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Analysis of honey in the comal district involves testing for moisture content, acidity levels, reduction of sugar levels, and sucrose sugar levels

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Abstract

Honey, a natural sweetening liquid produced from the nectar of plants by bees, is known for its diverse colors and medicinal properties for humans (Q.S, An-Nahl ayat 69). In Indonesia, the quality standard for honey is outlined in SNI 8664-2018. The 2020 case of counterfeit honey from Banten raised public concern, highlighting the need for consumer protection against fake honey consumption. A survey conducted by researchers in the Comal area revealed the prevalence of low-priced honey brands, prompting concerns about authenticity and safety. Consequently, an analysis of the quality of pure honey circulating in the Comal District is imperative, encompassing organoleptic, water content, acidity, and sucrose sugar content tests. This research is included in descriptive observational research. Honey samples were obtained through random sampling, with selections made from various honey types and brands. The assessment of honey quality involved both qualitative and quantitative analyses. Organoleptic tests were conducted to evaluate shape, color, smell, and taste, while quantitative analysis included water content, acidity, and sucrose sugar tests. The results of these tests were then compared against the standards outlined in SNI 8664-2018. The set requirements include a maximum allowable water content of 22%, a maximum acidity level of 50 mL NaOH/kg, a maximum sucrose sugar content of 5%, and a minimum reducing sugar content of 65%. The study focused on 20 brands of pure honey, encompassing four distinct types, all free from additional ingredients such as ginger, turmeric, ginseng, cumin, etc. These samples were sourced from Apotek, supermarkets, and herbal medicine sellers. Each honey sample exhibited unique organoleptic characteristics attributable to variations in bee type, flower source, and production location, yet all adhered to the specified requirements. However, the results of the honey quality tests, including assessments of water content, acidity levels, sucrose sugar levels, and reducing sugar levels, revealed that 5 out of the 20 samples failed to meet the stipulated standards. These non-compliant samples are identified by the codes B, D, F, J, and S. The acidity test results show that sample B does not meet the requirements. The test results for, sucrose sugar content were not satisfactory. The reducing sugar test results showed that all samples were less than 65% w/w.

Keywords: comal subdistrict honey quality, moisture content, multiflora honey; reducing sugar levels

Introduction

Honey is a natural liquid sugar produced by honey bees sourced from several flowers containing nectar, in which there are healing medicines for humans. Honey is classified as a food source and has medicinal properties, so it is necessary to test the quality of pure honey to maintain the authenticity and safety of public consumption from irresponsible traders. The contents of honey are carbohydrates, water, minerals, vitamins, amino acids, enzymes, proteins, aromatic substances and phenolic compounds (SNI, 2013). The quality of honey is the main factor that people review before consumption. The tests carried out to determine the quality of honey are tests for acidity levels and total sugar levels which play a role in determining the taste of honey, which consumers use as indicators for choosing honey (Batista De Sousa et al., 2015). The qualities of honey depending on the flower source taken, resulting in different colors, acidity, sugar content, ash and proline content (Wulandari, 2017).

Based on research conducted by Wulandari, (2017). There are several factors that influence the sugar content in honey, including water content, humidity, harvest time and storage temperature which influence the levels of reducing sugar and sucrose sugar. Sucrose levels in honey are influenced by the invertase enzyme, where the enzyme converts sucrose into glucose and fructose. Another thing is thought to be the cause of the sugar content in room temperature honey being lower than cold temperature honey because room temperature honey has a higher water content than cold temperature honey. The yeast in honey will degrade sugar, especially dextrose and levulose, into alcohol and CO2, thus affecting the dextrose (glucose) and levulose (fructose) content of honey (Wulandari, 2017). For this reason, determining the quality of honey is very important before marketing.

Research by Sulis Setio et al (2015), "Honey derived from rubber honey has a water content of 21.59% and rambutan honey 19.94%," (Harjo et al., 2015), "Randu honey from Nglorog Village has a water content that is not much different from honey randu from Kentengsari Village, namely 30.5%. Randu honey from Kentengsari Village has the highest water content and exceeds the standards set in the 2013 SNI with a value of 32.8%. Meanwhile, rubber honey from Medari Village has the lowest water content and its value meets the standards set in the 2013 SNI, namely 20.9%. Randu honey from Nglorog Village has the highest acidity level and exceeds the 2013 SNI, namely 67.96 mL NaOH/kg, meanwhile, kapok honey from Kentengsari Village has an acidity level of 64.2 mL NaOH/kg. "Rubber honey from Medari Village has the lowest acidity level compared to the acidity level in all honey samples studied, namely 34.59 mL NaOH/kg" (Savitri et al., 2017).

