Majalah Obat Tradisional (Trad. Med. J.), October-December 2025
Vol. 30(3), p 307-314
ISSN-p : 1410-5918 ISSN-e : 2406-9086

Submitted : 27-08-2024
Revised : 26-03-2025
Accepted : 05-06-2025

Formulation of Instant Drink from (*Moringa oleifera* Lam.) and (*Heterotrigona itama*) using Foam Mat Drying Method

Desy Siska Anastasia[1*], Sri Luliana[1], Nabila Mayang Ningrum[1]
[1]Department of Pharmacy, Tanjungpura University, Pontianak, West Kalimantan, Indonesia

ABSTRACT

Moringa contains nutrients that benefit the food and health sectors. The part that has many benefits is the leaves. Moringa leaves contain the compound *quercetin* (flavonoid), which has antioxidant properties. Kelulut honey contains *protocatechuic acid* (PCA), which has potent antioxidant activity and OH groups to attract free radicals. The development of a functional drink from Moringa leaves and kelulut honey can be packaged more practically as an instant drink. This research aims to determine the physical characteristics, antioxidant activity, and panelists' preference level (hedonics) for instant drinks with variations of drying temperatures (50, 60, 70°C) and maltodextrin concentrations (15, 20, 30%). Instant drink uses the foam mat drying method with tween 80 as the foaming agent. The results showed that variations in temperature and concentration of maltodextrin influenced the physical characteristics of instant drinks with the best values for each test, which are water content (0.60%), flow time (1.68 g/sec), angle of repose (32°), tapping (6.08%), dissolution time in warm water (3.21 seconds). The best antioxidant activity value produced is 94.73% at 15% formula at 50°C temperature. The panelist's preference levels showed significant differences in smell, color, and taste, with the most preferred being the 15% formula.

Keywords: Instant drink; Kelulut honey; Moringa leaves

INTRODUCTION

Health awareness encourages using natural medicines, as proven by the many studies conducted on developing medicines from various plants (Kamoda et al., 2021). Used Moringa and honey are widely used in medicine. Moringa (*Moringa oleifera* Lam.) is known as *The Miracle Tree* because almost all its parts are medicinal, but the leaves are most widely used (Marhaeni, 2021). Moringa leaves contain *quercetin* compounds with 4-5 times higher antioxidant power than vitamins C and E (Jusnita and Syurya, 2019). Meanwhile, honey contains nutrients and compounds such as protein, amino acids, ascorbic acid, α-tocopherol, phenolic acid, and flavonoids that are effective antioxidants (Wulandari, 2017).

A study combined Moringa leaves and honey as a supplement for pregnant women. The results show a synergistic effect that can increase hemoglobin and prevent cell damage in mothers and babies (Hadju et al., 2020). One type of honey, kelulut honey (Heterotrigona items), is known to have potent antioxidant activity due to the presence of *protocatechuic acid* (PCA) compounds (Kakkar and Bais, 2014). In-vitro and in-vivo studies show that PCA provides a strong antioxidant effect in reducing free radicals (Semaming et al., 2015). The diversity of kelulut species in Indonesia is high enough to support the development of cultivation. Especially in Kalimantan, kelulut honey is one of the most famous honey from stingless bees (Evelin et al., 2021).

Moringa leaves have a strong smell and are generally processed by boiling, while kelulut honey has a sour taste and high water content (Purba, 2020), (Pribadi and Wiratmoko, 2023). Therefore, innovations in processing Moringa leaves and stingless bee honey can obtain functional drinks for public consumption. The combination of plants can provide a more effective antioxidant effect when formulated as an instant drink. Instant drinks are chosen for formulation due to their practicality in serving and storing for a long time due to their low water content (Maulina et al., 2013). In addition, this is an alternative to support the natural wealth of Moringa leaves and kelulut honey made as functional drink products.

The preparation of instant drinks use the foam mat drying method, which involves foaming agents such as tween 80, fillers, and foam stabilizers such as maltodextrin. The ingredients are mixed until the foam forms, then heated at 50-80°C (Ariska and Utomo, 2020). Drying temperature can affect the resulting instant drink, especially its physical characteristics and antioxidant activity. Too high a temperature

***Corresponding author: Desy Siska Anastasia**
Email: desysiska@pharm.untan.ac.id

causes some antioxidant compounds to break down (Kusuma et al., 2019). The choice of maltodextrin can accelerate drying and inhibit damage from heat treatment, but increasing concentrations can reduce antioxidant activity because total solids increase, resulting in lower antioxidant activity (Tazar et al., 2017).

