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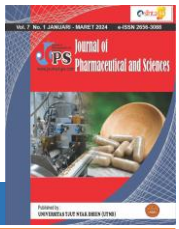

Effervescent Granule Formulation Containing *Cyclea barbata* Miers Leaf Extract: Physical Evaluation (Before and After Reconstitution)

Formulasi Granul Effervescent Mengandung Ekstrak Daun *Cyclea barbata* Miers: Evaluasi Fisik (Sebelum dan Sesudah Rekonstitusi)

Rangga Oktavian [a], Nur Cholis Endriyatno [a]*

[a] *Faculty of Pharmacy, Universitas Pekalongan, Pekalongan, Central Java, Indonesia.*

Corresponding Authors: nurcholisendriyatno@gmail.com

Abstract

Cyclea barbata Miers leaf extract contains flavonoid compounds that have anti-inflammatory activity. This study aims to determine the effect of variations in citric acid and sodium bicarbonate concentrations on the physical properties of effervescent granules before (organoleptic, flow time, angle of repose, water content, and compressibility index test) and after (organoleptic, dissolve time, foam height, pH, and hedonic) reconstitution. Effervescent granules were formulated using the wet granulation method using varying concentrations of citric acid: sodium bicarbonate, respectively, it is FI (17%: 30%), FII (20%: 27%) and FIII (23%: 24%). Based on the results of the evaluation test of the physical properties of effervescent granules, FI and FII are appropriate for the requirements of each test, while FIII did not appropriate the requirements in the flow time, angle of repose, foam height and pH tests. This study concludes that FI (17%:30%) demonstrated the most optimal physical properties, meeting all evaluation parameters and receiving the highest hedonic score.

***Keywords*: Citric acid, cyclea barbata Miers, effervescent granules, sodium bicarbonate.**

Abstrak

Ekstrak daun Cyclea barbata Miers mengandung senyawa flavonoid yang mempunyai aktivitas antiinflamasi. Penelitian ini bertujuan untuk mengetahui pengaruh variasi konsentrasi asam sitrat dan natrium bikarbonat terhadap sifat fisik granul effervescent sebelum (uji organoleptik, waktu alir, sudut diam, kadar air, dan indeks kompresibilitas) dan setelah (uji organoleptik, waktu larut, tinggi busa, pH, dan hedonik) rekonstitusi. Granul effervescent diformulasikan menggunakan metode granulasi basah dengan variasi konsentrasi asam sitrat: natrium bikarbonat berturut-turut yaitu FI (17%:30%), FII (20%:27%) dan FIII (23%:24%). Berdasarkan hasil uji evaluasi sifat fisik granul effervescent, FI dan FII sesuai dengan persyaratan masing-masing pengujian, sedangkan FIII tidak sesuai dengan persyaratan pada uji waktu alir, sudut diam, tinggi busa dan pH. Studi ini menyimpulkan bahwa FI (17%:30%) menunjukkan sifat fisik yang paling optimal, memenuhi semua parameter evaluasi dan memiliki skor hedonik tertinggi.

Kata Kunci: Asam sitrat, cyclea barbata Miers, granul effervescent, natrium bikarbonat.

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Introduction

Inflammation is a complex reaction and a biological response of the immune system caused by factors such as cell damage, toxic compounds and pathogens [1]. Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used to treat inflammatory problems. The use of NSAIDs has side effects associated with the gastrointestinal tract (GIT), where there is inhibition of the cyclooxygenase enzyme, affected in a decrease in gastroprotective prostaglandins [2]. Therefore, an anti-inflammatory alternative using a natural product is needed.

Cyclea barbata Miers leaf extract has been proven to be effective in reducing inflammation in vivo using white rats induced by carrageenan at a dose of 7.5 mg/kg BW, with a reduction of 36.75% [3]. The study also explained that the use of positive control sodium diclofenac obtained a reduction of 38.43%. *Cyclea barbata* Miers leaf extract contain flavonoid compounds [4]. Flavonoids have a mechanism of action as anti-inflammatory with various pathways. Molecular activities of flavonoids include inhibition of transcription factors such as NF-kB and activating protein-1 (AP-1), activation of nuclear factor-erythroid 2-related factor 2 (Nrf2), and involvement in inhibiting the synthesis and activity of various pro-inflammatory mediators such as eicosanoids, cytokines, adhesion molecules, and C-reactive protein [1,5]. Therefore, it is necessary to formulate to maximize the potential of the *Cyclea barbata* Miers leaf extract.

The effervescent granules consists of a mixture of acid and base components which, when added to water, will react to release carbon dioxide and foam [6]. Effervescent granules have advantages, including being easily portable, onset of action is faster, easy to consume, better taste, better patient compliance and more stable than the liquid dosage form [7]. Previous research explained that the concentration of acid (and base (Sodium Bicarbonate) excipients in effervescent granule formulations can affect the physical properties of the granules [8,9]. Several studies have shown that optimal citric acid concentrations are obtained at 20% and 23.2% [10,11]. Meanwhile, sodium bicarbonate concentrations are obtained at 30%, 27%, and 24% [11,12]. These studies will form the basis for this study.

