Jurnal Jamu Kusuma
Vol. 4, No 2, Desember 2024, pp. 75-85
ISSN : 2798-0332 (print)
ISSN : 2798-558X (online)

EVALUATION OF THE PHYSICAL, PHYTOCHEMICAL, AND HEDONIC QUALITY OF HERBAL POWDERED BEVERAGES COMBINING ELEPHANT GINGER (*Zingiber officinale* Roscoe), GARLIC (*Allium sativum* L.), AND CITRONELLA (*Cymbopogon nardus* L. Rendle)

Nur Atikah [1)*], Septiana Laksmi Ramayani [1)], Melinda Eka Pratiwi [1)]
[1] Departement of Pharmacy, Ministry of Health Polytechnic of Surakarta, Klaten, Central Java, Indonesia
[*]e-mail: ika.nuratikah01@gmail.com

ABSTRACT

Hypertension can be managed using traditional medicinal plants such as elephant ginger, garlic, and citronella, which can be processed into instant powdered beverage formulations. This study evaluates the physical quality, phytochemical properties, and hedonic characteristics of powdered formulations combining these three ingredients. The study employed an observational method. Instant powdered formulations were prepared using the crystallization method, with three variations of white sugar to palm sugar ratios: 2:0 (F1), 1.5:0.5 (F2), and 1:1 (F3). A univariate analysis was conducted to evaluate the physical qualities of the powders, including organoleptic properties, pH, moisture content, tapping density, angle of repose, and dissolution time, as well as to report the results of phytochemical screening and hedonic evaluation (taste, aroma, and color). The results revealed variations in the physical properties of the three formulations. The pH values were 5.91, 5.90, and 5.74 for F1, F2, and F3, respectively. Moisture content was recorded at 1%, 1.33%, and 3.33%, while tapping density was 8.33%, 11%, and 11.33%. Flow times were 10.57 seconds, 10.68 seconds, and 11.34 seconds, while the angles of repose were measured at 32.37°, 26.47°, and 37.81°. Dissolution times were recorded as 15.3 seconds, 17.17 seconds, and 18.15 seconds. Formula 1 (F1) demonstrated the best physical quality based on established standards among the formulations. Phytochemical screening for all three formulations (F1–F3) indicated the presence of flavonoids and saponins, while tests for alkaloids and terpenoids yielded negative results. The hedonic evaluation, conducted using F1 due to its superior physical quality, showed that out of 31 respondents, 17 rated it as "like," 8 as "neutral," and 6 as "very like." In conclusion, although the flow time parameter did not meet the standard requirement, F1 exhibited the best physical quality, contained beneficial phytochemicals (flavonoids and saponins), and was well-received by the majority of respondents in terms of taste, aroma, and color.

Keywords: herbal powdered beverages, physical test, phytochemical test, hedonic test.

INTRODUCTION

Hypertensive patients who neglect their condition and fail to seek timely treatment are at risk of serious complications, including death. The mortality rate in Indonesia is notably high, with 427,218 deaths attributed to hypertension (Riskesdas, 2018). The treatment of hypertension can be carried out through therapy using traditional ingredients.

The people of Bima, West Nusa Tenggara, often use plants such as ginger, garlic, and citronella, as they are believed to reduce blood pressure in cases of hypertension. Elephant ginger (*Zingiber officinale* Roscoe) remains a suitable choice for individuals who prefer a

milder flavor while gaining cardiovascular benefits compared to other ginger species. This practice is supported by a study conducted by Laila et al. (2020), which demonstrated that consuming ginger and garlic decoctions can lower hypertension. Consumption of ginger and garlic was reduced systolic blood pressure by 28.4 mmHg, while diastolic blood pressure decreased by 5.8 mmHg. This reduction in blood pressure is attributed to the flavonoid content, which has an inhibitory effect on angiotensin-converting enzyme (ACE) activity. The inhibition of ACE activity prevents the formation of angiotensin II from angiotensin I, leading to vasodilation, reduced cardiac output, and ultimately a decrease in blood pressure (Wang et al., 2017). The volatile oil compounds in garlic, particularly sulfur-containing allicin, play a role in thinning the blood and regulating blood pressure, thereby improving circulation (Laila & Tiolina, 2020).

