Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK), November 2022 Vol. 17 No. 3
ISSN : 1978 – 0303 DOI : 10.21776/ub.jitek.2022.017.03.5

CHARACTERISTICS OF FOREST AND MANUKA HONEY AS WELL AS THEIR APPLICATION AS HERBAL HONEY DRINKS WITH THE ADDITION OF QUSTHUL HINDI AND TURMERIC

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Submitted 12 August 2022; Accepted 24 November 2022

ABSTRACT

Manuka and forest honeys are types of honeys that are widely consumed because for their antioxidant properties. In this study, the properties of forets and manuka honey and the use of honey as a herbal drink with the addition of Qusthul hindi and turmeric were analyzed. The addition of Qusthul hindi (0,125 g and 0,375 g) and turmeric (0,125 g and 0,375 g) is given in two formulations. This study was conducted in two phase, namely analyzing the characteristics of manuka and forest honey and preparing herbal drinks to then analyzing their properties. The results showed that the properties of forest honey do not meet the standards for the variables of pH, HMF value, and diastase enzyme activity, while Manuka honey meets the standards only for variables of moisture, HMF value, and diastase enzyme activity. The addition of Qusthul hindi and turmeric to herbal drinks results in an increase in pH, DPPH inhibitoty activity, and antioxidant capacity, as well as a decrease of water content, but is not sensory evaluated because the addition of spices causes changes in taste and appearance.

Key words: Antioxidant; honey; qusthul hindi; turmeric

INTRODUCTION

Honey is a commodity that people are interested in because of the increasing public understanding of the benefits of honey, not only as a sweetener but also for health (SNI, 2018). Honey based on the type is known to be divided into two, namely monofloral honey whose nectar source comes from one flower, and multiflora whose nectar source is obtained from various types of flowers or other parts of the plant. SNI (2018) states that honey can be divided into three types based on the type of bee, namely forest honey produced by wild *Apis dorsata* bees and/or wild bees *Apis spp.* from flower extracts of forest plants (floral nectar) or other parts of forest plants (extra floral), cultivated honey produced by *Apis mellifera* bees or *Apis cerana* from plant flower extracts (floral nectar) or other parts of plants (extra floral), and stingless bee honey (Trigona) produced by stingless bees (Trigona) both wild and cultivated. The types of honey that are marketed are differentiated based on indicators of honey authenticity, the plant source of nectar obtained, and regional differences that cause plant vegetation to determine the type of honey produced.

The characteristics of real honey can be seen through several indicators such as the content of glucose, fructose, sucrose, water content, pH, color, and aroma (Saepudin, 2014). The sugar content indicator in real honey based on the U.S. Patent Application Publication has a value between 76 - 83˚Brix. The high sugar content is known to also affect the color of honey, the higher the sugar content, the brighter the honey color (Eleazu *et al.*, 2013). Indicators of honey authenticity based on color can also be influenced by storage time, high temperatures, processing processes, and the source of nectar from which the honey is obtained (Eleazu *et al.*, 2013). The honey authenticity indicator based on moisture is related to the fermentation process due to yeast activity, harvesting time, and storage time, with a quality standard of not more than 22% (SNI, 2018).

Honey's pH value indicator ranges from 3.4 to 6.1. The lower the pH, the more honey can prevent the emergence of bacteria that can cause damage to honey. The difference in the pH value of honey is also due to differences in the mineral and acid content of honey which are influenced by soil conditions, geographical location, and climatic conditions where plants grow as sources of nectar (Buba *et al.*, 2013).

Honey is widely consumed by humans because of its benefits for human health, including as an antibacterial, antioxidant, anti-inflammatory, and anticancer. Honey is known to have benefits as an antioxidant and antibacterial, one of which is manuka honey. Manuka honey is honey that comes from the *Apis mellifera* bee with its nectar source coming from the manuka plant (*Leptospermum scorparium*) which has a sweet taste plus a slightly sour taste (Arumsari, 2019).

The antioxidant properties of manuka honey are due to the type of flavonoid content such as pinobanksin, pinocembrin, and chrysin, as well as several other types found in small concentrations such as luteolin, quercetin, 8-methoxykaempferol, isorhamnetin, kaempferol, and galangin (Chan, 2013). The antibacterial properties of manuka honey are due to the type of chemical constituent methylglyoxal (MGO)

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How to cite:
Septiani, A., Suryati, T., Apriantini, A., & Endrawati, Y. C. (2022). Characteristics of Forest and Manuka Honey As Well As Their Application As Herbal Honey Drinks With The Addition of Qusthul Hindi and Turmeric. Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK), 17 (3), 183-196

in manuka honey, also known as the unique manuka factor (UMF). The higher the UMF value of manuka honey, the better the antibacterial properties it has. Indonesia also has local honey which is known for its benefits as a source of antioxidants and antibacterials, namely forest honey. Forest honey is believed to be the largest contributor to honey in Indonesia, estimated to produce around 50 liters of honey per year (Adalina, 2018).