Martin and Bagdanov (2002) stated that honey counterfeiting occurs because real honey is relatively expensive compared to granulated sugar which comes from sugar cane plants, so honey counterfeiting is done by adding liquid sucrose or granulated sugar solution, thereby changing the composition of the honey. According to Sukmawati Noor, & Firdaus (2015) other causes of differences in reducing sugar content in honey are the addition of other substances such as sucrose and water as well as harvesting honey that is not yet ripe because the bee invertase enzyme is not yet perfect, so the sucrose sugar content of honey

has a limit. maximum 5% to maintain the authenticity of the honey and the content of the honey (Sukmawati et al., 2015).

Several cases of honey counterfeiting in Indonesia, for example in the Banten area in 2020, have disturbed the public, so protection for consumers is needed to avoid consuming fake honey. The occurrence of honey counterfeiting is categorized into 3, namely, truly fake honey is made from ingredients that do not come from plant nectar and do not come from bees, second is that honey is processed by mixing a sugar solution, and third is stimulating bee food with sugar and harvesting (Debora & Gatra, 2020). The results "are the most difficult to analyze because honey really comes from bees, but the honey produced comes from sugar given to bees by breeders," said Kuntadi, Head of Education and Training at the Indonesian Beekeeping Association. The side effects of consuming fake honey are that it can cause diabetes and can cause diarrhea (Aditomo, 2021). Pure packaged honey produced under various brands is widely circulated in the Comal District area. The results of the research survey showed that there were 4 types of honey without a mixture of other ingredients, with a total of 26 honey from 22 brands found in pharmacies, supermarkets and brewed herbal medicine sellers. The large number of pure honey brands appearing and their low prices have raised consumer suspicions regarding its purity and safety.

SNI 8664 (2018), regulates the quality of honey which can be viewed from the organoleptic test, water content test, water content test, acidity test, reducing sugar content test and sucrose sugar content test (SNI, 2018). Determination of water content can be done using the moisture content method using a moisture analyzer. Determination of acidity levels can be done using the acid-base titration method. Determination of sucrose sugar content which aims to determine the percentage of sucrose sugar content of honey can use the luff schrool method. This analysis method is an accurate, sensitive and easy to carry out method.

The description explained shows that it is necessary to analyze of honey in the Comal area with a water content test, water content test, acidity test, reducing sugar content test and sucrose sugar content test.

1. Research Objectives

This research aims to determine the quality of honey in the Comal District involves testing for moisture content, acidity levels, reduction of sugar levels, and sucrose sugar levels.

2. Review of Related Literatures

Research conducted by Sulis Setio et al 2015 stated that "Honey is derived from rubber honey which has a water content of 21.59% and rambutan honey 19,94%," (Harjo et al., 2015), " Randu honey from Nglorog Village has a water content, not much different from kapok honey from Kentengsari Village, namely 30,5%. Randu honey from Kentengsari Village has the highest water content and exceeds it standard set in SNI 2013 with a value of 32.8%. Meanwhile, rubber honey from Medari Village has the lowest water content and the value meets the standards set in SNI 2013, namely 20,9%. Randu honey from Nglorog

Village has the highest acidity levels and exceeds SNI in 2013, namely 67,96 ml NaOH/kg, meanwhile, kapok honey from Kentengsari Village had an acidity level of 64,2 ml NaOH/kg. Rubber honey from Medari Village has the lowest acidity level compared with the acidity level in all honey samples studied, namely 34,59 ml NaOH/kg" (Savitri et al., 2017). Honey quality is carried out to ensure authenticity and safety consumers because when the water content in honey is more than 20% it will accelerate the process of bacterial growth "Results of analysis of the water content of rubber honey amounting to 24,25 ± 1.49%. The water content value of this honey does not comply with the requirements honey quality SNI 3545:2013, namely a maximum of 22%.

Based on the description above, it is important to carry out quality tests quality of honey to determine the levels that have been determined so that it is safe consumers and honey sellers' honesty was guaranteed.

Research Methodology

1. The Research Procedure Includes which are:

1.1 Organoleptic Test (SNI, 2018; Triwanto et al., 2021)

Test using the five senses, to determine color, smell and taste. A number of samples were smelled, felt, observed for color and shape. The organoleptic test results are compared with the organoleptic requirements for honey in table 1.