Another traditional plant, such as lemongrass, can also lower hypertension through the use of its decoction. According to a study by Sutik and Pangestuti (2022), the high polyphenol and potassium content in lemongrass can reduce hypertension. The study showed a reduction in systolic blood pressure by 13.28 mmHg, while diastolic blood pressure decreased by 7.34 mmHg. Research on the processing of these plants has so far only resulted in infusion preparations, which have the drawback of being less convenient for travel and unsuitable for long-term storage (Dewi & Farida, 2021). This limitation has led to the innovation of a new product: instant powdered formulations.

Beverages in the form of instant powdered formulations are known to have several advantages, such as long shelf life and ease of preparation. Instant powder is produced through a crystallization process using sucrose as the primary crystallizing agent (Nisfiyah & Desnita, 2021). White sugar contains 99.95% sucrose, while palm sugar contains 85.27% sucrose. White sugar is crystallized from sugarcane juice, characterized by its white color, hard and fine granules, and low moisture content (Firdausni et al., 2017). Palm sugar is produced by concentrating coconut and palm sap through heating until it thickens (Hasan et al., 2020). The difference in sucrose concentration affects the heating process, with palm sugar requiring longer heating due to its lower sucrose concentration and higher moisture content compared to white sugar (Firdausni et al., 2017).

To date, the optimal formulation for producing instant powdered functional beverages combining elephant ginger, garlic, and citronella has not been identified. Therefore, this study aims to evaluate the physical quality, phytochemical properties, and hedonic characteristics of powdered formulations combining these three ingredients.

METHODS

This study is an observational laboratory-based study. The equipment used includes a moisture balance (Ohaus MB3®), flow tester (Intralab®), tapped density tester (TDT-100®), pH meter (Hanna®), stopwatch (Casio®), blender, 80-mesh sieve, 100 mL graduated cylinder, test tubes, stove, non-stick pan, knife, filter cloth, and wooden spoon. The materials used for formulation are distilled water, 900 g of elephant ginger, 300 g of garlic, 300 g of citronella, 1,500 mL of distilled water, 375 g of palm sugar, and 1,125 g of white sugar. Phytochemical test used Mg. powder, 2N HCl, Mayer's reagent, Wagner's reagent, Dragendorff's reagent, H_2SO_4, and chloroform.

The elephant ginger, garlic, and citronella plants were sourced from Tawangmangu, Karanganyar. The selection process for high-quality elephant ginger included criteria such as fresh rhizomes, harvested at 6-7 months after planting, and grown in regions with temperatures between 20-30°C (Triyono & Sumarmi, 2018). The second material, garlic, was selected by choosing firm bulbs, grown in high-altitude areas with temperatures between 15-25°C, and with a harvest period of approximately 120-140 days (Titisari et al., 2019). In addition to the selection of elephant ginger and garlic, citronella was chosen based on its

large stems and its growth in areas with temperatures ranging from 15-25°C (Kusumayadi et al., 2013). The formulation of the instant powder used in this study is presented in Table 1.

Plant identification was conducted at the Integrated Laboratory of Setia Budi University, Surakarta. The identification results, documented in letter No. 106/DET/UPT-LAB/10.03.2024, confirmed that the elephant ginger sample used is *Zingiber officinale* Roxb. Additionally, letter No. 107/DET/UPT-LAB/12.03.2024 verified that the garlic sample used is *Allium sativum* L., and letter No. 108/DET/UPT-LAB/12.03.2024 confirmed that the citronella sample used is *Cymbopogon nardus* (L.) Rendle.

Table 1. Formulation of Instant Powdered Beverage Combining Elephant Ginger, Garlic, and Citronella

Materials	**Formula**			**Function**
	Formula I	**Formula II**	**Formula III**	
Elephant ginger	300 g	300 g	300 g	Active substance
Garlic	100 g	100 g	100 g	Active substance
Citronella	100 g	100 g	100 g	Active substance
Sugar	500 g	375 g	250 g	Sweeteners and crystallizers
Palm sugar	–	125 g	250 g	Sweeteners and crystallizers
Water	500 mL	500 mL	500 mL	Solvent

The beverage extract was prepared using a blender. The process began by sorting the elephant ginger, garlic, and citronella, followed by cleaning to remove any adhering dirt and peeling their skins. The cleaned elephant ginger, garlic, and citronella were then weighed and blended into a fine paste. The paste was then filtered using a cloth, and the filtrate was collected. The filtrate was left to stand for 30 minutes. After standing, the filtrate was heated over medium heat for 15 minutes. Once the filtrate had reduced, white sugar was added to the first formula, while both white sugar and palm sugar were added to the second and third formulas. After the sugar was added, the mixture was continuously stirred over low heat until a crystalline mass formed. The heat was then turned off, and the crystalline mass was allowed to cool to room temperature for approximately 20 minutes. Finally, the mixture was sieved using an 80-mesh sieve to obtain a fine and homogeneous powder.

