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The physicochemical properties of local Indonesia honey *Trigona* and *Cerana* produced in North Lombok, West Nusa Tenggara

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KEYWORDS

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ABSTRACT

T*rigona* and *Cerana* honey production in North Lombok was 24,751 L and 41,589 L, respectively, in 2020. The physicochemical properties of honey vary depending on the types of plants from which the bee collects nectar, climatic conditions and geographical region. Thus, a worldwide standard for honey bee products has yet to be determined. This research aims to analyze the physicochemical properties of honey originally produced in North Lombok. The results showed that moisture content, acidity, ash, pH, viscosity and colour of *Trigona* honey were significantly different from *Cerana* honey ($p<0,05$); meanwhile, reducing sugar, insoluble solids**,** and total phenolic did not differ between the two honey ($p>0,05$). Moisture content (27.56%), acidity (281.15 meq/kg), insoluble solids (1.87%) and total phenolic (19 mg GAE/g) in *Trigona* honey were higher than those in *Cerana* (moisture content (26.3%), insoluble solids (1.38%), total phenolic (16.56 mg GAE/g)). Meanwhile, reducing sugar (17.71%), pH (3.25), ash (0.85%), viscosity (596.33 cP), and diastase activity (0.1692 DN) of *Trigona* honey were lower than those in *Cerana* (reducing sugar (18.28%), pH (3.25), ash (1.35%), viscosity (956.33 cP) and diastase activity (31.28 DN)). The °Hue value of *Trigona* and *Cerana* honey was 53.5 and 65, which appears yellow red for both kinds of honey.

Introduction

North Lombok is one of the newest regions in NTB province. It has a variety of potential for agriculture and livestock. Recently, one of the potentials being developed by the government and the community is the cultivation of *Trigona* honey and *Cerana* honey. Based on data gathered from the Food Security and Agriculture Office of North Lombok Regency through the Livestock and Animal Health Sector, the total production of *Trigona* honey and *Cerana* honey in 2020 is 24,751.3 L and 41,589 L, which means the total production reached 66,340 L. Furthermore, a study conducted by Fitriyah et al. (2020) on the analysis of honey bee (*Trigona sp*) business income and the research from Saputri, R.J (2016) about honey (*Apis cerana*) in North Lombok district shows the B/C ratio value of 1.75 and 4.2, respectively. Thus, it is worth developing economically.

Honey is a naturally saturated sugar made from the nectar collected from flowers or plant excretions which is changed into honey by enzymes produced by bees. Using enzymes, nectar is converted into simple sugars and acids with varying acidity, ranging from pH 3.2 to 4.5 (Lim, Abu Bakar and Majid, 2019). Honey contains carbohydrates from natural sugars, 18% water, 2% minerals, vitamins, pollen and protein (Eswaran et al., 2015). Honey also contains phenolic compounds with biological activities such as antioxidant, antibacterial and anti-inflammatory. *Trigona* honey contains phenolic compounds, including gallic acid, caffeic acid, phenethyl ester, syringic acid, catechin, apigenin, chrysin, cinnamic acid, 2-hydroxycinnamic acid, kaempferol, p coumaric acid, quercetin-3-O-rutinoside and 4-hydroxybenzoic acid (Ranneh et al., 2019). In contrast, the phenolic compounds in *Cerana* honey are derivatives of benzoic acid (such as gallic, ellagic, protocatechuic acid) and

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cinnamic acid (such as caffeic, sinapic, ferulic, coumaric acid) (Machado De-Melo et al., 2017).

The physical properties and chemical composition of honey vary depending on the plant consumed by the bees to produce raw materials, climatic conditions and geographical origin (Rao et al., 2016). Some studies have found that honey from stingless bees has higher antioxidants than honey from Apis sp. (Ávila et al., 2018). *Trigona* honey has higher antioxidants due to its high phenolic content (Silva et al., 2013). Unlike *Cerana* honey which tends to be sweet, *Trigona* honey has a sour taste and a higher water content (Fadhilah and Kiki, 2015). Hence, no worldwide standards exist for honeybee products (Al-Hatamleh et al., 2020). Previous research investigating *trigona* honey and *Cerana* honey originating from North Lombok are still scarce. Syuhriatin (2019) conducted a study on the purity test of honey produced by bees of *Apis cerana sp* and *Trigona sp* species from North Lombok using the HMF method. Other research is more likely to focus on economic analysis of the *Trigona* and *Cerana* honey cultivation. *Trigona* and *Cerana* honey are one of the local treasures of the North Lombok area, which have abundant potential with their functional properties to improve people's welfare. Unfortunately, it has not been explored scientifically. Hence, it is crucial to do physical and chemical analysis to reveal various chemical components in *Trigona* and *Cerana* honey so that it can be a source of information and knowledge, especially in food and health.

