

Effect of Rotational Speed and Extraction Time on The Physicochemical Qualities of Klanceng Honey (*Trigona* sp.)

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Abstract. Klanceng honey is one of the livestock produced by the *Trigona* sp. Bees cultivated by KTH Telaga Lestari, Ngebel Village, Ponorogo. The quality of klanceng honey needs to be improved through the extraction process to optimize the quality of honey. The research objective is to determine the physical and chemical qualities (pH, acidity, reducing sugar content, water content, and specific gravity). The method used in this research was Completely Randomized Design (CRD) Factorial with two factors, which were rotational speed (30 (A1), 31 (A2), and 32 (A3) Hz) and extraction time (4 (B1), 5 (B2), and 6 (B3) minutes). The tested variables were pH, acidity, reducing sugar content, water content, and specific gravity. The data was analyzed using Analysis of Variance (ANOVA). The results showed that speed rotation had a significant effect ($P<0.05$) on pH 3.68 ± 0.08 , a highly significant effect ($P<0.01$) on acidity 197.22 ± 21.21 , and reducing sugar content 68.46 ± 25.71 . In contrast, the rotational speed did not significantly affect water content and specific gravity ($P>0.05$). The results showed that the extraction time used had a highly significant effect ($P<0.01$) on acidity 156.67 ± 44.82 and reducing sugar content 62.56 ± 30.09 , a significant difference ($P<0.05$) on water content 27.33 ± 0.50 and extraction time used did not give effect ($P>0.05$) to pH and specific gravity. In conclusion, the research results showed that the rotational speed of 32 Hz (A3) and the extraction time of 4 minutes (B1) gave the best value for pH, acidity, reducing sugar content, water content, and specific gravity.

1 Introduction

Indonesia has a diversity of honey species derived from two types of bees. Stingless bees are known as a bee and a stinger bee (*Apis* sp.). The honey production in Indonesia in 2021 was 189,780 liters or 186.36 tons, which has soared by 269.65% compared to 2020, based on BPS (Central Statistics Agency). Honey needs in Indonesia reached 15,000 tons/year. The data

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shows that honey needs in Indonesia must still fulfill the requirements. High demand often causes inefficient use of labor in the production process because it is wrong to estimate the amount of honey production [1]. Traditional harvesting techniques need to be more efficient in managing the amount of production so that the quality and quantity produced are not optimal, including high dependence on honey production in small quantities [2]. The amount of production that still needs to meet the need to increase production is better using extractors as the equipment.

One type of honey in Indonesia is klanceng honey, which is produced from stingless bees. This bee has a characteristic body length of 3-4mm with a black color, while the queen bee has a brownish color, a large belly, and reaches a 3-4 times larger size. According to Astuti and Laksamani [3], klanceng bees are better known as small, slender, and black bees. Klanceng bees are a species that only produce honey in small quantities. Klanceng bees have the advantage of their honey, which has very high antimicrobial properties. Klanceng bee has a disadvantage in production ability, only able to produce a small amount of honey when compared to *Apis sp. bees*. with the amount of klanceng honey production reaching 1 kg/year while *Apis sp.* was able to produce honey getting 75 kg/year [4]. Klanceng bees also have physicochemical characteristics such as a taste that tends to be more acidic because it has a pH of 3.05 – 4.55 with a high moisture content ranging from 30 – 35%, respectively. According to Syafiudin and Normagiat [5], the natural characteristics of klanceng-type honey are diluted honey and a sour taste. Stingless bee honey has different characteristics than bee honey in terms of color, flavor, viscosity, moisture content, and sugar content [6]. Klanceng honey has these characteristics, and it can be seen that the quality of the content contained in Klanceng honey still is not required by SNI 8664: 2018.

The quality of klanceng honey that still needs to meet SNI requires technological updates in quality development by using an extractor that will speed up the process of extracting honey at the time of harvesting klanceng honey. The extractor will help the efficiency of the harvesting process, which has been using *syringes* or manually using hand so that harvesting time will be faster. The working principle of the honey extractor uses centrifugal force, which results in a rotating force on the level that will constantly rotate so that the honey contained in the hive will come out and stick to the wall of the extractor [7]. A speed of 30 Hz and a long extraction time of 5 minutes showed an increase in the quality of planting honey regarding physicochemicals [8]. Further research is needed to determine the difference in rotation speed with different extraction time lengths on the quality of physical and chemical honey (pH, acidity, reducing sugar content, moisture content, and specific gravity) in klanceng honey.