All physical quality tests were replicated three times. Organoleptic testing, which involves sensory evaluation using sight, touch, smell, and taste, was conducted in three replicates by three different individuals (Suryono et al., 2018). The pH test was performed by dissolving 10 g of the instant powdered functional beverage in 50 ml of distilled water, followed by pH measurement using a pH meter. An acceptable pH value ranges from 5 to 7 (Nafilah & Zuniarto, 2022). The acidity testing was also conducted in three replicates. The moisture content test was carried out by weighing 2 g of the instant powder and placing it into a moisture balance. The device automatically operated until the final result was obtained. This test was also performed in three replicates to ensure accuracy. The maximum allowable moisture content for instant powder is 10% (BPOM, 2023).

The tapping test for the instant powdered beverage was conducted by placing the powder into a 100 ml graduated cylinder up to the marked line. The initial volume in the graduated cylinder was recorded as V0. The cylinder was then placed in the tapping apparatus, which was operated until a constant powder volume was achieved. This constant volume was recorded as Vk. The tapping index was calculated using the following equation, and an acceptable tapping index is less than 20%.

$$\text{Tapping index (\%)} = \frac{V_0 - V_k}{V_0} \text{ x } 100\%$$

Information:
V_0 : measuring cup volume; V_k : constant powder volume (volume after tapping)

The flow time test was conducted by weighing 100 g of instant powder and placing it into a funnel with its lower opening initially closed. The time required for the powder to flow out through the flow tester was recorded. The powder meets the requirements if it flows in 10 seconds or less (Nisfiyah & Desnita, 2021). The angle of repose test involved weighing 100 g of powder and placing it into a flow tester with its lower opening closed. The opening was then released, allowing the powder to flow and form a cone. The height (h) and base radius (r) of the cone were measured. This procedure was repeated three times to obtain an average result. An acceptable angle of repose is between 25° and 45°. The angle of repose can be calculated using the following equation:

$$tan\ \alpha\ = \frac{n}{r}$$

Information: α : the angle of repose; h : height; r : radius

The method for conducting the dissolution time test involves weighing 5 g of instant powder and dissolving it in 100 mL of water. The time required for the powder to dissolve in a beaker glass is recorded. This procedure is repeated three times to obtain an average result. The instant powder meets the criteria if it dissolves in less than 5 minutes (Siregar & Wikarsa, 2010).

The alkaloid test is performed by adding 2 mL of the test solution to a test tube, followed by 2 mL of 2 N HCl. Three test tubes are prepared, and 1 mL of filtrate is added to each. Mayer's reagent is added to the first tube, Wagner's reagent to the second, and Dragendorff's reagent to the third. A positive result is indicated by a white precipitate in the first tube, a brown precipitate in the second, and an orange precipitate in the third. For the flavonoid test, 1 mL of the test solution is added to a test tube, along with 1 g of Magnesium powder and 1 mL of concentrated HCl. A positive result is indicated by a color change to yellow. In the saponin test, 2 mL of the test solution is placed into a test tube, with the addition of 10 ml of water. The mixture is shaken for 10 minutes. The presence of saponins is indicated by foam or bubbles that persist for 10 minutes (Suryono et al., 2018).

The terpenoid test involves adding 1 ml of the test solution to a test tube, along with 2 mL of Chloroform and 3 mL of H_2SO_4. A positive result is indicated by the formation of a reddish-brown ring (Suryono et al., 2018). The hedonic test is conducted by 30 untrained panelists (general public) to assess preferences for color, aroma, and taste. This study utilized a 5-point hedonic scale as well as a numerical scale for respondents to provide their evaluations (Adi et al., 2022). The levels of the hedonic scale are detailed in Table 2.

Table 2. Hedonic Scales and Numerical Scales in Testing

Hedonic scales	**Numeric scales**
Very like	5
Like	4
Neutral	3
Don’t like	2
Very don’t like	1

Data analysis in this study uses univariate analysis. Results are presented in tables and narrative form based on average values. These averages are derived from organoleptic tests, pH tests, moisture content tests, tapping tests, flow time tests, and angle of repose tests, which will be compiled into tables and subsequently described in the narrative.