Forest honey has several names according to the nectar source area. Musi Rawas forest honey is known to inhibit the growth of *Staphylococcus aureus* with a concentration of 10% - 100% and the inhibition zone is 10.6 mm to 31.6 mm and *Escherichia coli* at a concentration of 10% - 100% with an inhibition zone of 16.3 mm to 31.6 mm (Huda, 2013). Saputri (2017) stated that forest honey in the Sumbawa area had free radical inhibition of 3.34% for Tepal honey, 3.24% for Punik honey, 9.87% for Lape honey, and 30.97% for Moyo Island honey. Along with the development of the era, the use of honey can not only be consumed directly but can be combined with various types of food products known as functional foods. The addition of honey can provide added value to the food product, both affecting the nutrients and benefits of the food product and the appearance of the food product such as color, taste, aroma, and texture.

Honey is generally mixed with traditional herbal medicine by the Indonesian people to increase the healing properties of diseases such as infections of the gastrointestinal and respiratory tracts, as well as improving body fitness. Another product that allows the addition of honey to increase its benefits is herbal drinks with the addition of spices such as qusthul hindi and turmeric. Qusthul hindi is also known as *Saussurea costus/Saussurea lappa*. Qusthul hindi is often used as herbal medicine to cure asthma, rheumatism, and inflammation (Choi *et al.*, 2012). Saleem's research (2013) also states that *Saussurea lappa* has several pharmacological properties, one of which is as an antioxidant. Another spice used in this study is turmeric which is known to be one of the spices that have benefits as antioxidants and anti-inflammatory (Nasution *et al.,* 2020). Turmeric can also be used as a form of treatment for digestive disorders, jaundice, and vaginal discharge to increase endurance.

Based on this, research was conducted on the manufacture of honey herbal drinks with the addition of qusthul hindi and turmeric. This research was conducted in two stages and with two types of honey, namely manuka honey and forest honey. The first stage of the two kinds of honey will be tested for quality through testing moisture, pH value, diastase enzyme activity, hydroxymethylfurfural (HMF) value, measurement of inhibitory activity against DPPH radicals, and antioxidant capacity.

Manuka honey and forest honey in the second stage were then used as a mixture in the manufacture of herbal drinks with the addition of qusthul hindi and turmeric made in two concentrations of each type of honey to then be tested for pH value, measurement of inhibitory activity against DPPH radicals, measurement of antioxidant capacity, and sensory assays.

MATERIALS AND METHODS

This research was conducted in January – February 2022. This research will be carried out at the Integrated Laboratory, Laboratory of Animal Products Technology, and Organoleptic Laboratory, Department of Animal Production and Technology, Bogor Agricultural University.

The tools used in this research are porcelain dish, pH meter (pH5S Spear pH Tester, IONIX), stopwatch, vortex mixer VM-300, oven (UNE 500 Universal Memmert), water bath (Memmert WNB14RACK), stirrer, stainless pans, gas stoves, plastic bottles, digital scales (Precisa XT 220A), UV-VIS 2453 spectrophotometer (Agilent, USA. PT. Berca Niaga Medika), water bath, test tubes,

and organoleptic test forms. While the materials used in this study were HVS paper, Whatman filter paper, qusthul hindi powder (e-commerce bakulsaudi), temulawak powder, manuka honey (Manuka Health New Zealand MGO 30+ imported by PT. Vita Shopindo), Sumbawa forest honey (production of CV.Prima Herbal), as well as several types of solutions, namely methanol, stock iodine solution, iodine solution 0.0007 N, acetate solution pH 5.3 (1.59 M), sodium chloride solution (0.5 M), starch solution, sodium bisulfite ($NaHSO_3$), Carrez I solution, Carrez II solution and standardization available at the Integrated Laboratory, Department of Animal Production and Technology, Bogor Agricultural University.

The research procedure was carried out in two stages. The first stage is testing the characteristics of honey and the second stage is making and testing honey-based herbal drinks with the addition of qusthul hindi and turmeric. The first stage on two honey samples was carried out six tests consisting of diastase enzyme activity test, hydroxymethylfurfural test, pH value measurement, moisture measurement, inhibition activity against DPPH radicals, and antioxidant capacity measurement. The second research stage on honey-based herbal drinks with the addition of qusthul hindi and turmeric carried out four tests, namely measuring pH values, measuring inhibitory activity against DPPH radicals, measuring antioxidant capacity, and sensory tests.

Herbal Drink Manufacturing

Procedure The process of making honey-based herbal drinks is carried out based on a procedure that refers to Mulyani (2021) with several modifications. Honey applied in herbal drinks uses three different formulations, namely formula 0 (P0), formula 1 (P1), and formula 2 (P2). Formula P0 controls, that is, there is no addition of qusthul hindi and turmeric in honey herbal drinks. Formula P1 was added with qusthul hindi and turmeric as much as 0.125 g of each type of spice.

Formula P2 was added with qusthul hindi and turmeric as much as 0.375 g of each type of spice. The first step is qusthul hindi powder and turmeric dissolved in 50 mL of warm water and then allowed to stand for 15 minutes, after separating between the water and the sediment then use the water part. The second step is the boiling water of qusthul hindi and turmeric mixed in a stainless pan with other ingredients based on the composition of the three formulas which can be seen in Table 1. of a plastic material after it is closed tightly.