MATERIALS AND METHODS

Materials

Ingredients: fresh Moringa leaves, kelulut honey, water, sugar, pH buffer solutions, maltodextrin food grade, methanol p.a. (Smartlab®), DPPH (Tokyo Chemical Industry Co.Ltd®), tween 80 (food grade).

Methods

Preparation of Moringa Leaves Juice

Moringa leaf juice preparation uses infundation. Fresh Moringa leaves weigh as much as 400 g. Put the washed leaves on a hotplate pot, then add the water ± 500 mL. The heating lasted 15 minutes, starting when the temperature reached 90°C and occasionally stirring. The results of the infundation were mashed using a blender, then filtered using a clean cloth to separate the infusa results (juice) with pulp.

Instant Drink Preparation

Instant drinks are produced using the foam mat drying method. All ingredients weigh in the amount specified in each formula. Moringa leaves juice was mixed with kelulut honey and tween 80 and then homogenized using a mixer. After the foam rose and stabilized, add the maltodextrin and homogenize again. After rising, pour the dough into a baking pan lined with paper. Drying using a food dehydrator for approximately 8 hours according to the set temperature. After the dough is dry, it is mixed with granulated sugar and mashed using a blender.

Table I. Instant Drink Formula

Materials	F I	F II	F III
Moringa juice (mL)	400	400	400
Kelulut honey (mL)	150	150	150
Tween 80 0.8% (mL)	4.4	4.4	4.4
Maltodextrin (g)	82.5	110	165
Add sugar (g)	100	100	100

Evaluation of Physical Characteristics

Organoleptic Test

Organoleptic tests are carried out by directly observing the instant drink's smell, color, and taste (Sudarsi et al., 2018)

Water Content Test

The test used a moisture balance for 3 minutes. Five g of instant drink was placed on the disk, leveled, and closed. The percent moisture content value will be indicated automatically (Rahmawati et al., 2022).

Particle Size Distribution Test

The test used several mesh sieves. A 100 g amount of instant drink was vibrated from the topmost sieve with a sieve shaker for 10 minutes. The weight left on each sieve was then weighed (Utami et al., 2022).

Flow Time Test

Put 100 g of instant drink into the funnel of the flow tester. Then, open the bottom cover of the funnel while turning on the stopwatch. Then, the time when the instant drink starts to flow until it runs out in the funnel is recorded (Voight, 1984).

$$\text{Flow time} = \frac{w\ (weight)}{t\ (speed)}$$

Angle of Repost Test

Put 100 g of instant drink into the funnel on the flow tester, and then the bottom cover of the funnel is opened until the instant drink can flow and form a pile. The height and radius of the instant drink pile were recorded (Nisfiyah et al., 2022).

$$\text{Tan } \alpha = \frac{h\ (height)}{r\ (radius)}$$

Compressibility Index Test

Tests were conducted on 50 g of instant drink put into a 100 ml measuring cup (V1), then compressed with a tapped density device from a height of 2.5 cm to a fixed or constant volume (V2) (Septianingrum et al., 2019).

$$T\% = \frac{Tapped\ Density - Bulk\ Density}{Tapped\ Density} \text{ x } 100\ \%$$

Solubility Time Test

Instant drink solubility was tested in hot water (60°) and plain water (27°C). Ten g of instant drink dissolved into 150 mL of each water. The time was calculated using a stopwatch and recorded from dissolving to complete dissolution (Rahmawati et al., 2022).

pH Test

Twenty g of instant drink was dissolved into 100 mL water. The pH meter was dipped into the instant drink solution. pH was measured until pH is constant (Departemen Kesehatan RI, 2014).

Antioxidant Activity Testing
Preparation of Sample Solution

Weigh accurately ±5 g of instant drink, then put it into a 50 mL volumetric flask and dissolved it with methanol (p.a.) until the limit mark (Adhayanti and Tahir, 2020).

Preparation of 40 Ppm DPPH Solution

Weigh accurately ±10 g of DPPH, then put into a 250 mL volumetric flask and dissolved with methanol (p.a.) until the limit mark (Adhayanti and Tahir, 2020). The solution was covered using aluminum foil to avoid light damage (Naila et al., 2023).

Determination of DPPH Maximum Wavelength

Two mL of 40 ppm DPPH solution was put in a 5 mL volumetric flask. The absorbance of the solution was measured using a UV-vis spectrophotometer at a wavelength of 400-800 nm (Iqbalunnajih et al., 2023).