RESULT AND DISCUSSION

The production of the powdered beverage involved stirring the filtrate and sugar mixture until crystals formed. The heating times for the filtrate varied for each formula. Formula I required 30 minutes of heating to form crystals. Formula II needed 1 hour and 23 minutes, while Formula III required 1 hour and 58 minutes to produce crystals.

The results obtained from the production of instant powdered combinations of elephant ginger, garlic, and citronella showed differences in the time required to form the crystalline mass. This variation is influenced by the use of palm sugar in Formulas II and III. The crystallization process of palm sugar in Formulas II and III differed from that of white sugar in Formula I, as palm sugar has a lower sucrose concentration and a higher moisture content compared to white sugar (Firdausni et al., 2017).

The yields from the production of instant powders combining elephant ginger, garlic, and citronella were as follows: Formula I produced 460 g, Formula II yielded 470 g, and Formula III resulted in the lowest yield of 445 g. The lower yield in Formula III is attributed to the sticky nature of palm sugar on the surface of the pan. The stickiness and tendency of palm sugar to clump can cause difficulties in producing fine and uniform particles. These larger and non-uniform particles affect the final volume of the powdered product. The results of the production of instant powdered functional beverage formulations combining elephant ginger, garlic, and citronella are presented in Figure 1.

FI FII FIII

Figure 1. Instant Powdered Beverage Formulation Combining Elephant Ginger, Garlic, and Citronella

Information: FI : Sugar (2) : Palm sugar (0)
FII : Sugar (1,5) : Palm sugar (0,5)
FIII : Sugar (1) : Palm sugar (1)

The instant powdered functional beverage formulation combining elephant ginger, garlic, and citronella was subsequently subjected to physical quality tests, including organoleptic testing, pH testing, moisture content testing, tapping testing, flow time testing, and angle of repose testing. These tests were conducted to determine the differences in physical quality among Formulas I, II, and III.

Table 3. Average Results of Physical Quality Testing for Instant Powdered Functional Beverage Combining Elephant Ginger, Garlic, and Citronella

Parameters	Formula			
	Formula I	**Formula II**	**Formula III**	**Standard**
Organoleptic:				
Taste	Sweet, a little spicy	Sweet, a little spicy	Sweeter, a little spicy	-
Aroma	Aroma of garlic	Aroma of garlic	Aroma of garlic	
Color	Light yellow	Brownish yellow	Brown	
pH	5.91	5.9	5.74	5-7 (Nafilah & Zuniarto, 2022)
Water content (%)	1	1,33	3,33	No more than

				10% (BPOM, 2023)
Tapping (%)	8.33	11	11,33	Less than 20% (Anastasia et al., 2022)
Flow time (second)	10.57	10.68	11.34	No more than 10 second
The angle of repose (^{o})	32.37	36.47	37.81	25-45^o (Nafilah & Zuniarto, 2022)
Dissolution time (second)	15.30	17.17	18.15	

The organoleptic test includes the evaluation of taste, aroma, and color of the instant powder. The results of the organoleptic evaluation revealed that Formulas I and II had a sweet and slightly spicy taste, while Formula III was sweeter and also slightly spicy. The taste variations among the three formulas are attributed to the different ingredients used. Formula III tasted sweeter due to the inclusion of palm sugar. Research indicates that palm sugar, which contains various types of sugars such as sucrose, fructose, glucose, and maltose, imparts a sweeter taste compared to granulated sugar, which consists solely of sucrose (Nisfiyah & Desnita, 2021). The spiciness in the instant powder is attributed to the use of elephant ginger, which contains gingerol, the primary compound responsible for the spicy flavor, along with shogaol and zingerone (Hartuti & Supardan, 2013).

The aroma from Formulas I, II, and III was similar across all samples, with garlic aroma being predominant in the instant powder. The use of garlic significantly impacts the aroma, a finding supported by Srihari et al. (2015), who noted that garlic powder has a pungent aroma. The color of the instant powdered drink in Formula I appears light yellow. This is because the powder produced from the grinding process has a yellow hue, and the addition of granulated sugar results in a light-yellow color. Formulas II and III exhibit a brownish color, with Formula III being the darkest. These color differences are influenced by the ingredients used, particularly the addition of palm sugar, which affects the final color of the powder.