Tabel 1. Formulas of honey-based herbal drinks

Material	Herbal drink formula					
	Manuka honey			Forest honey		
	P0	P1	P2	P0	P1	P2
Water	150 mL	150 mL	150 mL	150 mL	150 mL	150 mL
Honey	85 mL	85 mL	85 mL	85 mL	85 mL	85 mL
Qusthul hindi	-	0,125 g	0,375 g	-	0,125 g	0,375 g
Turmeric	-	0,125 g	0,375 g	-	0,125 g	0,375 g

Note: P0 controls, that is, there is no addition of hindi qusthul and temulawak. In P1 the addition of qusthul hindi and ginger is as much as 0.125 g of each type of spice. In P2, qusthul hindi and temulawak were added as much as 0.375 g of each type of spice

Analysis Procedure

Diastase Enzyme Activity Test

The diastase enzyme activity test was carried out according to the SNI 2018 provisions, with the principle that the honey and starch solution that had been obtained would be incubated, and the time required to reach the endpoint was measured photometrically. The result is expressed in mL of 1% hydrolyzed starch equivalent to enzymes in 1 g of honey in 1 hour. The procedure used consists of three main procedures, namely, sample preparation, determination of absorbance, and calculation of diastase enzyme activity with the formula:

$$DN = 300/t$$

Information :

DN = diastase enzyme activity

t = time taken to reach the absorbance value A

The procedure carried out was that 5 g of honey, 10-15 mL of water, and 2.5 mL of acetate buffer were put into a beaker (20 mL) in a cold state and homogenized until the honey was completely dissolved. The sample solution was transferred to a measuring flask (25 mL) and then 1.5 mL of NaCl solution was added (just to the mark with water and the solution had to be buffered before adding the NaCl solution). The next step is the determination of absorbance, 10 mL of the sample solution is taken using a pipette, then put into a test tube (50 mL) and 5 mL of starch solution is pipetted through the inner wall of the tube and then placed in a water bath of 40 °C ± 0.2 °C for 15 minutes after that it was homogenized and the stopwatch was turned on. Each time interval of 5 minutes, 1 mL of the mixture was pipetted and added to 10 mL of iodine solution for further homogenization, then diluted to the volume as before and the absorbance value was determined with a wavelength of 660 nm. The time from the mixing of the starch with the honey to the addition of the liquid to the iodine was recorded as reaction time. Taking the solution in a certain time interval is carried out continuously until the value of A < 0.235 is obtained.

Hidroksimetilfurfural Test

The hydroxymethylfurfural test was carried out based on the SNI 2018 standard with the principle of difference in sample absorbance at a wavelength of 284 nm from 336 nm with sodium bisulfite ($NaHSO_3$) solution as a comparison. The procedure carried out was that as much as 5 g of honey was separated in a small beaker, then put into a measuring flask (50 mL) and rinsed with water until the volume of the solution was 25 mL, then 0.5 mL of Carrez I solution was added and homogenized, then 0.5 mL of Carrez II solution was added and homogenized again and diluted with water up to the line mark.

A drop of alcohol is added to remove the foam on the surface and the solution is filtered through filter paper, the first 10 mL of the filter is not used, the next 5 mL of the filter is pipetted and each is put into a test tube measuring 18 mL x 150 mL, after that 5 mL of water is added to the sample. one tube (sample) and 5 mL of 0.2% sodium bisulfite into the other tube (comparison), then homogenized until completely mixed using a vortex mixer and the absorbance of the sample against the reference (comparison) was determined in a 1 cm cell at a wavelength of 284 nm and 336. nm. If the absorbance is higher than 0.6 to obtain precise results, the sample solution may be diluted with water as required. Likewise, the reference solution (reference solution) can be diluted in the same way using the $NaHSO_3$ solution. After that, the calculation is carried out with the formula:

$$\text{HMF } (\frac{mg}{100} \text{ g madu}) = \frac{A_{284} - A_{336}\ x\ 14.97\ x\ 5}{bobot\ contoh\ (g)}$$

$$\text{Faktor} : \frac{126}{216\,830} \; x \; \frac{1\,000}{10} \; x \; \frac{100}{5} = 14.97$$

Information :

126	= molecular weight HMF
216 830	= molecular absorbance of HMF at a wavelength of 284 nm
1 000	= mg/g
10	= centiliter/l
100	= grams of reported honey
5	= weight of the sample taken in grams

pH Value Measurement

The pH value is measured with a pH meter. The pH meter was first calibrated on a standard buffer solution of pH 4 and 7. The pH meter probe was then inserted into the honey. The pH value will be read on the pH meter display.

Moisture Measurement

The porcelain dish and its lid, which had been washed clean, were coded according to the sample and heated in an oven at a temperature of 100-105 ˚C for 2 hours. The porcelain cup was taken and put in a desiccator for ± 30 minutes, then the porcelain cup was weighed. Into a porcelain cup, 2 g of sample was added, then weighed. The porcelain cup containing the sample was dried in an oven at a temperature of 100 - 105 ˚C for 18 hours. After obtaining a constant weight, the sample was transferred to a desiccator and cooled for 30 minutes, and then weighed. Drying and weighing are carried out continuously until a constant weight is obtained and then the calculation is carried out. Moisture formula:

(w.cup + w.sampel) – (w.cup + b.sampel after the oven) x 100% net weight

Measurement of Inhibitory Activity against DPPH Radicals (*scavenging activity*)

A total of 1 g of sample was extracted for 24 hours using 2.5 mL of 100% methanol at room temperature and then filtered. The sample was re-extracted for 24 hours then the filtered result was filtered and mixed with the initial filtration. The extraction results were added to 10 mL of methanol. A total of 0.15 mL of sample extract solution was reacted with 0.1 mM DPPH solution (methanol solvent) as much as 0.9 mL in a vial tube. The solution was incubated in a water bath (37°C for 30 minutes) and then the absorbance was measured (spectrophotometer =517 nm). The free radical scavenging activity of DPPH is expressed in % scavenging activity (%SA) which is calculated based on the equation:

$$\%\,SA \; = \; 1 - \frac{Sample\ absrobance}{Standard\ absorbance} \times 100\%$$

Antioxidant Capacity Measurement

Antioxidant capacity is expressed in vitamin C equivalents or EVC (mg vitamin C converts %SA value based on standard curve).