Research Methods

Honey harvesting and vegetation observation

The sample of *Trigona* honey was obtained from stingless bees of the *Trigona sapiens* species from KUB Pade Tunaq at Loloan Village, Bayan District, North Lombok Regency. Meanwhile, *Cerana* honey was collected from *Apis cerana* bees from KUB Kulem Sejahtera at Akar-Akar Village, Bayan District, North Lombok Regency. Honey harvesting is carried out by the squeezing method based on SNI 8664-2018. Data collection techniques for potential food sources of bee is conducted using a survey method by observing directly and interviewing beekeeper. Vegetation types as bees' potential food sources were selected from the dominant plant species around the cultivation area with a radius of about 1 kilometer.

Materials and tools

Materials and tools used for analysis were methanol 85%, distilled water, Na2C03 5%, luff-schrool solution, boiling stone, KI 20%, H2SO4 26.5%, N2S2O3 0.1 N, 1% starch indicator, NaOH 0, 05 M, 0.05 M HCL, gallic acid, Folin reagent, pH 7 and pH 4 buffer solutions, tissue, membrane filter, Whatman 125 mm filter paper, Schott brand pH meter, Thermo Scientific Evolution 201 UV Vis spectrophotometer, Brookfield viscosimeter Manual model, MiniScan EZ colour reader.

Analysis of physical and chemical properties

a. ***Water content***

The analysis of water content was carried out using the thermogravimetric method proposed by AOAC (2005). Two grams of honey were measured and put in the oven for 5 hours at 105°C. Then it was cooled in a desiccator for 10 minutes and weighed. The sample was put back into the oven for 30 minutes, cooled in a desiccator, and weighed. The treatment was performed several times until it reached a constant weight (weighing difference of 0.2 mg), and the water content was calculated by the formula:

$$\text{Water Content (\%)} = \frac{\text{Weight of Material (Before-After)}}{\text{Material Weight (Before)}} \text{ x } 100\% \quad \ldots (1)$$

b. ***Reducing sugar***

Reducing sugar analysis was done using the Luff–Schoorl method by AOAC (2005). Honey was weighed 3 g, and 100 ml of distilled water was added and filtered. The filtrate was added to 250 ml of distilled water, and 25 ml was taken away. Then, 25 ml of Luff–Schoorl was added, and the boiling stone was then connected to the back cooler for 10 minutes. The sample was cooled, and then added 15 ml of 20% KI and 25 ml of 26.5% H2SO4 solution. Next, it was titrated until it changed into milk cream colour with Na2S2O3 0.1 N and given 1-2 ml of 1% starch indicator. The same treatment was carried out for the blanks. The reducing sugar content is calculated by the formula:

$$\text{Reducing Sugar Content (\%)} = \frac{(\text{blanks titration-titration sample}) \text{ x Fp}}{\text{weight sample (mg)}} \text{ x } 100\% \ldots\ldots\ldots\ldots (2)$$

c. ***Acidity***

Acidity analysis was carried out based on SNI 8664:2018. 10 g of honey was measured and dissolved in 75 ml distilled water. It was then titrated with 0.05M NaOH until it reached a pH of 8.50. After that, 10 ml of 0.05M NaOH was taken and titrated with 0.05M HCI until it reached a pH of 8.30. A

blank was analyzed by titrating 75 ml of CO2-free distilled water with NaOH to pH 8.5. Acidity is considered as ml equivalent/kg calculated by the formula:

Total acidity = free acid + lactone .....(3)

Notes:

Free acid = (ml 0.05M NaOH from burette – ml blank) x N NaOH x 1000/g sample

Lactone = (10.00 – ml 0.05M HCl from burette) x N HCl x 1000/g *sample*

d. ***Water-insoluble solids***

Analysis of water-insoluble solids was done based on SNI 01-2891-1992. Honey was weighed 20 g. Then, 200 ml of hot distilled water was poured into it and filtered. The filter paper was dried in an oven at a temperature of 105°C for 2 hours, then cooled in a desiccator and weighed to a constant weight. The formula calculates solids that are insoluble in water:

$$\text{Water Insoluble Solids (\%)} = \frac{w1-w2}{w} \text{ x } 100\% \quad .....(4)$$