2 Materials and Methods

Honey samples of klanceng bees were taken from the extraction process using a honey extractor located at Telaga Lestari KTH, Ngebel Village, Ponorogo Regency, East Java. Klanceng bee honey tested at the Laboratory of Animal Product Technology, Faculty of Animal Science, Universitas Brawijaya.

2.1 Material

The laboratory materials used in this research were klanceng honey as much as 100 mL in 9 bottles, H₂SO₄ (Nurra), Aquadest (Brataco), Luff school (Nurra), NaOH 0.1 N (Merck), KI 20% (Merck), Sodium Thiosulfate (Merck), Amylum 0,5 % (Nurra), PP Indicator (Nurra), Na₂CO₃ (Merck), Pb Acetate (Merck), and HCl (Nurra).

2.2 Instrumentation

Laboratory equipment used in this research conducted are hand refractometer (ATC 3in1), pH meter (HANNA HI 98107), Measuring cup (Pyrex), Analytical balances (Fujitsu), Electric Stove (Maspion), Erlenmeyer (Schott Duran), Drip pipette (Pyrex), Beaker Glass (Iwaki), Filter Paper (Beimu), Boiling Stone, Burette (Pyrex), Funnel (Pyrex), Aluminum foil wrap (Cling), Film Pot, Measuring flask (Iwaki), and Glass bottle (Vial).

2.3 Research Methods

The method used in this research is an experimental method using a Complete Random Design (CRD) factorial with two treatment factors and three replications. The first factor is the rotation speed (30 (A1), 31 (A2), and 32 (A3) Hz), and the second factor is the extraction time (4 (B1), 5 (B2), and 6 (B3) minutes). This research consisted of 3 treatments, each with three replications, so there were 27 experimental units with a 3x3x3 pattern. The parameters measured in this study were pH, acidity, reducing sugar content, water content, and specific gravity.

2.4 Klanceng Honey Extraction Procedure

The extraction procedure of klanceng honey begins with separating klanceng honey from the sting by using an extractor. It is fed into the extractor using rotational speed (30, 31, and 32 Hz) and the length of extraction time (4, 5, and 6 minutes). Klanceng honey that has been extracted is accommodated using a container. The honey is filtered, so bees do not enter when transferring klanceng honey into the bottle. Klanceng honey that has been extracted is ready to be used as a sample and labeled on the bottle for each treatment.

2.5 Molecular Dynamic Simulation

The data obtained from this research results were tabulated with the Microsoft Excel program (2020), and then statistical analysis was carried out using *Analysis of Variance* (ANOVA). If there are significant or highly significant results between treatments, proceed with Duncan's Multiple Range Test (DMRT).

3 Results and Discussion

3.1 Physicochemical Quality of Klanceng Honey with No Extraction Process

Klanceng honey is honey produced from *Trigona* sp. bees, a stingless bee species. Harvesting klanceng bees at Telaga Lestari KTH is still done manually or using hands. The manual technique can undoubtedly affect the harvesting process's efficiency and the quality of the klanceng honey. Harvesting manually is risky for microbial contamination, which can reduce the quality of klanceng honey. The physicochemical qualities of klanceng honey before the extraction process using an extractor can be seen in Table 1.

Table 1. Qualities physicochemical of klanceng honey before the extraction process

Parameter	Value
pH	3.50

Acidity	199.00 ml NaOH/kg
Reducing Sugar Content	21.20%
Water Content	28.00%
Specific Gravity	1.30 m ³ /kg

The physicochemical quality parameter of klanceng honey without extraction process shows a pH value of 3.50, where the value has met the pH of klanceng honey based on the statement of Afrillah, Taurina, and Andrie [9] which states that the pH value of klanceng honey The good ones range from 2.5 – 3.8. The acidity of klanceng honey without extraction is 199.00 ml NaOH / kg. The value has required the standards determined by SNI 8664 : 2018. The acidity standard of bee honey without a sting has a maximum value of 200 ml NaOH/kg.