The pH test was conducted to determine the acidity of the instant powdered drink. The results showed that the pH values ranged from 5.74 to 5.91. Formula III exhibited a more acidic average pH compared to Formulas I and II. The lower pH in Formula III is due to the use of palm sugar, which generally has a lower pH of around 5.2, compared to granulated sugar with a pH of 5.8 (Aulia et al., 2022).

The moisture content in all three formulas meets the standard requirement for instant powdered drinks, which is not exceeding 10% (BPOM, 2023). The moisture content ranges from 1% to 3.33% for Formulas I, II, and III. Formula III has the highest moisture content among the three, a difference attributed to the use of palm sugar in Formulas II and III, which has a higher moisture content compared to the granulated sugar used in Formula I.

The tapping test was conducted to determine the volume reduction of the powder due to vibration or tapping. The results of the tapping test for the instant powdered functional drink showed an average range of 8.33% to 11.33%. The findings indicate that all three formulas meet the requirement, with a desirable powder mass characteristic being less than 20% (Anastasia et al., 2022). Formula I had a lower tapping index compared to Formulas II and III, due to its lower moisture content.

The flow time test was performed to assess the flow properties of the instant powdered drink by measuring the time it takes for a certain amount of powder to flow through a Flow Tester. The results showed that Formula I had a lower average flow time compared to Formulas II and III, with a range of 10.57 to 11.34 seconds. The results indicate that none of

the formulas met the specified requirement for flow time, which is less than 10 seconds (Lubis et al., 2023). Poor flowability in the instant powder can be attributed to the sugar content, which can cause the powder to become sticky in humid conditions, thus reducing its flowability. Formula I had a longer flow time than Formulas II and III due to the higher moisture content in the latter two formulas. Increased moisture content can lead to stronger particle cohesion because of enhanced surface contact, causing the powder to lose its ability to flow (Nisfiyah & Desnita, 2021).

The angle of repose test reflects the flowability of the powder by assessing the degree of the resulting cone from the flow time test. The results show that Formula III has a higher angle of repose compared to Formulas I and II. The angles of repose range from 32.37° to 37.81°. All three instant powdered drink formulas meet the acceptable range for the angle of repose, which is between 25° and 45°, consistent with the findings of Nisfiyah and Desnita (Nisfiyah & Desnita, 2021) where F1 was 28.3° and F2 was 31.25°. The results suggest that the formula using palm sugar has a larger angle of repose. This is influenced by moisture content, as higher moisture levels result in a larger angle of repose due to stronger cohesive forces between particles.

The dissolution time test was conducted to determine how long it takes for the instant powder to dissolve completely in a given volume. Formula III exhibited the highest average dissolution time, with a range from 15.30 to 18.15 seconds. All three formulas met the requirement of dissolving in less than 5 minutes (Siregar & Wikarsa, 2010).

Phytochemical tests, including those for alkaloids, flavonoids, saponins, and terpenoids, were conducted to identify the compounds present in the instant powdered functional drink combining elephant ginger, garlic, and citronella. The type of sugar used in processing can influence the bioactive compound stability in natural ingredients such as ginger, lemongrass, and garlic. Studies suggest that white sugar and palm sugar have different impacts due to their composition and processing characteristics. White sugar, primarily composed of sucrose, has a neutral pH and minimal additional nutrients, which may not significantly protect or enhance bioactive compounds. On the other hand, palm sugar contains minerals and antioxidants, which might interact with and stabilize certain bioactive compounds like polyphenols and flavonoids during processing. However, high-temperature processing, often used in making powdered formulations, can degrade sensitive compounds such as gingerols in ginger, citral in citronella, and allicin in garlic (Mao et al., 2019).

Palm sugar's potential antioxidant properties might mitigate some of this degradation compared to white sugar. Specific research has highlighted the thermal sensitivity of ginger's phenolic compounds, such as gingerols, which convert to shogaols under heat, altering their bioactivity. Similarly, lemongrass's citral and garlic's allicin are susceptible to degradation, and sugar type might slightly modulate these effects due to varying pH and antioxidant properties of the sugars used. But, in this study, there were no different in phytochemical results in formula with different sugar combination (Kiani et al., 2022; Palakawong et al., 2010). The results of the phytochemical analysis for the instant powdered drink can be seen in Table 4.