Notes:

w1= Weight of weighing bottle and filter paper contains insoluble part (g)

w2= Weight of weighing bottle and empty filter paper (g)

w = Material weight (g)

e. ***Ash***

Analysis of ash content was carried out based on SNI 01-2891-1992. 1 g of honey was weighed and put into a furnace at 500-600°C for 8 hours. The sample is cooled to a temperature of ±120°C, put in a desiccator, and then weighed to a constant weight. The formula calculates ash content:

$$\text{Ash Content (\%)} = \frac{w1-w2}{w} \text{ x } 100\% \quad .....(5)$$

Notes:

w1 = Weight of sample and cup after ashing (g)

w2 = Weight of sample and cup before ashing (g)

w = Weight of empty cup (g)

f. ***Total phenol***

Total phenol was determined using the Folin-Ciocalteu method proposed by Ratnayani et al. (2012). The first step is to create a standard and standard curve for gallic acid. Then, 0.2 g of honey was weighed, dissolved in 85% methanol, and filtered. 1 ml was taken, and 0.8 ml of Folin reagent was added. Then, it was shaken. The solution was added with 5% Na2CO3 and let in for 60 minutes. Then, the absorption was measured at a wavelength of 760 nm. The formula calculates the total phenol:

$$\text{Total Phenolic Content(mg GAE/g)} = \frac{C \text{ x } V \text{ x } Fp}{g} \quad ..... (6)$$

Notes:

C = Phenolic concentration (x value) (mg/ml)

V = Extract volume (ml)

Fp = Dilution factor

g = Material weight (g)

g. ***Viscosity***

The viscosity of honey was measured using a Brookfield-type RV Viscometer proposed by David Brookfield (2011). Spindle number 03 was inserted into 500 ml of sample, and then it was read as the viscosity on the tool and calculated based on the conversion factor. The following formula can calculate viscosity:

Viscosity (cP) = Dial Reading x factor..... (7)

h. ***Colour***

Honey colour was analyzed using a colour reader by Yuwono and Susanto (1998). The colour reader tool would directly generate the values of L, a and b on the monitor. L value is brightness, positive (+) value means bright and negative value (-) means dim; axis a, a positive value (+) means red and negative value (-) means green; axis b, a positive value (+) means yellow, and a negative value (-) means blue.

i. ***Diastase enzyme***

Diastase enzyme was analyzed based on SNI 8664:2018. First, 5 g of honey was weighed. Next, 10-15 ml of water and 2.5 ml of acetate buffer solution were added and dissolved. The solution was poured into a 25 ml volumetric flask containing 1.5 ml NaCl and adjusted to the mark using water. Then, 10 ml of the solution was added with 5 ml of starch solution and put on a water heater of 40°C±0.2°C for 15 minutes. The solution was shaken. At every 5 minutes interval, 1 ml of the solution was pipetted, and 10 ml of iodine solution was added. Then, the absorbance value was determined at a wavelength of 660 nm. The solution was taken at specific intervals until A<0.235 was obtained. Then the absorbance value was set with time (minutes) from the top of millimeter paper. A straight line is drawn through several points. The graph shows the time needed to reach the absorbance value (A) = 0.235. The value of 300 divided by the time required to reach the

absorbance value (A) indicates the activity of the diastase enzyme (DN). The formula for the activity of the diastase enzyme is:

$DN = 300/t$ ..... (8)

Notes:

DN = Diastase enzyme activity

t = time for getting the absorbance value (A) (minute)

j. *Statistical analysis*

The homogeneity test and data normality test used Levene's Test and Kolmogorov-Smirnov. The statistical analysis used Independent Sample T-test at a 95% confidence interval using Minitab 16 to know the significant difference between the two samples.

Results and Discussion

Vegetation around the ranch

One factor that affects honey's physical and chemical properties is the different types of plants that bees consume to produce raw materials (Rao et al., 2016). Some types of bees can forage for food a maximum of 2 kilometers around the nest, and it will be more intensive at a distance of less than one kilometer (Kuhn-Neto et al., 2009). Based on a survey conducted (one kilometer) at two beekeeping locations, namely the *Trigona* bee farm in Loloan Village and the *Apis cerana* bee farm in Akar-Akar Village, Bayan District, North Lombok Regency, several types of plants have the potential as a source of bees' food that can be seen in Table 1.