Determination of Operating Time

Put 2 mL of 40 ppm DPPH solution into a 5 mL volumetric flask and add methanol (p.a.) until the limit mark. The solution was read for absorbance every 5 minutes using the wavelength obtained previously until the absorbance time stabilized (Iqbalunnajih et al., 2023).

Measurement of Absorbance of Sample Solution

Add 1 mL of sample solution with 4 mL of 40 ppm DPPH solution. The solution protects from light for 30 minutes. Then, the absorbance was measured using the wavelength obtained previously. The blank solution is from 4 mL of 40 ppm DPPH solution and 1 mL of methanol (p.a.) (Adhayanti and Tahir, 2020).

Hedonic Test

The test involved 20 panelists who responded to the smell, color, and taste of instant drinks brewed with water. The rating scale is in the form of a numerical scale, namely [1] immensely dislike, [2] dislike, [3] fair, [4] like, [5] very like (Nurlita and Anwarudin, 2019). This research has obtained ethical clearance No. 275/UN22.9/PG/2024.

Data Analysis

Data on physical characteristics are analyzed using SPSS software. Determination of antioxidant activity through absorbance data and then calculated the % inhibition value is:

$$\frac{Abs\ Blanko - Abs\ Sample}{Abs\ Blanko} \times 100\%.$$

The results of the hedonic test were analyzed using the score data provided by the panelists, and then the analysis used SPSS.

RESULTS
Organoleptic Test Instant Drink (Fiqure 1)
Test of Water Content, Particle Size Distribution, Flow Time, Angle of Repose, Compressibility Index (Table II)
Solubility Time and pH Test (Table III)
Antioxidant Activity Test (Table IV)
Hedonic Test (Table V)

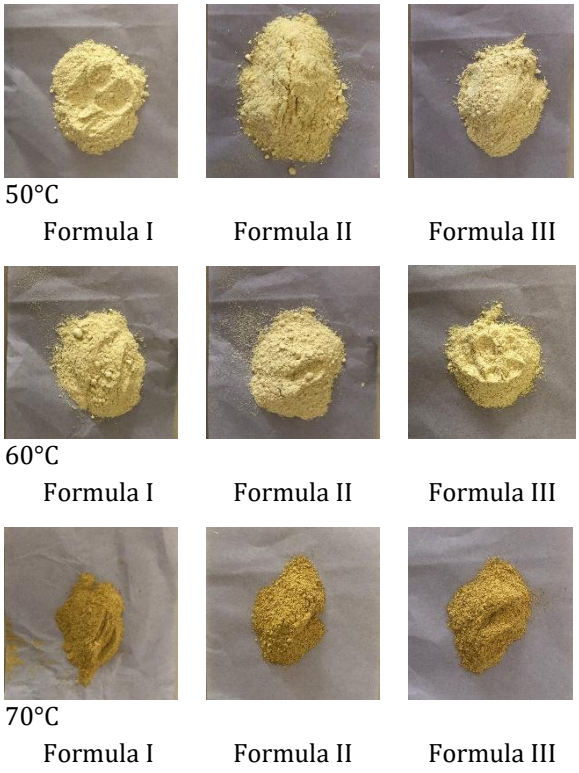

Figure.1 Instant Drink

DISCUSSION

Organoleptic Test

The instant drink dried at 50°C and 60°C produced an ivory white, while 70°C produced a darker brownish-yellow color due to higher heat treatment. The smell of the instant drink showed that the 15% formula at 50°C and 60°C gave a sour smell from kelulut honey, while the other instant drink dominantly had a languorous smell derived from Moringa leaves. The taste of 15% instant drink formula produced the sweetest taste due to adding more granulated sugar than the formula with 20% and 30% maltodextrin.

Table II. Result of Water Content, Particle Size Distribution, Flow Time, Angle of Repose, Compressibility Index