Table 4. Phytochemical Test Results for Instant Powdered Drink Combining Elephant Ginger, Garlic, and Citronella

Compund group	**Hasil**			**Explanation**
	FI	**FII**	**FIII**	
Alkaloids	-	-	-	No change
Flavonoids	+	+	+	Yellow
Saponine	+	+	+	Foam formed
Terpenoids	-	-	-	No change

Based on the phytochemical screening results conducted on the instant powdered functional drink combining elephant ginger, garlic, and citronella, which included three different formulas, the following results were obtained: positive results were observed for flavonoid and saponin tests, while alkaloid and terpenoid tests yielded negative results. These findings are consistent with studies by Balfas & Rahmawati (2022) and Munadi and Arifin (2022) which indicate that elephant ginger and citronella do not contain alkaloids. The negative results in these tests may be attributed to factors such as the solvent used during extraction, environmental conditions where the plants were grown, or the possibility that the alkaloids present in the sample were in insufficient quantities to be detected.

The positive results for flavonoid and saponin tests in the instant powdered functional drink combining elephant ginger, garlic, and citronella align with research by Aulia et. al., (2023) which found that garlic infusion contains flavonoid and saponin compounds. Supporting studies include Herawati & Saptarini (2020) which focused on the phytochemical analysis of red ginger (*Zingiber officinale Roscoe* Var. Sunti Val), and Balfas & Rahmawati (2022) which investigated the phytochemical screening, formulation, and physical properties of a foot sanitizer spray with citronella oil (*Cymbopogon citratus* sp.).

The hedonic test aimed to assess respondents' preferences for the combination of elephant ginger, garlic, and citronella formulas. The test involved 31 respondents from Jarum Village, Bayat District, Klaten. The quality parameters evaluated for the drink combination included taste, aroma, and color. Respondents' evaluations were expressed using two measurement scales: the hedonic scale and the numerical scale. The hedonic scale indicates the level of preference or aversion of respondents towards the instant drink powder formula combining elephant ginger, lemongrass, and garlic. Meanwhile, the numerical scale provides a quantitative measure of the hedonic scale ratings, which can be used for analysis and statistical purposes (Adi et al., 2022). The hedonic test was conducted on Formula I of the instant drink powder, which combines elephant ginger, garlic, and lemongrass. This choice was based on the results of the physical quality tests conducted on the three formulas, with Formula I showing the best results, while F2 and F3 doesn't met the criteria. The hedonic test results indicated that 6 respondents chose the "like it very much" scale, 17 respondents chose the "like it" scale, and 8 respondents chose the "neutral" scale. The percentage distribution of the hedonic scale results is presented in Table 5.

Table 5. Results of the Hedonic Scale Test for Respondents on Formula I of the Instant Drink Powder Combining Elephant Ginger, Garlic, and Citronella

Hedonic scales	Repondent	Percentage
Very like	6	18.6 %
Like	17	52.7 %
Neutral	8	24.8 %
Don't like	0	0 %
Very don't like	0	0 %

The assessment included organoleptic evaluation of taste, aroma, and color for the instant drink powder combination of elephant ginger, garlic, and lemongrass. Respondents who chose a neutral rating did so because the instant drink powder had a very strong aroma resulting from the garlic. The limitations of this study include the lack of testing for concentration, which prevents understanding the impact of differences among Formulas I, II, and III of the instant functional drink powder combining elephant ginger, garlic, and lemongrass. The study also did not include the preparation of instant powder using only palm sugar, so the physical quality testing results could not be analyzed. Consequently, the effectiveness and physical quality of the combination of these ingredients could not be confirmed.

CONCLUSION

In summary, the findings revealed differences in the physical properties of the three formulations. The pH levels were measured as 5.91, 5.90, and 5.74 for F1, F2, and F3, respectively. The moisture content was 1%, 1.33%, and 3.33%, while tapping density values were 8.33%, 11%, and 11.33%. Flow times were recorded at 10.57 seconds, 10.68 seconds, and 11.34 seconds, with angles of repose at 32.37°, 26.47°, and 37.81°. Dissolution times were observed at 15.3 seconds, 17.17 seconds, and 18.15 seconds. Formula 1 (F1) exhibited the best physical quality according to standard benchmarks. Phytochemical analysis of all three formulations (F1–F3) confirmed the presence of flavonoids and saponins, while tests for alkaloids and terpenoids were negative. A hedonic assessment, performed using F1 due to its superior physical properties, revealed that among 31 respondents, 17 rated it as "like," 8 as "neutral," and 6 as "very like.".