Physicochemical properties

The physical and chemical properties of honey testing are strongly correlated to the quality of the honey. In this study, there were nine physicochemical parameters tested, including diastase enzyme activity, water content, reducing sugar, acidity, water-insoluble solids and ash content, as well as testing for viscosity, colour and total phenolic from *Trigona* honey and *Cerana* honey.

Table 1. Potential food sources plant of a bee around the location of honey beekeeping

No.	Location	Local Name	Scientific Name	Family
1	KUB Pade Tunaq Desa Loloan (Trigona sapiens beekeeping)	Pohon Randu	*Ceiba pentandra*	Malvaceae
		Kelapa	*Cocos nucifera*	Arecaceae
		Lengkeng	*Dimocarpus longan Lour*	Sapindaceae
		Kopi	*Coffea sp.*	Rubiaceae
		Rambutan	*Neppelium lappaceum*	Sapindaceae
		Jambu Mete	*Anacardium occidentale L*	Anacardiaceae
		Mangga	*Mangifera indica*	Anacardiaceae
		Melinjo	*Gnetum gnemon Linn*	Gnetaceae
		Kedondong	*Spondias dulcis*	Anacardiaceae
		Rosella	*Hibiscus sabdariffa L*	Malvaceae
		Alpukat	*Persea Americana*	Lauraceae
		Pisang	*Musa sp.*	Musaceae
		Pinang	*Areca catechu*	Arecaceae
		Kersen	*Muntingia calabura L*	Muntingiaceae
		Nangka	*Artocarpus heterophyllus*	Moraceae
		Aren	*Arenga pinnata*	Arecaceae
		Padi	*Oryza sativa*	Poaceae
		Jagung	*Zea mays*	Poaceae
2	KUB Kulem Sejahtera Desa Akar-Akar (Apis cerana beekeeping)	Kersen	*Muntingia calabura L*	Muntingiaceae
		Kelapa	*Cocos nucifera*	Arecaceae
		Pisang	*Musa sp.*	Musaceae
		Srikaya	*Annona squamosa*	Annonaceae
		Jambu Air	*Syzygium aqueum*	Myrtaceae
		Pinang	*Areca catechu*	Arecaceae
		Pohon Randu	*Ceiba pentandra*	Malvaceae
		Matoa	*Pometia pinnata*	Sapindaceae
		Jeruk limau	*Citrus amblycarpa*	Rutaceae
		Mangga	*Mangifera indica*	Anacardiaceae
		Jambu Mete	*Anacardium occidentale L*	Anacardiaceae
		Lengkeng	*Dimocarpus longan Lour*	Sapindaceae

Table 2. Physicochemical properties of Trigona and Cerana honey

Parameter	Type of Honey	
	Trigona	**Cerana**
Moisture content (%)	27.56±0.15*	26.3±0.22
Reducing sugar (%)	17.71±0.65	18.28±0.03
Acidity (meq/kg)	281.15±0.75*	126.66±2.75
Ash content (%)	0.85±0.11*	1.35±0.13
Water insoluble solid (%)	1.87±0.26	1.38±0.31
Diastase activity (DN)	0.1692*	31.28
HMF content (mg/kg)	-	-
Total phenolic (mg GAE/g)	19±1.51	16.56±0.61
Viscosity (cP)	596.33±4.62*	956.33±2.52
Colour	L= 6.61	L= 7.34
	a= 6.19	a= 3.40
	b= 8.31	b= 7.28
	°Hue = 53.50*	°Hue = 65
Ph	3.25±0.01*	3.51±0.02

Remarks: *Mean values within rows followed by the * symbol are significantly different at $p < 0.05$ according to T-test

Based on the homogeneity test (Levene's Test) and normality test (Kolmogorov-Smirnov) using Minitab 16 (Table 2), it showed that the physicochemical data were in the form of water content, reducing sugar, acidity, total solids insoluble in water, ash content, viscosity, colour, pH and total phenol from *Trigona* honey and *Cerana* honey were homogeneous ($p>0.05$) and normally distributed ($p>0.05$). The results of the T-test found that the water content, acidity, ash content, pH and colour in *Trigona* honey and *Cerana* honey were significantly different ($p<0.05$). Meanwhile, reducing sugars, total insoluble solids and total phenol were not significantly different ($p>0.05$).

The high water content in honey is due to the high humidity during honey harvesting in the rainy season. Honey has hygroscopic properties, so it can easily absorb water (Suhaela, Noor and Ahmad, 2015). In addition, the moisture content of honey is also influenced by bee species and honey maturity when harvested (Fatima et al., 2016). Honey harvested at an old age has a lower moisture content than honey harvested at a young age. This is because the longer the honey is in the hive, the more perfect the water evaporation process by the bees will be (Prasetya and Andi, 2014).