1.2 Water Content Test (Wulandari, 2017)

Oven the petri dish for 15 minutes then place it in a desiccator for 20 minutes. Weigh a sample of 2 grams, put it in a petri dish of known weight, put the sample in an oven at a temperature of 105-110°C for 2 hours, then cool it in a desiccator for 10 minutes, weigh it and put it in the oven for 1 hour. This treatment was repeated until the weight was constant with a difference in successive weighings of less than equal 0,2 mg, then calculated using the formula in equation 1. Determination of water content was replicated 3 times for each sample.

$$Water\ Content\ = \frac{Initial\ weight\ of\ Sample - Weight\ constan\ after\ drying\ (g)}{Initial\ weight\ of\ Sample\ (g)}\ x\ 100\%$$ (SNI, 2013)

1.3 Acidity Test (SNI, 2013)

a. Standardization of 0.1 N Oxalic Acid with 0.1 N NaOH (SNI, 2013)

10 mL of 0.1 N oxalic acid solution was pipetted into an Erlenmayer, 20 mL of distilled water was added and 1% pp indicator was added in 4 to 5 drops. Titrate with 0,1 N NaOH solution until the color changes o pink. Repeat the titration up to 3 times with the same amount of oxalic acid. Calculate the concentration of the NaOH solution from the titration results.

b. Determination of Acidity Levels in Honey (SNI, 2013)

Carefully weigh 10 grams of honey, put it in a 250 mL Erlenmayer then dissolve it in 75 mL of distilled water and add 4 to 5 drops of pp indicator, titrate using 0,1 N NaOH solution until the end point

of the titration is marked with a constant pink color. for ten seconds, record the volume of 0,1 N NaOH used, calculate the acidity in the sample using equation 2, replicate three times.

$$Acidity\ Levels\ \left(mL\ \frac{NaOH}{Kg}\right) = \frac{a\ x\ b}{c}\ x\ 1000$$ (Batista De Sousa et al., 2015)

note:

a = Volume of 0,1 N NaOH used in the titration, expressed in mL;

b = Normality of 0,1 N NaOH.

c = Sample weight, expressed in grams

1.4 Determination of Sugar Levels (SNI, 1992)

a. Sample preparation

Prepare honey samples and label each honey container. Weigh 2 g of honey sample, put it in a 250 mL measuring flask, add distilled water to the mark and homogenize (Solution 1).

b. Standarisasi $KI0_3$ dengan Na Thiosulfate (Wihardika, 2015)

Take 10 mL of $KI0_3$ primary standard solution and put it into a 250 mL Erlenmeyer flask. Add 10 mL of 20% KI Indicator, add 25 mL of 25% H_2SO_4 solution (be careful that CO_2 gas is formed). The solution was then titrated with 0.1 N Sodium Thiosulfate solution until a light yellow color was formed, then 0.5% starch solution indicator was added until the blue color in the solution disappeared. Replication was carried out 3 times.

c. Blank titration (Wulandari, 2017)

The blank was determined with a sample containing 25 mL of water and 25 mL of Luff Schoorl solution (V2). Pipette 25 mL of distilled water and 25 mL of Luff Schoorl solution (with a volume pipette), Erlenmeyer connected to an upright cooler, heated over an electric heater, and tried within 3 minutes it should start to boil. The sample solution is heated continuously for 10 minutes (using a stopwatch) then removed and cooled in a tub filled with ice (do not shake). After cooling, add 10 mL of 20% KI solution and 25 mL of 25% H_2SO_4 solution (be careful to form CO_2 gas). The solution was then titrated with 0,1 N sodium thiosulfate solution until a light yellow color was formed, then 0,5% starch solution indicator was added until the color was blue and again titrated with 0,1 N sodium thiosulfate until the blue color of the solution disappeared.