The standard curve was obtained from the absorbance value of the reaction between 0.1 mM DPPH solution and the concentration of vitamin C solution. The concentration of the prepared vitamin C solution was 0; 0.5; 1.0; 1.5; 2.0 and 2.5 mg / 100 ml of distilled water.

Sensory Test

Sensory test is a test conducted using the human senses to assess the quality of a product. Sensory testing is important as an initial assessment of product quality so that

it can determine the length of storage and changes that occur in the product. Panelists in this sensory test are semi-trained panelists as many as 30 people. Panelists assessed the product samples presented using hedonic and hedonic quality organoleptic questionnaires.

Hedonic and hedonic quality testing uses a scale of 1 to 5, for hedonic quality with color attribute criteria 1 = very faded, 2 = faded brown, 3 = brown, 4 = dark brown, and 5 = very dark brown. Attributes of honey aroma, 1 = very no honey aroma, 2 = no honey aroma, 3 = moderate honey aroma, 4 = honey aroma, 5 = very honey aroma. Attributes of the aroma of spices, 1 = very little smell of spices, 2 = no aroma of spices, 3 = quite a smell of spices, 4 = aroma of spices, 5 = very aroma of spices. Sweetness attribute, 1 = very not sweet, 2 = not sweet, 3 = moderately sweet, 4 = sweet, 5 = very sweet. Bitter taste attributes, 1 = not very bitter, 2 = not bitter, 3 = moderately bitter, 4 = bitter, 5 = very bitter. The hedonic test uses the attributes of color, taste, aroma, and general appearance with a scale of 1 = very dislikes, 2 = dislikes, 3 = normal, 4 = likes, and 5 = very likes.

Data Analysis

The data from the first stage of testing were analyzed descriptively by comparing them to SNI. The experimental design used in the second phase of the research was a completely randomized design (CRD) with a 2 x 3 pattern. The first factor was the type of honey used (manuka honey and forest honey) and the second factor was the type of formula adding qusthul hindi and turmeric (formula 0 (formula 0). P0), formula 1 (P1), and formula 2 (P2)). Formula P0 controls, that is, there is no addition of qusthul hindi and turmeric in the honey herbal drink. Formula P1 was added with qusthul hindi and turmeric as much as 0.125 g of each type of spice.

Formula P2 was added with qusthul hindi and turmeric as much as 0.375 g of each type of spice. The three formulas that have been determined in two types of honey were analyzed in 4 replications. Parametric data were analyzed using variance and multiple comparison tests using the Tukey test if the treatment showed a significant effect. The statistical model used is a two-way ANOVA with a statistical model according to Rahmawati (2020):

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Information:

Y_{ijk} = Research response on the level of addition of qusthul hindi and temulawak extract for the i-th type of honey and the j-th type of formula factor on the k-th replication;

μ = General average of research responses;

α_i = Effect of type of honey (manuka honey and forest honey) to – i on the research response;

β_j = The effect of the type of formula adding qusthul hindi and temulawak extract (formula P0, P1, and P2) to - j on the research response;

$(\alpha\beta)_{ij}$ = The interaction between the type of honey and the type of formula on the i-th honey type factor and the j-th formula type factor

ε_{ijk} = Experimental error for the i-th type of honey and the j-th formula type factor on the -k repetition

Sensory test data, which are non-parametric data, were tested using the Kruskal-Wallis test. The statistical model used for organoleptic tests according to O'Mahony (1986) are:

$$H = \frac{12}{N\,(N+1)}\left[\sum_{i=1} \quad \frac{R_i^2}{n_i}\right] - 3\,(N+1)$$

Information:
N : Total number of observations;
R : The number of ranking values in the i- treatment; and
n : The number of observations in i- treatment

The statistical model used for the organoleptic test according to Steel and Torrie (1997) is as follows:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

Information:
Y_{ij} = Research response of the i-th organoleptic test attribute on the j-th test;
μ = General average of research responses;
α_i = The effect of the i-th organoleptic test attribute on the research response; and
ε_{ij} = The effect of the i-th organoleptic test attribute error on the j-th test

RESULTS AND DISSCUSION

The results showed that the characteristics of forest and manuka honey had met the standards and references with the exception of the pH variable, hydroxymethylfurfural (HMF) value, and diastase enzyme activity for forest honey, and the variables pH and DPPH inhibitory activity for manuka honey. The results of the research on the characteristics of honey can be seen in Table 2.

