0 U4 |
| P1        | P1 U1 | P1 U2 | P1 U3 | P1 U4 |
| P2        | P2 U1 | P2 U2 | P2 U3 | P2 U4 |
| P3        | P3 U1 | P3 U2 | P3 U3 | P3 U4 |
Table 2. The effect of decreasing moisture content on the viscosity of NTT forest honey (P<0.01).

| Moisture Content (%) | Average (Poise) |
|----------------------|-----------------|
| 23                   | 747.25<sup>a</sup> |
| 22                   | 882.25<sup>b</sup> |
| 21                   | 953.00<sup>b</sup> |
| 20                   | 953.00<sup>b</sup> |

Honey has an acidic pH that ranges from 2.6–4.5 [10]. The pH value of honey can be seen in Table 3. The data show that there is no significant effect of moisture content on honey pH (P>0.05). The pH value of honey can be seen in Table 3. The data shows that there is no significant effect of moisture content on honey pH. The low pH value of honey can provide a sour taste which can help improve the taste, inhibits the growth of fungi and bacteria, thereby extending the shelf life of honey [11]. Bacteria will grow in a pH range of 6.5 [12]. This shows that honey with moisture content of 23%, 22%, 21% and 20% has the ability to inhibit the growth of fungi and bacteria because it has a pH value between 3.77–3.79.

Table 3. The effect of decreasing moisture content on pH of NTT forest honey (P>0.05).

| Moisture Content (%) | Average |
|----------------------|---------|
| 23                   | 3.79<sup>a</sup> |
| 22                   | 3.77<sup>a</sup> |
| 21                   | 3.78<sup>a</sup> |
| 20                   | 3.78<sup>a</sup> |

Total dissolved solids is a measure of the combined content of all organic and inorganic substances dissolved in honey. Total dissolved solids in honey contain more than 80% sugar, both glucose and fructose [6]. The total value of dissolved solids can be seen in Table 4. The data showed that moisture content had a very significant effect on the TDS value (P<0.01). There is a difference in the value of total dissolved solids which is influenced by moisture content. An increase in total dissolved solids was also associated with a decrease in moisture content [13]. Honey with a moisture content of 20% had the lowest TDS value. Moisture content of 21% has the highest TDS value.

Table 4. The effect of decreasing moisture content on TDS of NTT forest honey (P<0.01).

| Moisture Content (%) | Average (ppm) |
|----------------------|---------------|
| 23                   | 331.25<sup>a</sup> |
| 22                   | 323.75<sup>a</sup> |
| 21                   | 343.75<sup>b</sup> |
| 20                   | 322.75<sup>a</sup> |

4. Conclusion
The conclusion of this research is that decreasing the moisture content in NTT forest honey using a vacuum evaporator can maintain the quality of honey in terms of viscosity, pH and total dissolved solids.

Acknowledgment
Thank you, PT. Kembang Joyo Sriwijaya which has helped in the smooth running of the research. Thank you to Mr. Ustadi as a honey bee farmer in Malang.
References

[1] National Standardization Institud SNI 8664:2018 Madu (Jakarta)
[2] Rebiai A, Lanez T and Chouikh A 2015 Physicochemical and biochemical properties of honey bee products in south Algeria Chemistry and Chemical Engineering, Biotechnology, Food Industry 16 133–42
[3] Haminiuk C W I, Maciel G M, Plata-Oviedo M S V, Quenehenn A and Scheer A P 2009 Study of the rheological parameters of honey using the Mitschka method International Journal of Food Engineering 5
[4] Acquarone C, Buera P and Elizalde B 2007 Pattern of pH and electrical conductivity upon honey dilution as a complementary tool for discriminating geographical origin of honeys Food chemistry 101 695–703
[5] Khalil M, Moniruzzaman M, Boukraâ L, Benhanifia M, Islam M, Sulaiman S A and Gan S H 2012 Physicochemical and antioxidant properties of Algerian honey Molecules 17 11199–215
[6] Nyau, Mwanz and Moonga H B 2013 Physico-chemical qualities of honey Harvested from different beehive types in Zambia Afric 13 1–19
[7] AOAC 2005 Official Methods of Analysis of AOAC International 18th Ed (Maryland: AOAC International)
[8] Bogdanov S 2009 Harmonized Methods of The International Honey Commission (Bern: International Honey Commission)
[9] Apriani D, Gusnedi and Darvina Y 2013 Studi tentang nilai viskositas madu hutan dari beberapa daerah di Sumatera Barat untuk mengetahui kualitas madu Pillar of Physics. 2 91–8
[10] Fazriyanti N 2015 Pengaruh Perbedaan Konsentrasi Madu dan Lama Fermentasi Terhadap pH, Total Asam, Gula Pereduksi dan Potensu Antibakteri Kefir Air Leri Skripsi (Malang: Fakultas Sains dan Teknologi Universitas Islam Negeri Maulana Malik Ibrahim Malang)
[11] Thohari I, Mustakim, Pedaga M C and Rahayu P P 2017 Teknologi Hasil Ternak (Malang: UB Press)
[12] Albaridi N A 2019 Antibacterial potency of honey International Journal of Microbiology 2019 1–10
[13] Sapriyanti R, Nurhartadi E and Ishartani D 2014 karakteristik fisikokimia dan sensori valva tomat (Lycopersium esculentum Mill) dengan pemanis madu Jurnal Teknologi Hasil Pertanian 7 59–69