Temp.	Formula	Water Content (%)	Particle Distribution *Mesh* 60 (g)	Flow Time (second)	The angle of repose (°)	Compressibility Index (%)
50°C	15%	1.50 ± 0.26	20.80	3.48 ± 1.43	33.45 ± 3.65	11.73 ± 2.00
60°C	20%	1.45 ± 0.10	27.64	3.68 ± 0.41	37.59 ± 0.95	15.76 ± 1.78
70°C	30%	1.44 ± 0.14	27.19	3.73 ± 0.68	39.60 ± 3.08	16.36 ± 1.00
50°C	15%	1.06 ± 0.05	35.02	3.17 ± 0.36	33.36 ± 2.84	6.54 ± 3.30
60°C	20%	0.88 ± 0.21	31.95	3.46 ± 0.80	34.49 ± 3.73	13.62 ± 2.35
70°C	30%	0.79 ± 0.09	45.23	5.05 ± 0.48	37.17 ± 2.73	16.34 ± 2.05
50°C	15%	0.67 ± 0.05	31.43	1.68 ± 0.23	32.00 ± 0.88	6.08 ± 4.94
60°C	20%	0.61 ± 0.10	40.76	2.21 ± 0.43	33.75 ± 5.01	13.62 ± 2.35
70°C	30%	0.60 ± 0.10	41.67	3.19 ± 0.57	37.09 ± 1.47	14.20 ± 3.21

Table III. Result of Solubility Time and pH Test

Temp.	Formula	Solubility Time		pH
		Warm Water	Plain Water	
50°C	15%	4.27 ± 0.04	5.40 ± 0.07	5.30 ± 0.17
60°C	20%	3.26 ± 0.08	4.32 ± 0.12	5.18 ± 0.11
70°C	30%	2.18 ± 0.04	3.53 ± 0.06	5.09 ± 0.11
50°C	15%	4.23 ± 0.15	5.33 ± 0.03	5.31 ± 0.06
60°C	20%	3.24 ± 0.15	4.35 ± 0.20	5.21 ± 0.08
70°C	30%	2.90 ± 0.30	3.39 ± 0.12	5.16 ± 0.22
50°C	15%	4.15 ± 0.07	5.21 ± 0.09	5.31 ± 0.03
60°C	20%	3.35 ± 0.09	4.31 ± 0.13	5.30 ± 0.18
70°C	30%	2.73 ± 0.36	3.21 ± 0.03	5.17 ± 0.03

Water Content Test

The test results of each formula show results that meet the requirements of instant drink moisture content, which is > 3% (BSN, 1996). The 30% maltodextrin formula found the lowest water content at each temperature due to the significant content of maltodextrin, which is hygroscopic and binds free water in a material so that the higher addition can reduce the water content (Fiana et al., 2016). Instant drinks with a 15% formula produce the highest water content due to the lower maltodextrin content. The drying temperature can affect water content—reduction of water content through the evaporation process. When the drying occurs, water will evaporate, diffusing through the surface of the sample material into the air (Syafrida et al., 2018). The higher the drying temperature, the lower the water content. The higher temperature can increase the evaporation of water into the air current so that the humidity of the air will increase and the amount of liquid mass evaporated by the material (Yunianto, 2017).

Particle Size Distribution Test

The test results show almost the same value on each mesh. A suitable granule or instant drink size is on mesh 60 because the instant drink accommodated on the mesh has a size that is not too large or small. Particle size distribution can affect the flowability of a granule. The test results show that drying at 70°C passes through mesh 60 the most compared to temperatures of 50°C and 60°C. According to the water content test results on the 70% temperature formula, thus the instant drink has good flowability due to the low water content.

Flow Time Test

The test results show that the instant drink with the best average value of flow time is at 70°C drying and 15% formula. It is related to the value of water content in the instant drink. Instant drinks with 70°C drying contain the least amount of water. Thus, the instant drink has drier properties and flows easily or quickly. However, the test results of each formula state that the results still meet the requirements of instant drink flow time, which is ≤ 10 seconds or > 10 g/second (Voight, 1984).

Angle of Repose Test

The test results showed that the best temperature was 70°C and the best formula was

15%. The angle of repose value is directly proportional to the flow time. If the flow time is faster, the angle of repose is smaller (Rohmani and Rosyanti, 2019). Based on the data obtained, the effect of the higher temperature is the smaller the angle of repose produced. The same thing also applies to the results of the flow time test, namely the temperature and formula with the best flow rate, making a smaller angle of repose value.

Table IV. Result of Antioxidant Activity Test

Temp.	Formula	% Inhibition
50°C	15%	94.7324
60°C	20%	79.9659
70°C	30%	78.0349
50°C	15%	73.2074
60°C	20%	61.3856
70°C	30%	62.3369
50°C	15%	45.9802
60°C	20%	41.2947
70°C	30%	55.7426

Table V. Hedonic Test Result of 20 Panelists

Formula	Total Score
15% (A)	253
20% (B)	200
30% (C)	211

Compressibility Index Test

The results of the compressibility index test showed the requirements of a good compressibility index value of > 20% (Akbar and Febriani, 2019). The results at 70°C and 15% formula gave the best compressibility index value. Several factors, such as shape and friability, influence the compressibility index. Due to the higher maltodextrin content, the 30% formula produced a more excellent impermeability value than the 15% and 20% formulas. Maltodextrin has a density of 1.419 g/cm3. A large density will have a more considerable molecular weight, making it easier to flow due to the greater gravitational force (Luliana et al., 2023).