Standards that have been determined by SNI 8664: 2018 on the reducing sugar content of klanceng honey has a minimum value of 55%, but the reducing sugar content produced from the process without extraction has a value of 21.20%. Klanceng honey Those harvested without the extraction process can be found to require the standards set. The water content of klanceng honey without the extraction process has a value of 28.00% where this value still does not require the standards set by SNI 8664: 2018 that the water content standard of klanceng honey and the maximum moisture content is 27.5%. The standard of SNI 8664: 2018 klanceng honey set at 1,474 – 1,489 m³/kg, but it can be seen in Table 3. that the specific gravity of klanceng honey. The result from manual harvesting has a value of 1,300 m³/kg. This data shows the specific gravity of klanceng honey. The result still did not require the standards set by SNI 8664: 201.

3.2 pH

The results of the analysis showed that the pH value of klanceng honey with rotational speed and extraction time showed a significant ($P < 0.05$). The average pH value of klanceng honey can be seen in Table 2.

Table 2. Average pH Value of Klanceng Honey

Rotational Speed (Hz)	Extraction Time (Minute)			Averages ± SD
	B1	B2	B3	
A1	3.60±0.10	3.67±0.06	3.63±0.15	3.63 ^b ±0.10
A2	3.70±0.10	3.63±0.06	3.70±0.10	3.68 ^c ±0.09
A3	3.47±0.06	3.53±0.06	3.60±0.10	3.53 ^a ±0.07
Average ± SD	3.59±0.09	3.61±0.06	3.64±0.12	

Note: Different notations (a-c) in the same line show a significant effect ($P < 0.05$)

Klanceng honey It has a characteristic sour taste accompanied by sweetness with a watery texture. The results showed that the rotation speed treatment used had a pH value ranging from 3.53 – 3.68, while the long extraction time treatment used had a pH value ranging from 3.59 – 3.64. The rotation speed treatment differs markedly ($P < 0.05$) from the pH value. The highest average pH value was 3.68±0.09 in the A2 treatment. Table 4. showed that the interaction between the rotation speed treatment and the length of extraction time used gave intangible results ($P > 0.05$). The overall results of the analysis show that the pH value with rotation speed treatment used has met the pH of klanceng honey based on research that has been conducted by Nur et al. [10], which states that the pH value of klanceng honey is 4.0. It can be seen that the pH value resulting from the rotation speed treatment and the length of

extraction time has increased when compared to the pH value produced from klanceng honey without the extraction process.

High acidity content in klanceng honey causes the degree of acidity (pH) to be low. This result follows Adalina [11], which states that the degree of acidity can be determined by the pH value, where the higher acidity of klanceng honey causes the pH in honey to be lower. Chayati (2008) states that klanceng honey with a low pH can prevent the growth of various bacteria. The pH parameter of honey helps determine the possibility of bacterial contamination that will affect the storage of klanceng honey [12]. Most microorganisms grow well at a pH close to 5.0. Bacteria are more likely to be sensitive to growth at pH 5.0 when compared to fungi and yeast. The degree of acidity (pH) will highly influence the growth and life of bacterial cells. Bacteria have an optimal range of acidity for life. When the pH is lower than the minimum limit of bacterial life, bacterial cells will stop their growth. Thus, bacteria will lose the ability to survive [13].

The rotational speed of the extractor used can separate the bag of honey, bee pollen, and propolis from the honey liquid to the maximum. This result is similar to research conducted by Awaly et al. [8], which states that the rotational movement of the extractor can maximize the squeeze of klanceng honey to remove all liquid phase contents in the klanceng honey bag. The rotational speed used in the study caused the liquid phase in the klanceng honey bag to be squeezed to the maximum to make the water content high. The high-water content resulted in increased acid and low sugar levels. This condition is due to the reaction of bacterial fermentation and sugar contained in klanceng honey, thus producing a sour flavor.

3.3 Acidity

The results of the analysis showed that the acidity of klanceng honey with different rotational speeds and extraction times was highly significant ($P < 0.01$). The average value of acidity of klanceng honey quality can be seen in Table 3.