1.5 Determination of Sugar Levels

a. Reducing Sugar Test (before inversion) (Wulandari, 2017)

The sample solution that has been prepared is pipetted in a quantity of 10 ml and 15 mL of distilled water and 25 mL of Luff Schoorl solution (with a volume pipette) are added, the Erlenmeyer is connected to an upright cooler, heated on an electric heater, and within 3 minutes it should start to boil. The sample solution is heated continuously for 10 minutes (using a stopwatch) then removed and cooled in a tub filled with ice (do not shake). After cooling, add 10 mL of 20% KI solution and 25 mL of 25% H_2SO_4 solution (be careful to form CO2 gas). The solution was then titrated with 0.1 N Sodium Thiosulfate solution until a light yellow color was formed, then 0,5% starch solution indicator was added until a blue color (V1)

was formed, and titrated with 0,1 N Sodium Thiosulfate until the blue color in the solution disappeared. Replication was carried out 3 times, the rough reducing sugar was calculated using equation 3.

$$\%\ Reducing\ Sugar\ = \frac{v1\ X\ FP}{W}\ X\ 100\ \%$$ (Wulandari, 2017)

b. Sucrose sugar test (after inversion) (Wulandari, 2017)

The prepared sample solution was pipetted into 50 mL and placed in a 100 mL Erlenmeyer flask. Add 25 mL of 25% HCl solution and hydrolyze using a water bath, if the temperature has reached 68-70°C then maintain for 10 minutes and cool. The solution was added with 30% NaOH until a pink color was formed with PP indicator, then distilled water was added until the 100 mL mark. 0 mL of the sample solution was pipetted and 15 mL of distilled water and 25 mL of Luff Schoorl solution were added (with a volume pipette), the Erlenmeyer was connected to an upright cooler, heated on an electric heater, and tried within 3 minutes it should start to boil. The sample solution is heated continuously for 10 minutes (using a stopwatch) then removed and cooled in a tub filled with ice (do not shake). After cooling, add 10 mL of 20% KI solution and 25 mL of 25% H_2SO_4 solution (be careful to form CO_2 (gas). The solution was then titrated with 0,1 N Sodium Thiosulfate solution until a light yellow color was formed, then 0.5% starch solution indicator was added until a blue color (V1) was formed, and titrated with 0,1 N Sodium Thiosulfate until the blue color in the solution disappeared. Replication was carried out 3 times, rough calculation of sucrose sugar using the equation 4.

$$\%\ Sucrose\ Sugar\ = \frac{V2\ X\ FP}{W}\ X\ 100\ \%$$ (Harjo et al., 2015)

Explanation of equations 3 and 4:

V1V2	= glucose, mg (in glucose list)
Fp	= dilution factor
W	= sample weight (mg)
% Gula total	= 0.95 x % sugar after inversion (as saccharose)
% Sakarosa	= 0.95 x % sugar (after- before inversion)

2. Research Instrument (s)

2.1 Tools and Materials

Tools : Oven, Petri Dish, Analytical Balance (Acs. Ad- 600 t), Burette (50 Ml) (Pyrex), Hotplate, Dropper pipette (One med), Stirring rod, Tweezers, Gloves (Sensi) Tissue, Label paper, Statives and clamps, Measuring cup (Herma), Measuring flask (Herma), Erlenmayer (Herma), Funnel (Pyrex), Filler (Worner lab), Bath water (Healt), measuring cup (Pyrex), filter paper (Whatman), beaker glass (Pyrex), evaporating cup (Herma), volume pipette (Pyrex).

Ingredients: Kapok Honey, Multiflora Honey, Pure Honey, Kelengkeng Honey, NaOH 0,1 N (Merck), Oxalic Acid 0,1 N (Merck), PP Indicator 1% (Brataco), Ethanol (One Med), KI solution 20 % (Merck), H_2SO_4 solution

25% (Merck), $Na_2S_2O_3$ solution 0,1 N (Merck), HCl solution 25% (Merck), Indikator Kanji 0,5% (Merck), Asam Sitat (Merck), $CUSO_4.5H_20$ (Merck), Na_2CO_3 (Merck), Akuades (One med), kristal ice (-)

3. Populations and Samples

3.1 Populations were

The population was taken for research comes from honey without a mixture of other ingredients such as ginger, cumin, ginger etc. circulating in Comal District, Pemalang Regency. The population distribution in the study was grouped into 4 based on type with a total population of 26. The 4 types of honey are pure, klengkeng, multifora, and kapuk. The population numbers for each type are 14, 3, 5, and 4.

3.2 Samples

The sampling method uses a random sampling technique, where the honey to be sampled was grouped by type and selected using a proportional random sampling technique by drawing the brand name of each type of honey so that each sampling unit has the opportunity to be selected as a sample. Samples were taken from sellers of packaged honey without a mixture of other herbal ingredients such as ginger, turmeric, ginseng, cumin, etc. circulating in Comal District, Pemalang Regency by observing the number of brands and types of honey.