Solubility Time Test

The test results show that the 30% formula in each temperature tends to dissolve faster, both with warm water (60°C) and plain water (27°C). The higher addition of maltodextrin can accelerate the dissolving time of the instant drink. In addition, the higher the water content in the instant drink, the longer it takes to dissolve. Increased water content can form bonds that cause clumps, so breaking the bonds between particles takes a long time (Permata and Kusuma 2016). The time required for an instant drink to dissolve is less than 5 minutes (Ningrum et al., 2021). Based on the test results, the instant drink dissolved more quickly in warm water than in plain water due to temperature and solubility, which are directly proportional, so higher temperatures can accelerate the time a substance dissolves.

pH Test

The pH test results obtained in each formula meet the range of pH test requirements, around 5-7 (Nafilah and Zuniarto, 2022). Based on the data obtained, a higher concentration of maltodextrin can reduce the pH value cause maltodextrin has a lower pH (around 4-7). The low pH value is likely caused by maltodextrin still having acid residues obtained during manufacture. The higher the acid, the higher the H^+ ions released, so the pH becomes lower (Yuliawaty and Susanto, 2015).

Antioxidant Activity Test

The maximum wavelength of DPPH using a UV-vis spectrophotometer is 514 nm. Determination of the maximum wavelength aims to make the absorbance of the sample at the maximum wavelength so that maximum results are obtained (Anngela et al., 2021). Then, the sample was mixed with DPPH solution and incubated for about 30 minutes in a container protected from light. After incubation, the sample reacted with DPPH perfectly. In addition, the incubation process makes the sample more stable and has a more significant decrease in absorbance than samples that are not incubated (Abdullah et al., 2020). After the incubation, the mixture of the sample and DPPH solution changed from dark purple to yellow. It indicates that the sample has antioxidant activity by reducing DPPH radicals.

DPPH has unpaired electrons (radicals), so a reaction can occur between the two when mixed with substrates containing hydrogen atoms. The substrate can donate hydrogen atoms to DPPH so that a reduced form appears with the loss of purple color in the solution. The solution loses color in proportion to the increasing concentration of antioxidants as DPPH captures antioxidant electrons. The higher the antioxidant content, the purple color in the DPPH solution will decrease, and a yellow solution formed (Molyneux, 2003).

Based on the tests, the higher the drying temperature, the lower the antioxidant activity. Due to the higher temperature, secondary metabolite compounds that act as antioxidants (flavonoids) are damaged (Dewi et al., 2016).

Based on the study's results, the 15% formula with a temperature of 50°C has the best antioxidant activity value, which amounted to 94.73%. 50°C is the lowest treatment temperature, and 15% maltodextrin formula is the least amount. Increased use of maltodextrin can reduce antioxidant activity. Maltodextrin is an incomplete starch hydrolysis compound that contains reducing sugars. Reducing sugars have hydroxyl (OH) groups that can act to attract antioxidant compounds. The more bioactive compounds coated by maltodextrin cause not all bioactive components to function when reacted with DPPH. The hydrogen atoms in the coated antioxidants cannot respond to DPPH, so the activity of counteracting free radicals decreases (Kusuma et al., 2023).

Hedonic Test

The hedonic test of 20 panelists gave the highest result in the 15% formula with a total score of 253, and the lowest was in the 20% formula. Thus, panelists preferred the instant drink with less maltodextrin content at 15% due to adding more granulated sugar, giving a better taste. The level of liking of panelists in the three formulas showed significant differences in smell, color, and taste.

CONCLUSION

This study concludes that temperature and maltodextrin concentration variations produce instant drinks with physical characteristics that meet the test requirements, with significant differences in the angle of repose, fixation, and dissolution time tests and good antioxidant activity values. The concentration of maltodextrin influenced the level of panelist acceptance of color, aroma, and taste. Formula preferred by panelists is the formula with the lowest maltodextrin concentration (15%) with the addition of the most sweetener (granulated sugar).

ACKNOWLEDGEMENT

The authors would like to thank all parties who have helped during the research process.

CONFLICT OF INTEREST

The authors declare no conflict of interest to any party in this research.