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Ministry of Health for funding this research, and to the Ministry of Health Polytechnic of Surakarta for their support throughout the research process.

REFERENCES

Adi, I. G. D. E., Wangiyana, S., Nikmatullah, A., & Gusti, I. (2022). *Diversity of Gyrinops versteegii from several agarwood plantation on Lombok Island (Indonesia) as raw material of Gyrinops tea*. *23*(1), 178–186. https://doi.org/10.13057/biodiv/d230123

Anastasia, D. S., Luliana, S., Desnita, R., & Atikah, N. (2022). Pengaruh Variasi Gula Terhadap Karakteristik Minuman Serbuk Instan Kombinasi Rimpang Jahe (*Zingiber officinale*). *Journal Syifa Sciences and Clinical Research*, *4*.

Aulia, N., Putri, N., & Agustina, R. (2022). Pengaruh Perbandingan Gula Aren dan Gula Pasir Terhadap Karakteristik Fisikokimia Sirup Kayu Manis. *Proceeding of Mulawarman Pharmaceuticals Conferences*, *11*(2), 99–105.

Aulia, N., Putri, N. E. K., & Agustina, R. (2023). Skrinning Fitokimia Infusa Bawang Putih (*Allium sativum*) dan Infusa Kemangi (*Ocimum basilicum*): Phytochemical Screening of Garlic (*Allium sativum*) and Basil (*Ocimum basilicum*) Infusions. *Proceeding of Mulawarman Pharmaceuticals Conferences*, *17*, 21–26.

Balfas, R. F., & Rahmawati, Y. D. (2022). Skrining Fitokimia, Formulasi, dan Uji Sifat Fisik Sediaan Foot Sanitizer Spray Minyak Atsiri Sereh Wangi (*Cymbopogon citratrus* sp.). *Jurnal Pharmascience*, *9*(1), 11. https://doi.org/10.20527/jps.v9i1.11990

BPOM. (2023). *Peraturan Badan Pengawas Obat dan Makanan No. 29 Tahun 2023 tentang Persyaratan Kemanan dan Mutu Obat Bahan Alam*. Badan Pengawas Obat dan Makanan.

Dewi, T., & Farida, S. (2021). Formulasi Kapsul Ekstrak Ramuan Jamu Saintifik Diabetes Melitus. *Prosiding Seminar Nasional Biologi Ke-9*, 336–339.

Firdausni, Hermianti, W., & Kumar, R. (2017).). Pengaruh Penggunaan Sukrosa Dan Penstabil Karboksi Metil Selulosa (CMC) Terhadap Mutu dan Gingerol Jahe Instan. *Jurnal Litbang Industri*, *7*(2), 137–146.

Hartuti, S., & Supardan, M. (2013). Optimasi Ekstraksi Gelombang Ultrasonik Untuk Produksi Oleoresin Jahe (*Zingiber Officinale* Roscoe) Menggunakan *Response Surface Methodology* (RSM). *E-Jurnal Agroekoteknologi Tropika*, *33*(4), 415–423.

Hasan, H., Ismail, I., Hasnida, H., Inggris, P. B., & Enrekang, U. M. (2020). *Universitas Muhammadiyah Enrekang*. *1*, 80–87.

Herawati, I. E., & Saptarini, N. M. (2020). Studi Fitokimia pada Jahe Merah (*Zingiber officinale* Roscoe Var. Sunti Val). *Majalah Farmasetika.*, *4*(Suppl 1), 22–27. https://doi.org/10.24198/mfarmasetika.v4i0.25850

Kiani, H. S., Ali, A., Zahra, S., Hassan, Z. U., Kubra, K. T., Azam, M., & Zahid, H. F. (2022). *Phytochemical Composition and Pharmacological Potential of Lemongrass (Cymbopogon) and Impact on Gut Microbiota*. *AppliedChem*, *2*(4), 229–246. https://doi.org/10.3390/appliedchem2040016

Kusumayadi, I., Sukewijaya, I., Sumiartha, I., & Antara, N. (2013). Pengaruh Ketinggian Tempat, Mulsa dan Jumlah Bibit Terhadap Pertumbuhan dan Rendemen Minyak Sereh Dapur (*Cymbopogon citratus*). *Agroekoteknologi Tropika*, *2*(1), 49–55.