4. Data Analysis

The results of honey quality testing based on organeptic tests, water content, acidity test, reducing sugar test and sucrose sugar test, are compared with the honey quality requirements listed in table 1.

Tabel 1: Honey Quality Requirements (SNI, 2018)

Test	Persyaratan Mutu		
Organoleptic Test	Smell	Flavor	Color
	Rotten	Not sweet	Blackish brown
	Less Rotten	Not sweet enough	Light brown
	Neutral	Quite sweet	White
	Slightly fragrant	Sweet	Bright yellowish
	fragrant	Very sweet	Yellow
Acidity Test	Max 50 mL NaOH/kg		
Water Content Test	Max 22% b/b		
Gula sukrosa	Max 5% b/b		
Reducing Sugar	Min 65 %b/b		

Tabel 1. Honey Quality Requirements (SNI, 2018) Test Persyaratan Mutu Organoleptic Test Smell Flavor Color Rotten Not sweet Blackish brown Less Rotten Not sweet (enough Light brown Neutral Quite

sweet White Slightly fragrant Sweet Bright yellowish fragrant Very sweet Yellow Acidity Test Max 50 mL NaOH/kg Water Content Test Max 22% b/b Gula sukrosa Max 5% b/b Reducing Sugar Min 65 %b/b

Results/Research

1. Organoleptic Test

Tests to determine the color, aroma and taste of physical honey samples ware carried out using organoleptic tests. The results of the organoleptic test slowed in table 2

Table 2: Organoleptic Test Results

No	Sampel Code	Types of honey	Color	Smell	Flavor
1.	A	Murni	Light brown	Pungent sweet fragrance	Very sweet
2.	B	Murni	Blackish brown	Pungent sweet fragrance	Very sweet
3.	C	Murni	Blackish brown	Pungent sweet fragrance	Sweet
4.	D	Murni	Light brown	Sweet fragrant	Sweet
5.	E	Murni	Bright yellowish	Sweet fragrant	Very sweet
6.	F	Murni	Light brown	Sweet fragrant	Sweet
7.	G	Murni	Blackish brown	Pungent sweet fragrance	Very sweet
8.	H	Murni	Light brown	Pungent sweet fragrance	Very sweet
9.	I	Murni	Light brown	Sweet fragrant	Sweet
10.	J	Murni	Light brown	Sweet fragrant	Sweet
11.	K	Murni	Light brown	Pungent sweet fragrance	Very sweet
12.	L	Multiflora	Light brown	Sweet fragrant	Sweet
13.	M	Multiflora	Light brown	Pungent sweet fragrance	Sweet
14.	N	Multiflora	Light brown	Sweet fragrant	Sweet
15.	O	Klengkeng	Bright yellowish	Sweet fragrant	Sweet
16.	P	Klengkeng	Light brown	Sweet fragrant	Sweet
17.	Q	Kapuk	Light brown	Sweet fragrant	Very sweet
18.	R	Kapuk	Light brown	Sweet fragrant	Quite sweet
19.	S	Kapuk	Bright yellowish	Sweet fragrant	Sweet
20.	T	Kapuk	Light brown	Sweet fragrant	Very sweet

2. The distribution permit tests, water content, acidity, sucrose sugar levels, and reducing sugar levels

Results of distribution permit tests, water content, acidity, sucrose sugar levels, and reducing sugar levels, showed ini table 3

Table 3: Results of distribution permit tests, water content, acidity, sucrose sugar levels, and reducing sugar levels

