EFFORTS TO REDUCE HONEY MOISTURE CONTENT USING THE CONDENSATION METHOD FOR ENHANCING PURE HONEY PRODUCTION

ISNINA'[1,♥♥], IMAM SOFI'I[2], SARONO[3], OKTAF RINA

[1,2]Politeknik Negeri Lampung. Jl. Soekarno Hatta No 10 Raja Basa Bandar Lampung, ♥email: ibuayang.kinan@gmail.com

Manuscript received: 16 June 2025; Revision accepted: 01 October 2025.

Abstract: High water content in honey can trigger yeast activity, leading to its growth and development. At ambient temperature, increased air humidity makes it easier for honey to absorb water. The high-water content causes the fermentation process to occur. Efforts to reduce the water content in honey are one way to prevent fermentation. Several methods commonly used in Indonesia to reduce water content still require updates and innovation. This study aims to improve the time efficiency of reducing honey's water content during the production process, compare the results of water content reduction using dehumidification and condensation methods, and examine the parameters of temperature, time, water content, humidity, and honey quality. The research was conducted both qualitatively and quantitatively. Qualitative testing showed that the samples' color, aroma, and taste, using dehumidification and condensation methods, retained honey characteristics. Meanwhile, quantitative testing demonstrated that the condensation method yielded better productivity and quality than the dehumidification method. This can be observed from temperature, water content, humidity, diastase enzyme activity, and hydroxymethylfurfural (HMF) analysis. The condensation method produces honey that meets the Indonesian National Standards 2018. Therefore, using the condensation method, honey water reduction equipment effectively reduces water content while maintaining its quality.

Keywords: Condensation, Honey Water content

Abbreviations (if any): All important abbreviations must be defined at their first mention there. Ensure consistency of abbreviations throughout the article.

Running title: a short title with five words

Honey is a natural liquid with various colors, a sweet and viscous taste, produced by bees through the secretion of sugar in the form of the monosaccharide fructose derived from flower nectar (National Honey Board, 2010). Honey is one of the food products with high nutritional value and many health benefits. Based on phytochemical tests, trigona honey (Tetragonula biroi) contains alkaloids, flavonoids, triterpenoids, and vitamin C (Syamsul et al., 2022). Based on this information, honey can potentially serve as a source of nutrition. Honey has also been reported to exhibit antibacterial properties against *Escherichia coli* and *Staphylococcus aureus* (Evahelda et al., 2018), which can be used as an alternative treatment and help reduce dependence on modern medicines. Based on the above description, honey is a highly potential commodity for supporting food security.

The nutritional content of honey is complete, containing complex enzymes and sugars that facilitate biochemical reactions, which may affect the decline in honey quality (Johanes, 2015). Trigona honey is rich in nutrients obtained from various flower nectars and is considered one of the high-quality honey types (Kholil et al., 2021). The chemical content and properties of honey allow it to be stored for long periods by paying attention to the honey's water content and storage temperature. The parameters that determine honey quality based on the Indonesian National Standards include water content, total sugar content, acidity, and pH. These quality elements are interrelated. One of the challenges honey producers face in Indonesia is honey's hygroscopic nature, making it very susceptible to absorbing moisture from the surrounding environment. Therefore, measures are needed to reduce honey's water content to prolong its storage (Wibowo et al., 2022). High water content in honey becomes a factor that triggers honey spoilage if stored for extended periods. According to the Indonesian National Standard (SNI 8664:2018), the maximum allowable water content for honey is 22%. In contrast, for trigona honey, the water content must not exceed 27.5%, with the maximum acidity level in honey being 200 ml NaOH/kg.

High water content in honey triggers yeast activity, promoting its growth and development. At ambient temperature, increased air humidity causes honey to absorb more water. The high water content leads to fermentation. Efforts to reduce the water content in honey are one way to prevent fermentation. Several methods commonly used in Indonesia to reduce water content are considered in need of innovation and improvement. Reducing water content at high temperatures will cause chemical changes in the structure of honey, with glucose being converted into hydroxymethylfurfural (HMF)

(Suhaela, Alfian Noor, 2023). This study employs the condensation process to reduce honey's water content. The outcome of this study is to propose the condensation process as a new alternative in the effort to reduce honey's water content.