Table 3. Average Value of Acidity (ml NaOH/kg) Klanceng Honey

Rotational Speed (Hz)	Extraction Time (Minute)			Average \pm SD
	B1	B2	B3	
A1	98.00 \pm 2.65	232.33 \pm 2.52	225.33 \pm 3.06	185.22 ^a \pm 2.74
A2	176.67 \pm 3.51	191.00 \pm 3.61	224.00 \pm 2.65	197.22 ^b \pm 3.26
A3	195.33 \pm 3.51	217.00 \pm 3.61	195.33 \pm 5.01	202.56 ^c \pm 4.05
Average \pm SD	156.67 ^a \pm 3.22	213.44 ^b \pm 3.25	214.89 ^b \pm 3.58	

Note: Different notations (a, b, and c) in the same row and column show a very significant effect ($P < 0,01$)

The results showed that the rotation speed treatment had an acidity value ranging from 185.22 – 202.56 ml NaOH/kg. Padjula [14] showed that the acidity levels found in klanceng honey range from 196.34 – 200.34 ml NaOH/kg on the extraction times treatment, the extraction time used has an acidity value ranging from 156.67 – 214.89 ml NaOH / kg. This result was not comparable to Adityarini, Suedy, and Darmanti [15], who showed data on the acidity of klanceng honey in the Kebonrejo area amounted to 271.00 \pm 50.82 ml NaOH/kg with the use of an extractor for 2 minutes. The treatment of rotation speed and length of extraction time showed very noticeable ($P < 0.01$) to the acidity value. The average best acidity value was 185.22 ml NaOH/kg in the A1 treatment and 156.67 ml NaOH/kg in the B1 treatment. Klanceng bee honey, the interaction between the rotation speed treatment and the length of extraction time used gave very noticeable results ($P < 0.01$). The best interaction is found in A1, A2, and A3 with B1, where the value shows a range of 98.00 – 195.33 ml NaOH

/ kg where the value is below the maximum SNI 8664: 2018 that has been determined still on average from the treatment of A1, A2 with B1 the value has met the acidity standards of klanceng honey which has been determined by SNI 8664: 2018 where the quality requirements of klanceng honey has a maximum acidity value of 200 ml NaOH/kg. The acidity produced from klanceng honey through the extraction process using an extractor showed a decrease of 3.67 – 101.00 ml NaOH / kg compared to the acidity quality of klanceng honey without the extraction process. The longer extraction time will cause the liquid bag in the honeycomb to be extracted optimally so that the water content becomes high that the klanceng honey has a watery texture, which results in the fermentation process quickly occurring and affects the acidity level of klanceng honey.

The high 98.00 – 225.33 ml NaOH/kg in Ngebel Village can be known to be caused by the influence of nectar sources. The high sour flavor is caused by the available nectar sources at the location of Ngebel Village, which are coconut plants, durian, kaliandra, coffee, and bridal tears. The nectar produced by coconut plants and Kaliandra pagoda has a sweet-sour flavor and is suitable for consumption. Its abundant production and knowing no season make its availability always there. Environmental conditions in Indonesia make it challenging to expect the same quality of honey due to the influence of climate, different topography, and agricultural patterns, different ways of testing samples, storage duration of samples analyzed, and different types of feed [16]. Karnia et al. [4] stated that the watery texture of klanceng honey affects acidity. The dilution of honey shows the high water content in the honey, which results in the fermentation process quickly occurring and affects the acidity level in the honey. Fermentation that has yet to occur makes free acids not appear much, even though the water content in the honey is high. The acidity of klanceng honey. The high 98.00 – 225.33 ml NaOH/kg in Ngebel Village can be known to be caused by the influence of nectar sources.

3.4 Reducing Sugar Content

The results of the analysis showed that the reducing sugar content of klanceng honey with the treatment of rotational speeds and extraction times was highly significant ($P < 0.01$). The average value of quality-reducing sugar content of klanceng honey can be seen in Table 4.

Table 4. Average Reducing Sugar Content (%) of Klanceng Honey

Rotational Speed (Hz)	Extraction Time (Menit)			Average ± SD
	B1	B2	B3	
A1	51,13±0,00	51,79±0,00	50,46±0,00	51,13 ^a ±0,00
A2	34,53±0,00	51,79±0,00	34,53±0,00	40,28 ^b ±0,00
A3	50,46±0,00	52,23±1,54	102,70±1,92	68,46 ^c ±1,15
Average ± SD	45,37 ^a ±0,00	51,94 ^b ±0,51	62,56 ^c ±0,64	

Note : Different notations (a,b, and c) in the same row and column show a highly significant effect ($P < 0.01$).