No	Sample Code	Types of Honey	distribution permit	Water Content (%)±SD	Acidity Levels (mL NaOH/kg±SD)	Sucrose sugar levels (%)±SD	reducing sugar levels (%)± SD
1	A	Murni	Not Registered	18,33±0,288	18,63±0	8,79±0,02*	36,11±0,32*
2	B	Murni	Not Registered	23,6±0,288*	56,53±0,057*	5,61±0,0068*	25,73±0,29*
3	C	Murni	Not Registered	16,83±0,288	20,50±0	2,11±0	18,38±0*
4	D	Murni	Not Registered	25,5±0,5*	17,70±0	1,32±0	22,86±0*
5	E	Murni	Not Registered	19,6±0,288	10,25±0	1,74±0,034	37,71±0,31*
6	F	Murni	Not Registered	22,83±0,288*	29,6±0	4,28±0,02	25,21±0,31*
7	G	Murni	Registered	18,83±0,288	27,64±0,057	1,50±0,0068	22,25±0,29*
8	H	Murni	Registered	16,66±0,288	9,31±0	3,34±0,013	29,59±0,30*
9	I	Murni	Registered	17,83±0,288	18,63±0	3,56±0,013	24,58±0,30*
1	J	Murni	Not Registered	23,33±0,288*	18,63±0	3,90±0,02	40,57±0,31*
1	K	Murni	Registered	16,66±0,288	26,71±0,057	1,05±0,01	21,73±0,30*
1	L	Multiflora	Not Registered	18,83±0,288	16,77±0	1,45±0,013	50,65±0,30*
1	M	Multiflora	Terdaftar	21,83±0,288	15,84±0	4,28±0,02	34,82±0,30*
1	N	Multiflora	Not Registered	19,66±0,288	11,18±0	4,20±0,01	40,59±0,30*
1	O	Klengkeng	Not Registered	21,33±0,288	11,18±0	1,32±0	43,06±0,31*
1	P	Klengkeng	Not Registered	21,83±0,288	13,97±0	3,51±0,0068	24,17±,29*
1	Q	Kapuk	Not Registered	19,16±0,288	18,63±0	2,54±0	45,87±0*
1	R	Kapuk	Not Registered	19,33±0,288	44,10±0,057	2,66±0,0068	9,80±0,28*
1	S	Kapuk	Not Registered	22,66±0,288*	12,11±0	4,60±0,02	43,68±0*
2	T	Kapuk	Registered	16,16±0,288	9,31±0	3,53±0,027	48,78±0,25*

Note: if there is a mark (*) it does not meet the requiremen

The Research of honey in Comal District, Pemalang Regency showed that the results of organoleptic color tests were grouped into 3 color levels, namely bright yellow, light brown and blackish brown; aromas are grouped into pungent odors, sweet odors, and pungent odors; and tastes are grouped into moderately sweet, sweet, and very sweet. Overall organoleptic test results of honey samples meet the requirements. The results of the water content test showed that 5 samples, namely codes B, D, F, J and S were more than 22% w/w, so they did not meet the requirements. The acidity test results show that sample B does not meet the requirements, because the value is more than 50 mL NaOH/kg. The test results for sucrose sugar content 2 were not satisfactory, namely A and B levels were more than 5%w/w. The reducing sugar test results showed that all samples were less than 65% w/w, so they did not meet the requirements

Discussion

Honey samples were took by survey on 11-14 May 2022, in 17 villages in Comal District. Samples obtained ware 20 honey samples with inclusion criteria, namely packaged or branded honey that does not contain a mixture of other ingredients. Samples were taken using a random sampling method, first the samples were grouped based on the type of honey, and selected using a proportional random sampling technique by drawing lots on the brand name of each type of packaged honey. The number of samples taken was determined using the Slovin formula.

The distribution permit for each honey sample is checked to determine the distribution permit number registered with the BPOM, the permit number is not registered, or the permit number listed is a distribution permit for another honey product. The BPOM testing process is carried out using the BPOM application which can be downloaded on Android or PC by looking at the permit number on the packaging, open the BPOM RI page (https://cekbpom.pom.go.id/). The web page contains several information such as registration number, product name and registrant. The test results registered with the BPOM Agency are seen in Figure 1, and Figure 2 presents results that are not registered with the BPOM RI.

Based on table 3, the results of BPOM RI distribution permit testing show that there are 13 unregistered samples that only include P-IRT permits. Based on a quote from (dev yandip prov jateng, n.d.), if the P-IRT permit has been registered with BPOM, it will appear on the web page, but if it has not been registered, it will not appear in the application or web, The results for 13 sample, the quality of the honey were not guaranted, because samples were not registered at the BPOM RI .

Figure 1: test results registered at The BPOM RI

Figure 2: test results that are Not registered at The BPOM RI

Tests to determine the color, aroma and taste of physical honey samples are carried out using organoleptic tests. The parameters for organoleptic test results according to SNI 8664 2018 are only aroma and taste test results which have unspecific parameters, and there is no color test to determine the type and factors of each honey, so in this research honey color parameters were tested. The difference in honey color results is caused by the product coming from a different type of honey. The color of the honey distributed in the comal area of the 20 samples can be seen in image 3, namely A is bright yellow, image B is brown, and image C is blackish brown.