The objectives of this study are: (1) To improve the time efficiency of reducing honey's water content during the production process. (2) To compare the results of the previous water content reduction process (dehumidification) with the condensation process. To examine the parameters of temperature, time, water content, humidity, and honey quality (HMF, diastase enzyme) for dehumidification and condensation processes.

MATERIALS AND METHODS

This research will be conducted from February to March 2024. The research will occur at the Suhita Honey Production Center, at Jalan Purnawirawan 1 No. 40, Langkapura, Bandarlampung, Lampung Province. The material used in this research is trigona honey or klanceng honey from the *Heterotrigona itama* bee species, sourced from Suhita Bee Farm. The tools used include a Honey Saver as the condensation process equipment to reduce the water content of honey, a Showcase as a closed/isolation test chamber, plastic containers for storing the trigona honey samples to be tested, spatulas for taking honey samples to measure water content, a refractometer to measure the water content, a digital scale to weigh the trigona honey with an accuracy of 1 gram, a power consumption meter to record electricity usage during the honey water content reduction process, and a thermohygrometer to record temperature and humidity. Qualitative research data, including honey's color, aroma, and taste, will be analyzed using descriptive analysis. In contrast, quantitative data obtained during the research will be analyzed using the mean value and percentage.

RESULTS AND DISCUSSION

Water Content

The operation of this machine is based on the principle of capturing water vapor from honey in a room with circulating air at a temperature below 30°C. A perforated stainless steel disk assists the honey inside the machine's storage tube in facilitating air circulation and increasing the surface area of the honey, making the water removal process faster. As the air circulates and carries water molecules from the honey, the water will be captured and separated into the water collection containers in the machine's system. This process will continue until the desired water content is achieved. Reducing the water content of honey using the condensation process aims to obtain honey with a water content that meets the Indonesian National Standard (SNI), which should not exceed 27% for stingless bee honey, as stated by Hidayatullah et al. (2022). The result of reducing honey's water content using the HoneySaver tool shows that it only takes 7 hours to achieve honey water content that meets the SNI (Table 1).

Table 1. Reduction of Honey Water Content Using the HoneySaver Tool

Time (Hour number)	Moisture content (%)
1	30
2	28
3	26
4	25
5	24
6	22
7	21

The operation is based on capturing water vapor from honey in an airtight room with a specific room size. The honey is spread over a tray inside the room, with periodic air circulation. The honey is stirred manually to ensure uniformity on the surface, facilitating the release of water from the honey to be captured by water molecules through the dehumidifier machine. Reducing water content using the dehumidifier machine requires 7 days to achieve a humidity level that meets the SNI standard (Table 2). The dehumidifier machine consumes 715 watts per hour, with a production capacity of up to 320 kg.

Table 2. Reducing Honey's Water Content Using a Dehumidifier Tool

Time (Hour number)	Moisture content (%)
1	30
2	28
3	26
4	25,5
5	23,5
6	22
7	21

Honey's water content is a limiting factor in determining its quality, stability, and resistance to fermentation. The higher the water content, the greater the likelihood of fermentation occurring during storage (Kek et al., 2018). Reducing the water content in honey aims to maintain its quality during long storage periods. When honey has a low water content, it will be protected from spoilage during relatively long storage times and can minimize the presence of microbes in the honey (Savitri et al., 2017). The reduction in water content from both methods above shows that using the condensation method with the HoneySaver is faster in reducing the water content. The speed of water content reduction significantly affects the effectiveness of honey production.

Organoleptic Test

The organoleptic results of the honey show that honey processed using the HoneySaver and dehumidifier tools has the characteristic honey aroma, honey taste, a yellow-brown color, and a thick texture typical of honey (Table 3).