Tabel 2. Characteristics manuka and forest honey

Variabel	Forest honey	Manuka honey	Standards and references
pH	2,52 ± 0,01	2,39 ± 0,01	3,6 – 5,6 (IHC)
Moisture (%)	14,25 ± 1,32	17,50 ± 1,35	maks 22 (SNI 2018)
Inhibitory activity against DPPH radicals (%)	81,73 ± 2,98	33,30 ± 2,57	min 81.43 (Septiana 2019)
Antioxidan capasity (mgVCE/g)	102,73 ± 3,86	40,08 ± 3,32	min 5.83 (Sumarlin *et al.* 2014)
Hidroksimetilfurfural (mg/kg)	1519	26,70	maks 50 (SNI 2018)
Diastase enzyme activity (DN)	0	5,94	min 3 (SNI 2018)

*The numbers in the same line and followed by different letters indicate that they are significantly different ($p<0.05$)

Table 2 shows that both types of honey are known to have not met the honey pH standard based on the International Honey Commission (IHC), which is 3.6 – 5.6. The lower the pH value of honey, the higher the acidity level and can prevent honey from spoiling. The pH value can be influenced by organic acid content, honey processing process, stability, and shelf life of honey (Kivrak *et al.*, 2017). The standard of honey water content according to SNI 8664 in 2018 is less than 22%, based on research results the moisture content of forest honey and manuka honey still meets SNI requirements. The lower the water content of honey is known, the better the quality. Ariandi and Khaerati (2017) state that water content can affect the fermentation process, the lower

the water content, the longer the shelf life of honey because it can suppress the growth of yeasts that cause fermentation such as the genus Zygosaccharomyces (Evahelda *et al.*, 2015).

Hydroxymethylfurfural (HMF) is a compound resulting from the breakdown of sucrose and fructose. The standard HMF value according to SNI (2018) is that it should not be more than 50 mg/kg, if it exceeds this limit, honey is indicated to be false because of a mixture of sugar from the added ingredients. The results showed that the HMF value of forest honey did not meet the SNI standard, but for manuka honey, it had fulfilled it because the value was not more than 50 mg/kg. High HMF values can also be caused by excessive heating in the processing, storage, and shipping processes so that honey will produce a caramel-like aroma. Real honey with good quality is known to have high diastase enzyme activity. The value for forest honey does not meet SNI standards, because the value of diastase enzyme activity based on SNI (2018) is at least 3 DN. Another standardization states that the diastase enzyme activity value is at least 8 DN according to the International Honey Commission (IHC). The low value of diastase enzyme activity can be caused by forest honey undergoing a long storage process before testing, which causes enzyme inactivation (Eshete and Eshete 2019).

Tabel 3. Variabel characteristics of herbal drinks

Variabel	Addition of Qusthul hindi and curcuma extract	Type of honey		Average
		Manuka honey	Forest honey	
pH	P0	4,51 ± 0,02	2,75 ± 0,01	3,63 ± 1,24c
	P1	4,49 ± 0,02	2,84 ± 0,01	3,67 ± 1,17b
	P2	4,50 ± 0,01	2,91 ± 0,04	3,71 ± 1,12a
Average		4,50 ± 0,01a	2,83 ± 0,08b	
Inhibitory activity against DPPH radicals (%)	P0	55,45 ± 3,93	72,42 ± 1,99	63,94 ± 12,00b
	P1	57,69 ± 2,07	68,32 ± 5,07	63,00 ± 7,52b
	P2	71,89 ± 2,63	80,69 ± 5,43	76,29 ± 6,22a
Average		61,68 ± 8,92b	73,81 ± 6,30a	
Antioxidant capasity (mgVCE/g)	P0	89,64 ± 6,38	102,96 ± 29,69	96,3 ± 9,42b
	P1	93,29 ± 3,36	110,56 ± 8,24	101,93 ± 12,21b
	P2	116,37 ± 4,27	130,68 ± 8,82	123,53 ± 10,112a
Average		99,77 ± 14,49b	114,73 ± 14,32a	

*The numbers in the same row and column followed by different letters showed significantly different ($p<0.05$). P0 is a control that there is no addition of hindi qusthul and temulawak. In P1 the addition of qusthul hindi and ginger is as much as 0.125 g of each type of spice. In P2, qusthul hindi and temulawak were added as much as 0.375 g of each type of spice.

The IC_{50} value which is the main variable in describing the inhibitory activity of DPPH is grouped into four categories, namely weak antioxidant (150-200 ppm), moderate (100-150 ppm), strong (50-100 ppm), and very strong (<50 ppm). (Tristantini *et al.*, 2016). The IC_{50} value of Sumbawa forest honey and manuka honey is

included in the category of strong antioxidants, which is 1.128 when compared to honey from the Lombok area of 1550 ± 0.02 and the South Sulawesi area of 398.57 ± 3.47 (Djakaria *et al.,* 2020) . Manuka honey and forest honey have a higher IC_{50} value than ascorbic acid which is a common compound as a comparison of antioxidant activity. The high IC_{50} value can be caused by reducing substances contained in honey which are groups of sugars and amino acids that can affect the absorbance value.

Variable values of pH, DPPH inhibitory activity, and antioxidant capacity were significantly different ($p<0.05$). The results of measuring the physical characteristics of herbal drinks can be seen in Table 3.