REFERENCES

Abdullah, Magfirah, Fitriana, And St. Maryam. 2020. "Uji Aktivitas Antioksidan Isolat Fungi Endofit Daun Galing-Galing (Cayratia Trifolia L.) Dengan Metode 1,1-Diphenyl-2-Picrylhydrazil (Dpph)." *As-Syifaa Jurnal Farmasi* 12(2): 117–22. Http://Journal.Um-Surabaya.Ac.Id/Index.Php/Jkm/Article/View/2203.

Adhayanti, Idha, And Tahir Ahmad. 2020. "Karakter Mutu Fisik Dan Kimia Serbuk Minuman Instan Kulit Buah Naga Yang Diproduksi Dengan Metode Pengeringan Yang Berbeda." *Media Farmasi* 16(1): 57–64.

Akbar, Aris Khairul, And Alik Kandhita Febriani. 2019. "Uji Kompresibilitas Granul Pati Bengkoang Dengan Metode Granulasi Basah." *Jurnal Ilmiah Jophus : Journal Of Pharmacy Umus* 1(1): 7–11.

Anngela, Oppie, Afidatul Muadifah, And Dhanang Prawira Nugraha. 2021. "Validasi Metode Penetapan Kadar Boraks Pada Kerupuk Puli Menggunakan Spektrofotometer Uv-Vis." *Jurnal Sains Dan Kesehatan* 3(4): 375–81.

Ariska, Septiani Budi, And Deny Utomo. 2020. "Kualitas Minuman Serbuk Instan Sereh (Cymbopogon Citratus) Dengan Metode Foam Mat Drying." *Teknologi Pangan : Media Informasi Dan Komunikasi Ilmiah Teknologi Pertanian* 11(1): 42–51.

Bsn. 1996. *Serbuk Minuman Tradisional Sni 01-4320-1996.* Badan Standarisasi Nasional.

Depkes, R.I. 2014. *Farmakope Indonesia (V)*. Departemen Kesehatan Republik Indonesia.

Dewi, Ni Luh Putu Diyan Utami, Luh Putu Wrasiati, And Dewa Ayu Anom Yuarini. 2016. "Pengaruh Suhu Dan Lama Penyangraian Dengan Oven Drier Terhadap Karakteristik Teh Beras Merah Jatiluwih." *Jurnal Rekayasa Dan Manajemen Agroindustri* 4(2): 1–12.

Evelin, Okta, Febri Prima, And Ivan Sujana. 2021. "Strategi Pemasaran Madu Kelulut Dalam Rangka Mendukung Produk Unggulan Khas Kalimantan Barat Menggunakan Analisis Swot Dan Qspm." *Jurnal Tin Universitas Tanjungpura* 5(1): 45–52. Https://Jurnal.Untan.Ac.Id/Index.Php/Jtinuntan/Article/View/47523.

Fiana, Risa Meutia, Wenny Surya Murtius, And Alfi Asben. 2016. "Pengaruh Konsentrasi Maltodekstrin Terhadap Mutu Minuman Instan Dari Teh Kombucha." *Jurnal Teknologi Pertanian Andalas* 20(2): 1–8.

Hadju, Veni Et Al. 2020. "Effects Of Moringa Oleifera Leaves And Honey Supplementation During Pregnancy On Mothers And Newborns: A Review Of The Current Evidence." *Open Access Macedonian Journal Of Medical Sciences* 8: 208–14.

Iqbalunnajih, Muhammad, Muhammad Alfian, And

Listiana Hidayati. 2023. "Uji Aktivitas Antioksidan Pada Minuman Serbuk Instan Kunir Asam (Curcuma Domestika Val.- Tamarindus Indica L.) Produksi Umkm 'Mitra Sehat' Desa Wisata Jamu Kiringan Bantul Dengan Metode Dpph." *Farmasi Dan Herbal* 5(2): 13–19.

Jusnita, Nina, And Wan Syurya. 2019. "Karakterisasi Nanoemulsi Ekstrak Daun Kelor (Moringa Oleifera Lamk.) (Characterization Of Nanoemulsion From Moringa Oleifera' Extract) Nina Jusnita*, & Wan Syurya Fakultas Farmasi Universitas 17 Agustus 1945 Jakarta, Jl Sunter Permai Raya, Jakarta 14350,." *Jurnal Sains Farmasi & Klinis* 6(1): 16–24.