Table 3. Results of honey organoleptic testing

Sample	Aroma	Taste	Color	Texture
Honey Saver Tool	Characteristic honey	Characteristic honey	Yellow brown	Characteristic honey
Dehumidifier Tool	Characteristic honey	Characteristic honey	Yellow brown	Characteristic honey

The organoleptic test on honey can be used as a qualitative quality test. In the organoleptic test, all honey samples provided results that meet the honey quality standards according to the 2018 Indonesian National Standard (SNI).

HMF and Diastase Enzyme Test

The HMF and diastase enzyme test results show that honey processed using the HoneySaver and dehumidifier tools meets the SNI 8664-2018 standards (Table 4). According to the 2018 SNI for honey, the maximum HMF content is 40 mg/kg, while the minimum diastase enzyme content is 3 DN.

Table 4. Results of HMF and Diastase Enzyme Tests on Honey (HoneySaver)

Sampel	Parameter	Unit	Result	SNI 8664-2018
HoneySaver Tool	Diastase Activity	DN	13.15	Min 3
	Hydroxymethylfurfural (HMF)	Mg/Kg	Not detected	Max 40
Dehumidifier Tool	Diastase Activity	DN	3.77	Min 3
	Hydroxymethylfurfural (HMF)	Mg/Kg	0.13	Max 40

HMF (5-hydroxymethylfurfural) Analysis is a method used to measure the quality of honey and serves as a reference in several studies to determine the authenticity of honey (Shapla et al., 2018). The organic molecule HMF is formed when honey sugars decompose thermally. The HMF content can indicate that the quality of honey has deteriorated due to excessive heating or the addition of invert sugar (Koesprimadisari et al., 2018). The higher the HMF content, the lower the quality of the honey. From both methods used, the HMF results meet the SNI 8664-2018 standard, which is a maximum of 40 mg/kg.

The HMF content can serve as a standard for honey freshness. Honey that has been stored for an extended period will show an increase in HMF levels, as HMF is a cyclic aldehyde produced by the degradation of sugars through the Maillard reaction (a non-enzymatic browning reaction) during the processing or long-term storage of honey (Shapla et al., 2018). The HMF value is an indicator of honey authenticity. According to Koesprimadisari et al. (2018), if honey contains more than 50 mg/kg of HMF, it can be concluded that it is adulterated or mixed with added sugars.

The diastase enzyme activity analysis results for both methods showed that the diastase enzyme values were above 3 DN. Diastase is an enzyme produced by bees that plays a role in the maturation process of honey (converting complex sugars into simple sugars), which can easily be damaged by heating (Kuc, 2017). These results indicate that both water content reduction methods did not damage the quality of the honey, although there was a significant difference in the values. The condensation method showed a higher DN value, which may be due to the difference in the duration of the water content reduction process. Honey exposed to temperatures above 25°C for varying lengths will decrease diastase enzyme activity (Sajid et al.). This is consistent with the characteristic of enzymes, which are easily damaged when heated, also known as protein denaturation. Protein denaturation alters the secondary, tertiary, and quaternary structures without changing the primary structure (without breaking peptide bonds), causing the protein to lose its enzymatic function (Acharya & Chaudhuri, 2021).

This study concludes that the reduction of honey moisture content using the condensation method or the HoneySaver tool is faster than the dehumidifier method, making the condensation method more efficient in terms of time and production costs. The honey quality test results also show the moisture reduction process.

REFERENCES

Acharya, V., & Chaudhuri, P. (2021). Modalities Of Protein Denaturation And Nature Of Denaturants. International Journal Of Pharmaceutical Sciences Review And Research, 69, 19–24. Https://Doi.Org/10.47583/Ijpsrr.2021.V6 9i02.002

Badan Standarisasi Nasional. (2018). Madu. Standar Nasional Indonesia. SNI8664:2018

Evahelda, E., Pratama, F., & Santoso, B. (2018). Sifat Fisik Dan Kimia Madu Dari Nektar Pohon Karet Di Kabupaten Bangka Tengah, Indonesia. Agritech, 37(4), 363. Https://Doi.Org/10.22146/Agritech.1 6424.