The variable pH of herbal drink was significantly different ($p<0.05$) for each treatment in the type of forest honey, but not significantly different in each treatment in the type of manuka honey. The pH of herbal drinks is higher than the pH of honey, this can be caused by the addition of spices. However, this value is much more acidic when compared to the pH of herbal drinks with the addition of curcuma and curcuma in the Sihombing study (2021), which is in the range of 6.10 to 4.55. The addition of qusthul hindi and turmeric treatment significantly increased the pH value, antioxidant activity, and antioxidant capacity variables. These results are in line with research by Akinola *et al.,* (2014) which reported that three plant species have high antioxidant values including methanol extract of curcuma (*Curcuma longa*), ginger (*Zingiber officinale*), and turmeric (*Curcuma xanthoriza*). Antioxidant activity can be influenced by phenolic content and flavonoid content. One of the reasons for the high antioxidant capacity of ginger is the effect of harvesting time. Curcuma rhizomes aged 9 months had the greatest antioxidant activity compared to those aged 7 and 8 months.

Sensory Test

Sensory is a test that uses the senses of sight, smell, taste, and touch to assign a value or score to the characteristics of a product including appearance, aroma, taste, and texture. This test can be used as a benchmark for panelists' acceptance of a product (Garnida and Yudi 2020). The hedonic test of herbal drinks consisted of four variables, namely color, taste, aroma, and general appearance with a range of values from 1 to 5.

Tabel 4. Characteristics hedonic test of herbal drink

Parameter	Addition of qusthul hindi and curcuma extract					
	Forest honey			Manuka honey		
	P0	P1	P2	P0	P1	P2
Color	3,00 ± 1,28	3,00 ± 0,81	3,00 ± 0,98	3,00 ± 0,92	3,00 ± 0,92	4,00 ± 0,97
Taste	3,00 ± 1,02^{bc}	3,00 ± 0,92^{bc}	2,00 ± 0,99^{c}	3,00 ± 1,15^{a}	3,00 ± 0,98^{ab}	3,00 ± 0,94^{c}
Aroma	3,00 ± 0,74^{ab}	3,00 ± 0,66^{ab}	3,00 ± 0,70^{b}	3,00 ± 1,07^{a}	3,00 ± 0,67^{ab}	4,00 ± 0,93^{ab}
General appearance	4,00 ± 0,81^{ab}	3,00 ± 0,89^{b}	3,00 ± 0,85^{b}	3,00 ± 0,92^{a}	3,00 ± 0,92^{b}	3,00 ± 0,93^{b}

* The numbers in the same row and column followed by different letters showed significantly different ($p<0.05$). P0 is a control that there is no addition of hindi qusthul and temulawak. In P1 the addition of qusthul hindi and ginger is as much as 0.125 g of each type of spice. In P2, qusthul hindi and temulawak were added as much as 0.375 g of each type of spice.

Tabel 5. Characteristics quality hedonic test of herbal drink

Parameter	Addition of qusthul hindi and curcuma extract					
	Forest honey			Manuka honey		
	P0	P1	P2	P0	P1	P2
Color	1,00 ± 0,35^{d}	2,00 ± 0,66^{c}	2,00 ± 0,92^{bc}	2,00 ± 0,76^{ab}	3,00 ± 0,76^{bc}	3,00 ± 0,94^{a}
Honey aroma	2,00 ± 0,94^{bc}	2,00 ± 0,84^{bc}	3,00 ± 0,81^{c}	4,00 ± 1,19^{a}	3,00 ± 1,07^{ab}	3,00 ± 1,07^{ab}
Spice aroma	2,00 ± 0,69^{b}	3,00 ± 1,05^{a}	3,00 ± 0,86^{a}	2,00 ± 1,09	3,00 ± 1,14	3,00 ± 0,88
Sweetness	4,00 ± 0,89^{bc}	3,00 ± 0,85^{b}	3,00 ± 0,91^{c}	5,00 ± 0,78^{a}	4,00 ± 0,84^{b}	3,00 ± 0,99^{bc}
Bitter taste	2,00 ± 0,89^{cd}	3,00 ± 0,84^{bc}	4,00 ± 0,81^{a}	2,00 ± 0,81^{d}	2,00 ± 0,81^{cd}	3,00 ± 0,99^{ab}

* The numbers in the same row and column followed by different letters showed significantly different ($p<0.05$). P0 is a control that there is no addition of hindi qusthul and temulawak. In P1 the addition of qusthul hindi and ginger is as much as 0.125 g of each type of spice. In P2, qusthul hindi and temulawak were added as much as 0.375 g of each type of spice.

The results of the hedonic test showed the level of panelists' acceptance of herbal drink products. The color variable was not significantly different in the three treatments of formulation 0, formulation 1, and formulation 2, both on forest honey and manuka honey. Testing the color parameters of herbal drinks in the treatment of formulation 2 manuka honey was preferable to the treatment of formulation 0, formulation 1, and formulation 2 forest honey as well as formulation 0 and formulation 1 manuka honey.

Parameters of taste and scent were significantly different in each treatment, due to differences in the percentage of added spices. The general appearance that was significantly different in the three treatments could be due to the influence of taste and aroma in herbal drinks derived from different types of honey and the addition of qusthul hindi and turmeric, overall the panelists preferred herbal drinks without the addition of turmeric and qusthul hindi spices.