Laila, W., & Tiolina, P. (2020). Pengaruh Pemberian Air Rebusan Jahe (Zingiberaceae) dan Bawang Putih (*Allium sativum* L.) terhadapTekanan Darah Pasien Hipertensi. *Proceeding Seminar Kesehatan Perintis*, *3*(1).

Lubis, R. T., Lubis, M. S., Dalimunte, G. I., & Sari, M. (2023). Formulasi Sediaan Minuman Serbuk Jeli Lidah Buaya (*Aloe vera* (L.) Burn.F.). *Farmasainkes: Jurnal Farmasi, Sains Dan Kesehatan*, *2*(2), 178–188.

Mao, Q. Q., Xu, X. Y., Cao, S. Y., Gan, R. Y., Corke, H., Beta, T., & Li, H. Bin. (2019). *Bioactive compounds and bioactivities of ginger* (*Zingiber officinale* roscoe). *Foods*, *8*(6), 1–21. https://doi.org/10.3390/foods8060185

Munadi, R., & Arifin, L. (2022). Identifikasi Senyawa Metabolit Sekunder Dan Uji Aktivitas Antioksidan Ekstrak Daun Jahe Putih (*Zingiber officinale* Rosc. var. officinarum). *Spin*, *4*(2), 163–174. https://doi.org/10.20414/spin.v4i2.5420

Nafilah, N., & Zuniarto, A. (2022). Uji Efektivitas Sedatif Serbuk Instan Ekstrak Kering Daun Putri Malu (*Mimosa pudica* Linn.) pada Mencit Putih Jantan. *Jurnal Farmasi Dan Sains*, *5*(2), 112–120.

Nisfiyah, I. L., & Desnita, R. (2021). Formulasi minuman serbuk instan kombinasi jahe (*Zingiber officinale* Rosc) dan kunyit (*Curcuma domestica* Val .) dengan variasi gula pasir dan gula merah Formulation of instant powder drink combination of ginger (*Zingiber officinale* Rosc) and turmeric. In *Universitas Tanjung Pura*. Tanjung Pura.

Palakawong, C., Sophanodora, P., Pisuchpen, S., & Phongpaichit, S. (2010). *Antioxidant and antimicrobial activities of crude extracts from mangosteen* (*Garcinia mangostana* L.) *parts and some essential oils*. *International Food Research Journal*, *17*(3), 583–589.

Riskesdas. (2018). Hasil Riset Kesehatan Dasar Tahun 2018. *Kementerian Kesehatan RI*, *53*(9), 1689–1699.

Siregar, C., & Wikarsa, S. (2010). *Teknologi Farmasi Tablet, Dasar-Dasar Praktis*. Buku Kedokteran EGC.

Srihari, E., Lingganingrum, F. S., Damaiyanti, D., & Fanggih, N. (2015). Proses Spray Drying. *Jurnal Teknik Kimia*, *2*(1), 62–68.

Suryono, C., Ningrum, L., & Dewi, T. R. (2018). Uji Kesukaan dan Organoleptik Terhadap 5 Kemasan Dan Produk Kepulauan Seribu Secara Deskriptif. *Jurnal Pariwisata*, *5*(2), 95–106. https://doi.org/10.31311/par.v5i2.3526

Sutik, & Pangestu, R. (2022). Rebusan Air Serai Efektif Menurunkan Tekanan Darah Pada Penderita Hipertensi di Posyandu Lansia Desa Turus. *Jurnal Penelitian Keperawatan*, *8*, 203–211.

Titisari, A., Setyorini, E., Heryati, S., & Nia, R. (2019). *Kiat Sukses Budi Daya Bawang Putih*. Kementerian Pertanian RI.

Triyono, K., & Sumarmi. (2018). Budidaya Tanaman Jahe di Desa Plesungan Kecamatan Gondangrejo Kabupaten Karanganyar Provinsi Jawa Tengah. *Jurnal Adiwidya*, *II*(November), 1–9.

Wang, Q., Dong, L., Jian, Z., & Tang, X. (2017). *Effectiveness of a PRECEDE-based education intervention on quality of life in elderly patients with chronic heart failure*. 1–7. https://doi.org/10.1186/s12872-017-0698-8