The results showed that the rotation speed treatment produced the value of the reducing sugar content of klanceng honey ranging from 40.28 to 68.46%. This result was followed by [17], which stated that the reduced sugar content of klanceng honey shows a 25.28 – 65.39% value. In the long extraction time, the value of the reducing sugar content of klanceng honey ranges from 45.37 – 62.56%. This result was different from Wardhani, Ratnasari, and Khotimah [18], showing that the reducing sugar content of klanceng honey showed a value of 68.77 – 71.43% using the Luff Schoorl method test. Klanceng bee honey, the interaction between the rotation speed treatment and the length of time used gave very noticeable results ($P < 0.01$). The best interaction is found in A3 and B3, where the value shows 102.7±1.92%

and is above the minimum SNI 8664: 2018 that has been determined, but on average, A3 and B3 require the standards set. The value of reducing sugar content found in klanceng honey in Ngebel Village following the standards set by SNI 8664: 2018, which showed the quality requirements of klanceng honey has a reducing sugar content value of at least 55%. Value of reducing sugar content of klanceng honey in the treatment, rotational speed, and extraction time, there was an increase of 81.50% when compared to the reducing sugar content of klanceng honey resulting from a process without extraction.

The reduced sugar content in honey is a determinant of sweetness in honey. This result was similar to Ikhsan et al. [17], who stated that the reduced sugar content of klanceng honey is used as a reference to whether or not it will be sweet in klanceng honey. The reduced sugar content of honey is also influenced by the origin of nectar sources, geographical origin, climate, processing, and storage [19]. Awwaly et al. [8] stated that samples of klanceng honey manual harvesting have a sweet flavor with bitter or sourness, while samples of klanceng honey harvesting using an extractor have a sweet flavor when compared to samples of klanceng honey (*Trigona* sp.) manual harvesting. That process is because using extractors is more hygienic than manual techniques. After all, it minimizes hand contact to reduce the risk of contamination. Hand contact in manual harvesting causes a sour flavor, and the intense aroma in honey klanceng can result from fermentation reactions between bacteria and sugar in honey so that a sour flavor and aroma are produced. The composition of reducing sugars in honey can affect its functional properties, namely its ability to retain water and extend its shelf life. The osmotic nature of honey is caused by the reduced sugar content in honey so that yeast growth can be inhibited [18]. Klanceng honey, located in Ngebel Village, has a characteristic sour flavor accompanied by sweetness. The sour flavor of klanceng honey This has made it characteristic because the source of nectar consumed by klanceng bees comes mostly from coconut and kaliandra trees with a sour and sweet flavor in the honey produced.

3.5 Water Content

The results of the analysis showed that the water content of klanceng honey with the treatment of rotational speed and extraction time showed a significant effect ($P < 0.05$). The average value of water content can be seen in Table 5. The results showed that the rotational speed treatment had a water content value ranging from 27.67 to 28.22%. The extraction time has a water content value ranging from 27.33 to 28.22%. The length of extraction time factor gave a real difference ($P < 0.05$) to the water content. The average best value was 27.33% in the B2 treatment. This result was similar to Astawa, Arsana, and Wahyudi (2023), who stated that the water content in klanceng bee honey is 27.27%. Table 5. showed that the interaction between the rotation speed factor and the length of extraction time used gave intangible results ($P > 0.05$) on the water content of klanceng honey. Klanceng honey, located in Ngebel Village, requires SNI 8664: 2018, where the maximum water content is 27.5%. The water content of klanceng honey resulting from the treatment of rotation speed and length of extraction time decreased by 0.67% compared to the water content of klanceng honey without the extraction process.

Table 5. Average Water Content (%) of Klanceng Honey

Rotational Speed (Hz)	Extraction Time (Minute)			Average \pm SD
	B1	B2	B3	
A1	28.33 \pm 0.58	27.67 \pm 0.58	28.67 \pm 0.58	28.22 \pm 0.58
A2	28.67 \pm 0.58	27.00 \pm 0.00	28.00 \pm 1.15	27.78 \pm 0.58
A3	27.67 \pm 0.58	27.33 \pm 0.58	28.00 \pm 1.00	27.67 \pm 0.42
Average \pm SD	28.22 ^b \pm 0.58	27.33 ^a \pm 0.39	28.11 ^b \pm 0.61	

Note : Different notations (a, b, and c) in the same column show a significant effect (P<0.05)