Kakkar, Sahil, And Souravh Bais. 2014. "A Review On Protocatechuic Acid And Its Pharmacological Potential." *Isrn Pharmacology* 2014: 1–9.

Kamoda, Anugrah P M D Et Al. 2021. "Uji Aktivitas Antioksidan Alga Cokelat Saragassum Sp. Dengan Metode 1,1- Difenil-2-Pikrihidrasil (Dpph)." *Pameri: Pattimura Medical Review* 3(1): 60–62.

Kusuma, Birgitta Artadila, Erni Setijawaty, And Rachel Meiliawati Yosha Ignasius Radix Astadi Praptono Jati. 2023. "Pengaruh Perbedaan Konsentrasi Maltodekstrin Dan Na-Cmc Terhadap Sifat Fisikokimia Bubuk Buah Semangka Merah." *Teknologi Pangan* 14(1): 59–77.

Kusuma, I Gusti Ngurah Sujana, I Nengah Kencana Putra, And Luh Putu Trisna Darmayanti. 2019. "Pengaruh Suhu Pengeringan Terhadap Aktivitas Antioksidan Teh Herbal Kulit Kakao (Theobroma Cacao L.)." *Jurnal Ilmu Dan Teknologi Pangan* 8(1): 85–93.

Luliana, S., Amalia, S. Dan Isnandar, I. 2023. "Formulasi Serbuk Instan Ekstrak Pegagan (Centella Asiatica) Dan Jahe Merah (Zingiber Officinale Roscoe Var. Rubrum)." *Journal Syifa Sciences And Clinical Research* 5(3): 372–81.

Marhaeni, Luluk Sutji. 2021. "Daun Kelor (Moringa Oleifera) Sebagai Sumber Pangan Fungsional Dan Antioksidan." *Agrisia* 13(2): 40–53.

Maulina, Cynthia Anggi, Ahdayani Rosarrah, And Mohammad Djaeni. 2013. "Aplikasi Spray Dryer Untuk Pengeringan Larutan Garam Amonium Perklorat Sebagai Bahan Propelan." *Jurnal Teknologi Kimia Dan Industri* 2(4): 84–92.

Molyneux P. 2003. "The Use Of The Stable Free Radical Diphenylpicryl-Hydrazyl (Dpph) For Estimating Antioxidant Activity." *Songklanakarin Journal Of Science And Technology* 26(2): 211–19.

Nafilah, Nella, And Ahmad Azrul Zuniarto. 2022. "Uji Efektivitas Sedatif Serbuk Instan Ekstrak Kering Daun Putri Malu (Mimosa Pudica Linn) Pada Mencit Putih Jantan." *Praeparandi* 5(2): 112–20.

Naila Imroatus Sholikhah, Muhammad Alfian, And Fitri Andriani Fatimah. 2023. "Uji Aktivitas Antioksidan Minuman Serbuk Instan Temulawak (Curcuma Xanthorriza Roxb) Produksi Mitra Sehat Kiringan Bantul." *Jurnal Kefarmasian Akfarindo* 8(1): 50–55.

Ningrum, Meilina Purnama, Juniza Firdha Suparningtyas, And Niken Indriyanti. 2021. "Aktivitas Antioksidan Pada Formulasi Minuman Serbuk Instan Dari Sari Daun Suruhan (Peperomia Pellucida)." *Proceeding Of Mulawarman Pharmaceuticals Conferences* 14: 117–24.

Nisfiyah, Isna Lailatul, Isnindar, And Rise Desnita. 2022. "Formulasi Minuman Serbuk Instan Kombinasi Jahe (Zingiber Officinale Rosc) Dan Kunyit (Curcuma Domestica Val.) Dengan Variasi Gula Pasir Dan Gula Merah." *Jurnal Mahasiswa Farmasi Fakultas Kedokteran Untan* 6(1): 1–9.

Nurlita, Yuli, And Wawang Anwarudin. 2019. "Formulasi Sediaan Permen Antioksidan Dari Ekstrak Kulit Manggis (Garcinia Mangostana L.) Dan Susu Sapi." *Herbapharma : Journal Of Herbs And Pharmacological* 1(6): 1–6. Http://Ojs.Stikes-Muhammadiyahku.Ac.Id/Index.Php/Herbapharma/Article/View/90.

Permata, D. A Dan Kusuma, S. 2016. "Pembuatan Minuman Serbuk Instan Dari Berbagai Bagian Tanaman Meniran (Phyllanthus Niruri)." *Jurnal Teknologi Pertanian Andalas* 20(1): 44–49. Tpa.Fateta.Unand.Ac.Id/Index.Php/Jtpa/Article/Download/31/Pdf_12.