Honey acidity is the number of organic acids, internal esters and inorganic ions such as phosphate, chloride, sulfate and nitrate that can produce acid in honey. Acidity is strongly influenced by the nectar source, bee species and enzyme or bacterial activity (Machado De-Melo et al., 2017). The results reveal that *Trigona* honey has a higher acidity than *Cerana* honey. This is in line with De Almeida-Muradian et al. (2013), who states that, in general, *Trigona* honey has a higher acidity. The acidity of honey is determined by the number of hydrogen ions and several minerals (such as Ca, Na, K). The more minerals that honey contain, the higher the pH value. High acidity can also indicate sugar fermentation into organic acids (Evahelda et al., 2021). Honey contains organic compounds, especially reducing sugars, namely fructose, glucose, maltose and sucrose, which are very suitable for the growth of osmophilic yeasts. The high water content in honey, namely >17.1% and the appropriate storage temperature (23-27°C), can accelerate the yeast growth process and cause fermentation (De Almeida-Muradian et al., 2013).

Diastase is another term for the enzyme amylase, which is naturally found in honey. This enzyme breaks down complex carbohydrates (polysaccharides) into simple carbohydrates (monosaccharides), which are made by bees during the ripening of honey. This enzyme can only be found in freshly harvested honey or pure honey without processing, so the presence of the diastase enzyme can be used as an indicator of the authenticity or purity of honey. Enzymes are proteins activated under certain conditions and will be damaged in a condition which has too acidic, too alkaline, or exposed to heat or heavy metals (Tulandi, 2019). The activity of diastase enzymes in *Trigona* honey and *Cerana* honey were 0.1692 DN and 31.28 DN, respectively. Research done by De Almeida-Muradian et al. (2013) also showed that the diastase enzyme activity of *Apis mellifera* honey was 42.87 DN, while the diastase enzyme in stingless bee honey

was not detected. In this case, the absence of diastase enzyme activity does not mean that the honey has been adulterated or has low quality. However, it is a unique characteristic of that type of honey. The difference in diastase activity in honey indicates that the enzyme is produced by bees and does not come from plant sources that feed the bees.

Reducing sugar is a group of carbohydrates or sugars that can reduce due to free aldehyde or ketone groups (Hakim, Wahyuningtyas and Rahmanto, 2021). The reducing sugars in *Trigona* honey and *Cerana* honey were 17.71% and 18.28%, respectively. Honey harvested in the rainy season has lower reducing sugar content than those harvested in the dry season, where humidity is so high that the water content increases and then reduces reducing sugar levels (Ridoni, Radam and Fatriani, 2020). In addition, another factor, such as the length of storage, can also affect the reducing sugar content of honey. The longer the storage, the higher the reducing sugar content will be, with a decrease in the acidity level (Karnia, Hamidah and Thamrin, 2019). In this study, honey was harvested for one day during the rainy season and analyzed the next day.

Total water-insoluble solids consist of bee pollen, honeycomb pieces, dirt particles and bees (De Almeida-Muradian et al., 2013). The test results of total water-insoluble solids in *Trigona* honey and *Cerana* honey were 1.87% and 1.38%, respectively. The honey harvesting process is carried out based on SNI 8664 (2018) by squeezing a pot or honeycomb and filtering it. This harvesting method allows excreta, such as pieces of honeycomb, to contaminate the resulting honey. Total insoluble solids are also a hygiene parameter to determine the impurity of honey.

The minerals in honey are defined as the ash content. Minerals are absorbed by the roots in water-insoluble salts and then continue to the plant sap and into the nectar. Essential minerals found in honey include potassium, sodium, calcium and magnesium. Furthermore, minerals such as iron, copper, manganese, chlorine, phosphorus, sulfur, silicates, nickel, and others are also found. The ash content in *Trigona* honey and *Cerana* honey were 0.85% and 1.35%, respectively. In general, the mineral content contained in honey is minor and highly dependent on the nectar composition and soil type of the plants that bees consume as well as climatic conditions and geographical origin (De Almeida-Muradian et al., 2013).

pH is a measurement to determine the acid or base of a product on a scale of 0 to 14 (Fatima et al., 2016). The pH of honey ranges from 3.15 to 6.64 (Nordin et al., 2018). A low pH is always associated with a more significant number of hydrogen ions and a higher level of acidity. This study found that the pH of *Trigona* honey and *Cerana* honey were 3.25 and 3.51, respectively. The lower the pH, the greater the honey's ability to inhibit the growth of microorganisms (Fatima et al., 2016).