The results showed that the sweet and bitter taste parameters were not affected by the different types of honey used. The sweet taste parameter in the P0 treatment had the highest value in both types of honey, this could be due to the bitter taste of turmeric and qusthul hindi that could mask the sweet taste of honey in line with Septiana's research (2019) which stated that the steeping of turmeric drinks had the lowest level of sweetness compared to beverages with the addition of ginger and kencur because turmeric has a sharp aroma with a bitter and slightly spicy taste. The bitter taste can also come from the propolis content of honey obtained from plants containing resin or the presence of phenolic compounds such as tannins and flavonoids (Pujiarti *et al.*, 2021).

Changes in taste can also be caused due to the long storage time of honey, the longer the storage time, the lower the glucose content in honey. Turmeric contains curcuminoids which causes the color of the drink to darken with a higher percentage of addition of turmeric (Hadi *et al.*, 2018) and causes a strong aroma due to evaporation of essential oils from steam distillation and solvent extraction in the form of curcumin and camphor compounds.

It is known that qusthul hindi can also affect aroma, in line with research (Binti and Ahmad 2021) which states that qusthul hindi can be used as a fragrance for fumigation and purifying the smell of menstrual blood for Arab women.

CONCLUSION

Forest honey based on the tests carried out met the standards except for the variables of pH, HMF value, and diastase enzyme activity. Manuka honey met the standards except for the variables of pH, DPPH inhibitory activity, and antioxidant capacity. The addition of qusthul hindi and turmeric was able to increase the antioxidant activity of herbal drinks with the highest value in the formulation adding 0.375 g of qusthul hindi and turmeric (formula P2). The antioxidant activity value of herbal drinks is higher than the antioxidant activity of honey, but it is sensory not very favored because the addition of spices causes changes in taste and appearance.

REFERENCES

Adalina, Y. (2018). Analisis habitat koloni lebah hutan *Apis dorsata* dan kualitas madu yang dihasilkan dari Kawasan Hutan Dengan Tujuan Khusus (KHDTK) Rantau, Kalimantan Selatan. *Jurnal Penelitian Hutan dan Konservasi Alam.* 15 (1), 25-40. https://doi.org/10.20886/jphka.2018.15.1.25-40.

Akinola, A. A., Ahmad, S., & Mazinah, M. (2014). Total antioxidant capacity, total phenolic compounds and the effects of solvent concentration on flavonoid content in *Curcuma longa* and *Curcuma xanthorhhiza* rhizomes. *Medicinal and Aromatic Plants.* 3(2), 3-6. https://dx.doi.org/10.4172/2167-0412.1000156.

Ariandi., & Khaerati. (2017). Uji aktivitas enzim diastase, hidroksimetilfurfural (HMF), kadar gula pereduksi, dan kadar air pada madu Hutan Battang. [Prosiding] Seminar Hasil Penelitian (SNP2M) 2017. ISBN : 978-602-60766-3-2. https://doi.org/10.17605/OSF.IO/J2U34.

Arumsai, A., Herawati, D., & Afrizal, M. (2019). Uji aktivitas antibakteri beberapa jenis madu terhadap *Pseudomonas aeruginosa* dan *Staphylococcus aureus* dengan metode difusi agar. *Jurnal Ilmiah Farmasi Farmasyifa.* 2 (1), 26-32. https://doi.org/10.29313/ jiff.v2il.4218.

[BSN] Badan Standarisasi Nasional. (2016). *SNI No:01-2346-2006. Petunjuk Pengujian Organoleptik dan atau Sensori.* Jakarta : Badan Standarisasi Nasional.

[BSN] Badan Standarisasi Nasional. (2018). *SNI No:8664:2018. Madu.* Jakarta: Badan Standarisasi Nasional.

Buba F, Gidado A, Shugaba A. (2013). Analysis of biochemical composition of honey samples from North East Nigeria. *Biochemistry & Analytical Biochemistry*. 2 (3). 1-7. https://doi.org/10.4172/2161-1009.1000139.

Chan, C. W., Benjamin, J. D., Merilyn, M. H., Alistair, L. W., Dagmar, G. A., & Elizabeth, H. (2013). Analysis of the flavonoid component of bioactive New Zealand Manuka (*Leptospermum scoparium*) honey and the isolation, characterization and synthesis of an unusual pyrrole. *Food Chemistry*. 141 (3). 1772-1781. https://doi.org/10.1016/j.foodchem.2013.04.092.

Choi, H. G., Lee, D. S., & Li, B. (2012). Santamarin a sesquitepene lactone isolated from *Saussurea lappa* represses LPS-induced inflamantory responses via expression of heme oxygenase-1 in murine macrophare cells. *International Immunopharmacology*. 13 (3). 271-279. https://doi.org/10.1016/1.intimp/2012/04/016.

Djakaria, S. A., Batubara, I., & Raffiudin, R. (2020). Antioxidant and antibacterial activity of selected indonesian honey against bacteria of acne. *Jurnal Kimia Sains dan Aplikasi.* 23 (8). 267-275. https://doi.org/10.14710/jksa.23.8.267-275.

Eleazu, C. O., Amarachi, I. M., Eleazu, K., & Okoronkwo, J. O. (2013). Determination of the physico-chemical composition, microbial

quality and free radical scavenging activities of some commercially sold honey sampels in Aba, Nigeria: 'The effect of varying colors'. *International Journal of Biological Research.* 4 (1). 32-41. https://doi.org/10.4172/2155-9600.1000189.