The extraction mechanism of klanceng honey using the extractor is as follows: klanceng honeycomb is separated from sting, then klanceng honeycomb transferred into the extractor tube, after which set the rotation speed and the length of extraction time used. The extractor works by rotating the klanceng honeycomb using centrifugal force to remove klanceng honey liquid until it runs out. Water bag on klanceng honey It is also extracted during the extraction process using an extractor, causing the squeezed klanceng honey to have a thinner consistency. Honey in Indonesia has a relatively high water content compared to other countries because Indonesia has high rainfall, reaching 60% [20]. Several factors, including humid environmental conditions during honey production, can cause the high water content in honey. Honey that has hygroscopic properties will quickly absorb water content in the free air [21]. Wulandari [22] states that low water content (<27.5%) will keep klanceng honey from damage for a relatively long period. Honey that has too high a moisture content has low quality because it can reduce the stability of honey shelf life, thereby increasing the risk of contamination by yeast osmotolerant *Zygosaccharomyces*, the causative agent of fermentation during honey storage, which can affect the increase in acidity. Ngebel Village is in Ngebel District, Ponorogo Regency, East Java Province. The topography of the height in the village is about 700 m above sea level. In the 2019 BPS data of Ponorogo Regency, the village has a temperature of around 29°C. Based on data in the field with temperatures ranging from 29°C, klanceng bee honey can be said to be humid because the location of the place is higher, and the humidity of the air will be affected to be high. This condition corroborates the results of analysis data carried out by almost all samples with high water content, which is between 27.33 and 28.67%.

3.6 Specific Gravity

Results of statistical analysis of the specific gravity of klanceng honey with the treatment of rotation speed and length of extraction time showed no significance (P>0.05). The average values of specific gravity can be seen in Table 6. The results showed that the rotation speed treatment and the length of extraction time used ranged from 1.279 – 1.314 kg/m³. The factor of rotation speed and length of extraction time were insignificant (P>0.05) to the specific gravity of klanceng honey, averaging the highest value of 1,314 kg/m³ at B2. This result is almost close to the research of Wibowo et al. [23], which shows that density density (specific gravity) in klanceng honey carried out has a value of 1,358 kg/m³. Table 6. showed that the interaction between the speed factor and the length of time used gave no significant difference (P>0.05). Honey standards according to SNI 8664: 2018, where honey quality requirements have specific gravity values ranging from 1.474 – 1.489 kg/m³, so it can be said that klanceng honey The situation in Ngebel Village still does not require the specified standards. The specific gravity of klanceng honey resulting from the treatment, rotation speed, and length of extraction time are not much different from the specific gravity of klanceng honey produced without the extraction process is 1.30 m³/kg.

Table 6. Average Specific Gravity (m³/kg) of Klanceng Honey

Rotational Speed (Hz)	Extraction Time (Minute)			Average ± SD
	B1	B2	B3	
A1	1.30±0.03	1.31±0.02	1.28±0.02	1.30±0.03
A2	1.29±0.02	1.29±0.03	1.28±0.03	1.29±0.02
A3	1.30±0.01	1.29±0.02	1.29±0.02	1.30±0.01
Average ± SD	1.30±0.02	1.30±0.02	1.28±0.02	

The principle of extraction of klanceng honey is the optimal separation of honey liquid from the hive through an extractor. The honey liquid produced through the extractor is known to have a high-water content, which can affect the specific gravity of klanceng honey. The higher addition of water volume causes the density between molecules in honey to be lower, which is not indicated by the more liquid the honey so that the rays that hit honey are easy to refract when measured using a refractometer, the easier the rays are refracted causing the refractive index of honey to be lower. Conversely, the lower addition of water volume in honey causes the density between honey molecules to be higher, which is indicated by the thicker the honey so that the rays that hit the honey klanceng it is more challenging to refract and cause a high refractive index of 1.5 with a specific gravity of 1.4 [24]. One factor that affects specific gravity is water content; high water content causes lower specific gravity. In contrast, low water content causes specific gravity to be high, making the texture of honey thick.

4 Conclusion

The rotational speed influences the physical and chemical qualities of klanceng honey. Honey extraction with a rotational speed of 32 Hz (A3) with 4 minutes of an extraction time (B1) provides optimal results for the physical and chemical quality of klanceng honey.

Acknowledgement. We express our deepest gratitude to the Ministry of Education, Culture, Research, and Technology in Matching Fund Program in 2022 for facilitating this research.

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