Viscosity is an important property in handling, processing, storage and sensory quality that determines consumer acceptance of the honey product. Honey's viscosity is influenced by plant sources, moisture content, temperature, amount of fructose or glucose, granulation and chemical composition of honey (Machado De-Melo et al., 2017). This study found that the viscosity of *Trigona* honey and *Cerana* honey were 596.33 Cp and 956.33 cP, respectively. In this study, it was also known that the water content of *Cerana* honey was 26.3% lower than that of *Trigona* honey, which was 27.56%. Meanwhile, the reducing sugar content in *Cerana* honey was 18.28% higher than *Trigona* honey, which was 17.71%. Based on these components, *Cerana* honey has a higher viscosity than *Trigona* honey. This is in accordance with Machado De-Melo et al. (2013), which states that the higher the water content and the lower the polysaccharide content, the lower the viscosity of the honey produced.

Colour is the first physical property seen by consumers. According to Moniruzzaman et al. (2014), the honey colour ranges from bright yellow (light yellow) to yellow (amber) and dark yellow (dark amber), and in some instances, it can be black and green or red. Based on this research, it is known that the colour of *Trigona* honey and *Cerana* honey is Yellow Red based on the hue values of 53.50 and 65, respectively. Plant sources, soil conditions and climate strongly influence the colour of honey. Some researchers also state that the colour of honey is influenced by pollen, products related to sugar, carotenoids, xanthophylls, anthocyanins, minerals, amino acids and phenolic compounds, especially flavonoids that affect the colour of honey. The brightness levels of *Trigona* honey and *Cerana* honey were not significantly different ($p>0.05$), which is 6.61 ± 0.48 and 7.34 ± 0.23, respectively, which is more likely to be dark. Honey that tends to brown or dark is strongly influenced by the basic color, chemical composition, storage and heating. Honey that tends to be dark has high mineral content,

polyphenolic compounds and dextrins as well as higher acidity than honey that tends to be light (Machado De-Melo et al., 2017).

The phenolic components of honey are directly influenced by plant sources such as pollen, nectar, sap and oils found in bees. Therefore, bee consuming different types of plants has different bioactive components. The total phenols in honey ranged from 1.3 – 126.0 mg GAE/100 g (Ávila et al., 2018). Based on the results of this study, the total phenols of *Trigona* honey and *Cerana* honey were not significantly different ($p>0.05$), namely 19 mg GAE/g and 16.56 mg GAE/g, respectively. Research Kek et al. (2014) on the total phenol content in *Apis* honey and *Trigona* honey from Malaysia showed that *Trigona* honey had a higher total phenol than apis honey. Research by Ranneh et al. (2019) which identified polyphenolic compounds in *Trigona* honey originating from Johor Bahru, Malaysia using LC-ESI-MS/MS showed that *Trigona* honey has 18 components of polyphenolic compounds, namely 8 phenolic acids and 5 flavonoids. The phenolic acids in *Trigona* honey include gallic acid, caffeic acid, caffeic acid phenethyl ester, syringic acid, cinnamic acid, p coumaric acid and 4-hydroxybenzoic acid. While the flavonoid content includes catechin, apigenin, chrysin, kaempferol and quersetin-3-O-Rutinosid. However, the polyphenol component in honey is strongly influenced by geographic area (Rao et al., 2016).

Conclusion

The type of bee, nectar source, season, geographic area, and harvesting conditions strongly influence honey's physical and chemical properties. Moisture content (27.56%), acidity (281.15 meq/kg), insoluble solids (1.87%) and total phenolic (19 mg GAE/g) were higher in *Trigona* than *Cerana* (moisture content (26.3%), insoluble solids (1.38%), total phenolic (16.56 mg GAE/g)). Meanwhile reducing sugar (17.71%), pH (3.25), ash (0.85%), viscosity (596.33 cP), and diastase activity (0.1692 DN) of *Trigona* were lower than *Cerana* (reducing sugar (18.28%), pH (3.25), ash (1.35%), viscosity (956.33 cP) and diastase activity (31.28 DN)). The °Hue value of *Trigona* and *Cerana* honey was 53.5 and 65, which appears yellow red colour for both kinds of honey.

Declarations

Conflict of interests The authors declare no competing interests.

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