Hidayatullah, M., Handoko, C., & Maring, A. J. (2022). SNI Madu Dan Manfaat Madu Untuk Kesehatan. Standard: Better Standard Better Living, 1(6), 23–26.

Johanes, Kuniawan, I., & Yohanes. (2015). Penurunan Kadar Air Madu Dengan Dehidrator Vakum. Jurnal Online Mahasiswa Bidang Teknik Dan Sains, 2(1), 1–5. Https://Jom.Unri.Ac.Id/Index.Php/Jomfteknik/Article/View/6308/6008.

Kek, S. P., Chin, N. L., Yusof, Y. A., Tan, S. W., & Chua, L. S. 2014. Total Phenolic Contents And Colour Intensity Of Malaysian Honeys From The Apis Spp. And Trigona Spp. Bees. Agriculture And Agricultural Science Procedia, 2(12), 150–155. Https://Doi.Org/10.1016/J.Aaspro.2014.11.022.

Kholil, K., Ariani, N. Dan Setiawan, A.B., 2021. Model Bisnis Dan Rantai Nilai Madu Trigona Di Era COVID-19 Studi Kasus Di Lombok Utara Nusatenggara Barat. Prosiding SNITT POLTEKBA, 5(0), Pp.44–51.

Koesprimadisari, A. R., Arrisujaya, D., & Syafdaningsih, R. (2018). Uji Kandungan Hidroksimetilfurfural (Hmf) Sebagai Parameter Kualitas Madu. Jurnal Sains Natural, 6(2), 44. Https://Doi.Org/10.31938/Jsn.V6i2.1 59

Kuc, J. (2017). Determination Of The Diastase Activity In Honeys. Czasopismo Techniczne, 8, 29–35. Https://Doi.Org/10.4467/2353737xct.17. 126.6877

National Honey Board. (2012). Honey Sugar Content National Honey Board. 303, 1–4.

Sajid, M., Yasmin, T., Asad, F., & Qamer, S. 2019. Changes In HMF Content And Diastase Activity In Honey After Heating Treatment. Pesquisa Agropecuaria Brasileira, 8(2), 1668– 1674. Https://Doi.Org/10.19045/BSPAB.2019. 80109

Savitri, N. P. T., Hastuti, E. D., & Suedy, S. W. A. (2017). Kualitas Madu Lokal Dari Beberapa Wilayah Di Kabupaten Temanggung. Buletin Anatomi Dan Fisiologi, 2(1), 58-66. Https://Doi.Org/10.14710/Baf.2.1.2017.58-66

Shapla, U. M., Solayman, M., Alam, N., Khalil, M. I., & Gan, S. H. (2018). 5-Hydroxymethylfurfural (HMF) Levels In Honey And Other Food Products: Effects On Bees And Human Health. Chemistry Central Journal, 12(1), 1–18. Https://Doi.Org/10.1186/S13065- 018-0408-3

Suhaela, Alfian Noor, A. A. (2016). Pengaruh Pemanasan Dan Lama Penyimpanan Terhadap Kadar 5-(Hidroksimetil)Furan-2-Karbaldehida(Hmf) Pada Madu Asal Mallawa Suhaela. Http://Repository.Unhas.Ac.Id/Handle/123456789/17769. 1–10.

Syamsul,T,D., Lala., & Syaharuddin. (2022). Kandungan Fitokimia, Polifenol Dan Flavonoid Madu Trigona (Tetragonula Biroi) Bone, Sulawesi-Selatan. Journal Of Training And Community Service Adpertisi (JTCSA), 2(2), 62–70. Retrieved From Https://Jurnal.Adpertisi.Or.Id/Index.Php/JTCSA/Article/View/424

Wibowo, S. A., Lastriyanto, A., Vera, V. V., Susilo, B., Sumarlan, S. H., Hawa, L. C., & Zubaidah, E. (2022). Analisis Mutu Madu Setelah Proses Pasteurisasi Dan Pendinginan Cepat. Jurnal Ilmiah Rekayasa Pertanian Dan Biosistem, 10(2), 203–212. Https://Doi.Org/10.29303/Jrpb.V10i2.407.