Pribadi, Avry, And Michael Daru Enggar Wiratmoko. 2023. "Karakteristik Fisikokimia Madu Heterotrigona Itama Asal Provinsi Riau." *Wahana Forestra: Jurnal Kehutanan* 18(2): 13–28.

Purba, Endang Christine. 2020. "Kelor (Moringa Oleifera Lam.): Pemanfaatan Dan Bioaktivitas." *Jurnal Pro-Life* 7(1): 1–12.

Rahmawati, Azizzah Dwi Et Al. 2022. "Formulation Of Instant Granule Containing Meniran, Turmeric, And Moringa Leaf Extracts With Maltodextrin And Lactose As Diluents." *Medical Sains : Jurnal Ilmiah Kefarmasian* 7(3): 621–34.

Rohmani, Sholichah, And Hilda Rosyanti. 2019. "Perbedaan Metode Penambahan Bahan Penghancur Secara Intragranular-Ekstragranular Terhadap Sifat Fisik Serta Profil Disolusi Tablet Ibuprofen." *Jpscr : Journal Of Pharmaceutical Science And Clinical Research* 4(2): 95–108.

Semaming, Yoswaris, Patchareewan Pannengpetch, Siriporn C. Chattipakorn, And Nipon Chattipakorn. 2015. "Pharmacological Properties Of Protocatechuic Acid And Its Potential Roles As Complementary Medicine." *Evidence-Based Complementary And Alternative Medicine* 2015: 1–111.

Septianingrum, Made Ayu Nila, Widarika Santi Hapsari, And Muhammad Khoirul Amin. 2019. "Formulasi Dan Uji Sediaan Serbuk Effervescent Ekstrak Okra (Abelmoschus Esculentus) Sebagai Nutridrink Pada Penderita Diabetes." *Journal Media Farmasi* 16(1): 11–20.

Sudarsi, Yulisma, And Musyirna Rahmah Nst. 2018. "Uji Aktivitas Antioksidan Dan Sifat Organoleptik Teh Herbal Campuran Daging Buah Pare (Momordica Charantia L.) Dan Kulit Buah Naga Merah (Hylocereus Lemairei (Hook.) Britton & Rose)." *Photon: Jurnal Sain Dan Kesehatan* 8(2): 59–66.

Syafrida, Mulia, Sri Darmanti, And Munifatul Izzati. 2018. "Pengaruh Suhu Pengeringan Terhadap Kadar Air, Kadar Flavonoid Dan Aktivitas Antioksidan Daun Dan Umbi Rumput Teki (Cyperus Rotundus L.)." *Bioma : Berkala Ilmiah Biologi* 20(1): 44–50.

Tazar, Nurzarrah, Fidela Violalita, Mimi Harmi, And Khandra Fahmy. 2017. "Pengaruh
Perbedaan Jenis Dan Konsentrasi Bahan Pengisi Terhadap Karakteristik Pewarna Buah Senduduk." *Jurnal Teknologi Pertanian Andalas* 21(2): 117–21.

Utami, Sheila Meitania, Nurwulan Adi Ismaya, Tri Okta Ratnaningtyas, and Nanang Yunarto. 2022. "Formulasi Sediaan Minuman Serbuk Fungsional Kombinasi Biji Jagung (Zea Mays L.) Dan Madu." *Jurnal Kefarmasian Indonesia* 12(2): 109–17.

Voight, R. 1984. *Buku Pelajaran Teknologi Farmasi (N. S. Soendani (Ed.); V)*. UGM Press.

Wulandari, Devyana Dyah. 2017. "Kualitas Madu (Keasaman, Kadar Air, Dan Kadar Gula Pereduksi) Berdasarkan Perbedaan Suhu Penyimpanan." *Jurnal Kimia Riset* 2(1): 16–22.

Yuliawaty, Siska Tresna, and Wahono Hadi Susanto. 2015. "Pengaruh Lama Pengeringan Dan Konsentrasi Maltodekstrin Terhadap Karakteristik Fisika Kimia Dan Organoleptik Minuman Instan Daun Mengkudu (Morinda Citrifolia L)." *Jurnal Pangan dan Agroindustri* 3(1): 41–52.

Yunianto, Bambang. 2017. "Pengaruh Debit Air Semburan Terhadap Efektivitas Dirrect Evaporative Cooling Posisi Horizontal." *Jurnal Teknik Mesin* 19(1): 12–17.