Figure 3: Differences in Honey Color

Based on the organoleptic test results in table 2, honey has many compound components, especially gluconic acid, flying acid, minerals and phenolics which play a role in the formation of color, aroma and taste in honey (Pattamayutanon et al., 2017). The mineral content in honey also affects the color. Honey that contains high minerals will be dark in color, and the lower the mineral content, the brighter the color will be (Pribadi & Wiratmoko, 2019). According to L.G. Berry and B. Mason Minerals are homogeneous solid compounds that are formed inorganically, which have a chemical composition within certain limits, and are composed of ordered atoms. The mineral content in honey is based on color, so it can be concluded that honey that has a blackish brown color has a higher mineral content than honey that is light brown and bright yellowish.

The aroma test results on honey have an average sweet smell like sugar, but there is a scent that is not overpowering. The fragrance level of honey is influenced by the presence of volatile acid compounds such as acetaldehyde, formaldehyde, acetone, isobutiraldehyde and diacetyl. Honey that has a non-pungent aroma indicates a lower content of volatile acid compounds. Research conducted by (Pattamayutanon et al., 2017) states that the aroma of honey is closely related to the volatile terpene content. There are several other factors that influence the pungent aroma of honey, namely damaged honey with the characteristics of gas content which is indicated by damage to the honey lid seal and brownish foam, honey with codes A and B have these characteristics and the taste test results are very sweet, indicating a mixture of solutions sugar, this is proven by the results of the sucrose sugar content, namely that it does not meet the requirements.

The results of the taste test in the research showed differences, namely very sweet, sweet and quite sweet. There were several factors that influenced the taste of honey, namely water content, harvest time, gluconic acid compound content and sucrose sugar content. Honey contains gluconic acid compounds which give a sweet taste which then changes to a slightly sour taste, so that the higher the

gluconic acid compound content, the sweeter the resulting honey tastes. The results of the research stated that the honey samples with codes A and B which had different very sweet tastes, namely like a sugar solution, were not the same as the results for the honey samples coded E, Q and T with a very sweet taste which ended with a slightly sour taste, so the honey taste factor Very sweet in codes A and B are influenced by high levels of sucrose because the results obtained in codes A and B have high levels of sucrose (Saepudin et al., 2014)

The water content test is related to the shelf life of honey which can influence the growth of putrefactive bacteria and yeast, according to SNI 8664 2018 the maximum water content contained in honey is 22% because honey that has a water content of more than 22% will easily ferment because the yeast that causes fermentation grows so that The shelf life of honey does not last long and of course this affects the content of the honey which changes the benefits of the honey. Based on table 3, the results obtained in this study are that of the 20 samples there were 5 honeys that had a water content of more than 22%, including 4 types of pure honey, namely sample names with code B, D, F, and J were 23,6%, 25,5%, 22,83%, 23,33%, and the type of kapok honey was 1, with code S was 22,66%.

Based on the data obtained, honey with codes B, D, F, J and S has requirements that do not meet the water content, and there was a possibility that honey with a high category was took from kapok flowers, because in Savitri's research (2017) that kapok honey has a high water content compared to other types of honey (Savitri et al., 2017). Factors that influence high water content according to Wulandari, 2017 ware environmental conditions such as high humidity, harvest time such as morning, afternoon or evening, honey harvested in the morning has higher humidity conditions, so the honey will have a smooth texture more dilute, besides the storage temperature also affects the water content (Wulandari, 2017).

The acidity level test is used in honey testing parameters, especially during the shelf life of honey, the higher the acidity level will indicate sugar fermentation which is related to the water content, honey fermentation occurs because glucose and fructose become carbon dioxide and alcohol, in the presence of oxygen the alcohol will be oxidized and converted into acetic acid and water thereby increasing the acidity of honey (Pujiarti et al., 2021). The data in table 3 shows the results of the acidity water content test in honey circulating in the Comal sub-district, there is 1 honey sample, namely with sample code B pure type honey with plastic bottle packaging, with dark honey color and very sweet taste with a result of 56,53 mL N NaOH /kg, so that honey with code B does not meet the requirements based on SNI 8664 2018. According to Pujiarti et al., 2021, the factor that influences high acidity levels is the ongoing fermentation process which is characterized by increased gas content, damage to the packaging lid seal, and the presence of foam chocolate on honey(Pujiarti et al., 2021) .