Eshete, Y., & Eshete, T. (2019). A review on the effect of processing temperature and time duration on commercial honey quality. *Madridge, Journal of Food Technology*. 4 (1). 158 – 162. https://doi.org/10.18689/mjft-1000124.

Evahelda., Pratama, F., Malahayati N., & Santoso, B. (2015). Uji aktivitas enzim diastase, kadar gula pereduksi dan kadar air pada madu bangka dan madu kemasan yang dipasarkan di Kota Palembang. Paper presented at Seminar Nasional Lahan Suboptimal 2015. (pp 1-6). Palembang, Indonesia.

Garnida., & Yudi. (2020). Uji Inderawi dan Sensori pada Industri Pangan. Bandung, Indonesia: Penerbit Manggu.

Huda, M. (2013). Pengaruh madu terhadap pertumbuhan bakteri gram positif (*Stapyhlococcus aureus*) dan bakteri gram negatif (*Escherecia coli*). 2 (3). 250 – 259. https://dx.doi.org/10.26630/jak.v2i2.437.

Kivrak, S., Kivrak, I., & Karababa, E. (2017). Characterization of Turkish honeys regarding of physicochemical properties, and their adulteration analysis. *Food Science and Technology*. 37 (1). 80 -89. http://dx.doi.org/10.1590/1678-457X.07916.

Mohamed, Z. B. H., Abdulsalam, H., & Alfarisi, H. (2017). Tualang honey: composition, physiochemical properties and clinical importance. *International Research Journal of Pharmacy*. 8 (9). 1 – 5. http://doi.org/10.7897/2230-8407.089150.

Mulyani, C., & Iswahyudi. (2021). PKM pembuatan minuman herbal untuk mitigasi COVID-19 kepada masyarakat Gampong Simpang Wie, Langsa Timur, Selaparang. *Jurnal Pengabdian Masyarakat Berkemajuan.* 4 (2). 1 – 5. https://doi.org/10.31764/jpmb.v4i2.3340.

Nasution, D. A. D, Erlina, E., & Muda, I. (2020). Dampak pandemi COVID-19 terhadap perekonomian Indonesia. *Jurnal BENEFITA: Ekonomi Pembangunan, Manajemen Bisnis & Akuntansi*. 5 (2). 212 – 224. http://doi.org/10.22216/jbe.v5i2.5313.

Pujiarti, R., Amin, A., Ngadianto, A., Septiana, R. M., Purba, B. A. V., & Parmadi, D. B. (2021). Kualitas tiga jenis madu hutan suku baduy Kabupaten Lebak, Provinsi Banten. *Jurnal Ilmu Kehutanan.* 15 (2). 123 – 136. http://doi.org/10.22146/jik/v15i2.1529.

Saepudin, R., Sutriono., & Saputra, R. O. (2014). Kualitas madu yang beredar di Kota Bengkulu berdasarkan penilaian konsumen dan uji secara empiric. *Jurnal Sain Peternak Indonesia.* 9 (1). 30 – 40. http://doi.or/10.31186/jspi.id.9.1.30-40.

Saleem, T. S., Lokananth, N., Prasanthi, A., Madhavi, M., Mallika, G., & Vishnu, M. N. (2013). Aqueous extract of *Saussurea lappa* root ameliorate oxidative myocardial injury induced by isoproterenol in rats. *Journal of Advanced Pharmaceutical Technology & Research.* 4 (2). 94 – 100. http://doi.org/10.4130/2231-4040/111525.

Saputri, D. S., & Putri, Y. E. (2017). Aktivitas antioksidan madu hutan di beberapa kecamatan di Kabupaten Sumbawa Besar. *Jurnal Tambora.* 2 (3). 1 – 6. https://doi.org/10.36761/jt.v2i3.170.

Septiana, A. T., Triyanto., & Winarsa, H. 2019. Pengaruh penambahan ekstrak jahe dan ekstrak kencur terhadap sifat fisikokimia minuman temulawak instan dan sifat sensoris minuman seduhannya. *Jurnal Gipas.* 3 (2). 157 – 166.

Sihombing, D. R. (2021). Formulasi pembuatan minumann herbal dari

campuran sari jahe dan temulawak. *Jurnal Riset Teknologi Pangan dan Hasil Pertanian.* 1 (2). 69 – 75. https://doi.org/10.54367/retipa/v1i2.1211

Suhendy, H., Nurviana, V., Risviana, D., Mahendra, N. A., Nasir, A. S., Fitriani, I., Suarsih, A., Nurnanengsih, N., Sanusi, C. K., & Naser, F. M. (2021). Formulasi minuman herbal antioksidan jahe merah (*Zinger officinale Rosc. var. rubrum*). *Jurnal Ilmiah Farmasi Farmasyifa.* 4 (2). 79 – 86. https://doi.org/10.29313/jiff.v4i2.7617.

Tristantini, D., Ismawati, A., Pradana, B. T., & Jonathan, J. G. (2016). Pengujian aktivitas antioksidan menggunakan metode DPPH pada daun tanjong (*Mimusops elengi L*). Paper presented at Seminar Nasional Teknik Kimia "Kejuangan", Pengembangan Teknologi Kimia untuk Pengolahan Sumber Daya Alam Indonesia 2016. (pp. 1-7). Yogyakarta, Indonesia.