The sucrose sugar test is a test to determine the level of sucrose in honey. Sucrose is a disaccharide sugar that cannot be reduced and is often found in everyday life, namely granulated or cane sugar. The presence of high levels of sucrose sugar in honey can indicate the presence of a mixture of sugar solutions in the honey. High levels of sucrose can affect health, especially triggering diabetes and changing the benefits of honey. Based on table 3, it shows that the results of this research contained 2 samples that had

high sucrose levels, namely code A honey had a sucrose content of 8.79% and code B had a sucrose content of 5.61% so that both honeys had quality that did not meet the requirements. This can be seen from honey, namely that there is brown foam and lots of ants approaching it and there is gas which is indicated by damage to the packaging seal. These results are the same as research by Pujiarti et al 2021 namely damaged honey which is indicated by high levels of sucrose sugar, there is brownish foam and contains gas (Fatma et al., 2017).

The high sucrose levels in this study could be caused by damage to the honey or honey feed, beekeepers provide additional intake which is placed in the bee stimulant box in the form of sugar syrup, there are several factors that make beekeepers add sugar syrup, namely to maintain the bee colony due to the weather. making flower nectar difficult to obtain, such as not during the flowering season (Fatma et al., 2017). The process of forming honey is that flower nectar contains sucrose which is used as food for bees and is digested by the invertase enzyme in the bee's stomach. The function of this enzyme is to convert sucrose sugar into glucose and fructose. Sucrose is a non-reducing sugar because it cannot reduce like fructose and glucose (Sukmawati et al., 2015). Sucrose is a disaccharide sugar which consists of two types, namely glucose and fructose which have glycosidic bonds. Sucrose can be found every day, namely granulated sugar, so it is necessary to test the sucrose content to determine the sucrose sugar content in honey.

The carbohydrate test officially determined by BSN in SNI 01-2891-1992 is total carbohydrate analysis using the Luff Schoorl method. In 1936, the International Commission for Uniform Methods of Sugar Analysis considered the Luff-Schoorl method as one of the methods used to standardize the analysis of sucrose sugar. The principle of analysis using the Luff-Schoorl Method is the reduction of Cu^{2+} to Cu^{1+} by monosaccharides. Free monosaccharides will reduce the basic solution of the metal salt to its oxide or free form. The excess of unreduced $Cu2^{+}$ is then quantified by iodometric titration (SNI 01-2891-1992). The reactions that occur in determining levels using the Luff-Schoorl method are:

Complex carbohydrates $\longrightarrow$ simple sugars (reducing sugars)

Reducing sugar + 2 Cu^{2+} $\longrightarrow$ $Cu_2O(s)$

2 Cu^{2+} (excess) + 4 I– $\longrightarrow$ 2 CuI_2 $\longrightarrow$ 2 CuI- + I_2

I_2 +2$S_2O_3^{2-}$ $\longrightarrow$ 2 I^- + $S_4O_6^{2-}$

Reducing Sugar Content Test

The process of forming honey is that flower nectar contains sucrose which is used as food for bees and is digested by the invertase enzyme in the bee's stomach. The function of this enzyme is to convert sucrose sugar into glucose and fructose. Sucrose is a non-reducing sugar because it cannot reduce like fructose and glucose (Sukmawati et al., 2015). Honey has a minimum requirement of 65% because the component of honey is reducing sugar. Based on table 3, none of the 20 samples met the requirements for reducing sugar content.

Reducing sugar is sugar that can reduce other compounds produced by bees. Factors that influence the low level of reducing sugar are the presence of a mixture of sugar solutions such as cane sugar or other

sugars that do not come from the bee's stomach, unripe honey, water content, humidity, storage temperature and harvest time. Honey that is harvested early or in an immature state (honey cells are not completely closed) so that the inversion process by the amylase enzyme which breaks down complex sugars into simple sugars (reduction) in imperfect honey will reduce the levels of the diasase enzyme which plays a role in converting sucrose sugar into sugar simple. The diastase enzyme comes from the bee's stomach during the process of expelling honey into the hive.

Suggestions

Based on the research findings on honey in Comal District, Pemalang Regency involves testing for moisture content, acidity levels, reduction of sugar levels, and sucrose sugar levels, here are some suggestions:

1. Verify the results of reducing sugar tests using other methods such as Fehling and Dinitrosalicylic Acid (DSA)

2. Honey farmers or honey producers regularly check reducing sugars and honey quality parameters to ensure honey quality standards are achieved.

3. Honey farmers are given training in selecting and processing pollen substitute food sources, to produce honey with reducing sugar content that meets standards.

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