Based on the background, research on the formulation of effervescent granule preparation of *Cyclea barbata* Miers leaf extract is necessary. This study aims to determine the effect of variations in the concentration of citric acid and sodium bicarbonate on the physical properties of effervescent granules before and after reconstitution. In addition, the best formula from the concentration variations is also determined.

Experimental Section

Materials

Cyclea barbata Miers (obtained in Pemalang Regency, Central Java, Indonesia), 96% ethanol, distilled water, citric acid, tartaric acid, sodium bicarbonate, aspartame, mannitol, PVP K-30.

Cyclea barbata Miers leaf extraction

Cyclea barbata Miers leaf extract was obtained using the maceration method. *Cyclea barbata* Miers leaves are dried and powdered, then macerated using 70% ethanol and re-macerated (ratio 550 grams : 3 liter). The extract was concentrated using a rotary evaporator and waterbath to produce a thick extract [3]. The extract was characterized (yield, water content, organoleptic, and flavonoid phytochemical tests). [13].

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Effervescent granule formulation of *Cyclea barbata* Miers leaf extract

The formulation of effervescent granules of *Cyclea barbata* Miers leaf extract was divided in 3 Formulas as shown in Table 1. The dose conversion of *Cyclea barbata* Miers leaf extract was carried out. The dose from white rats (7.5 mg/kg BW) to humans was obtained at 0.084 g. The formulation refers to previous studies with some modifications [8,9]. Each Formula is formulated with a comparison of acid components (citric acid) and base (sodium bicarbonate), to determine its effect on the characteristics of the physical properties of the granules.

Tabel 1. Effervescent granule formulation

Ingridients	FI (g)	FII (g)	FIII (g)	Function
Cyclea barbata Miers leaf extract	0.084	0.084	0.084	active substance
Tartaric acid	0.75	0.75	0.75	Acid
Citric acid	0.85	1	1.15	Acid
Sodium bicarbonate	1.5	1.35	1.2	Base
PVP K-30	0.25	0.25	0.25	Binder
Aspartame	0.25	0.25	0.25	Sweetener
Mannitol	1.316	1.316	1.316	Filler
Total	5 g	5 g	5 g	

The formulation used wet granulation method. PVP binder solution was prepared using distilled water (14 ml). Mixture 1 (prepared the acid part by mixing citric acid, tartaric acid, half mannitol and PVP solution). Mixture 2 (prepared the base part by mixing sodium bicarbonate, half mannitol and PVP solution). Each mixture was stirred until homogeneous and sieved. granules were oven-dried at 60°C for 1 hour. After that, sieved using a 14 mesh. Then, mixed between mixture 1 and 2.

Effervescent Granule Evaluation Procedure

Before Reconstitution

Organoleptic Test

Organoleptic tests on effervescent granules were conducted by directly observing the shape, color, odor, and taste. Triplicate was conducted [14].

Flow Time Test

The flow time test on effervescent granules was conducted by flowing 100 grams of granules through a funnel. The time required for all granules to flow was recorded, triplicate was conducted [14]. Flow time measurement is shown in Equation 1.

$$Flow\ time = \frac{Granule\ weight\ (g)}{Time\ (s)} \qquad (1)$$

Angle of Repose Test

The angle of repose test on effervescent granules was conducted by flowing 100 grams of granules through a funnel. The diameter and height of the cone formed were calculated [8]. The angle of repose (α) measurement is shown in Equation 2.

$$Tg\ (\alpha) = \frac{h\ (height)}{r\ (radius)} \qquad (2)$$

Water Content Test

Measurement of water content of effervescent granules using a moisture analyzer instrument [15]. granules (5 g) are put into the moisture analyzer, then set the temperature at 105ºC for 1 hour. % Water content will appear on the device screen.

Compressibility index test

The granules are put into a measuring cup until they reach a volume of 100 ml (Vo). The measuring cup is installed on the volumenometer, and tapping is done. The change in volume on tapping is recorded as (Vf).

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Tapping is done until the volume of the granules is constant [16]. The compressibility index measurement is shown in Equation 3.

$$Compressibility\ index\ (\%) = \frac{Vo - Vf}{Vo} x100\% \qquad (3)$$

After Reconstitution

Organoleptic Test

Organoleptic observations after reconstitution of effervescent granules in the form of shape, taste, smell and color [8].

Dissolve time test

The dissolve time test was carried out by inserting 1 sachet of effervescent granules (5 grams) into aquadest (200 mL) at a temperature of 25˚C. The time required for the effervescent granules to dissolve completely was calculated [8,15].

Foam height test

The foam height test was determined on effervescent granules dissolved in aquadest (200 mL). Then the height of the resulting foam was measured [8].

pH test

The acidity level is measured using a pH meter on the effervescent granules that have been dissolved. Before conducting the pH test, make sure the pH meter has been calibrated. The pH value of the effervescent granules after reconstitution will appear on the device screen [8].

Hedonic test

The reconstituted effervescent granule formula was measured for its level of preference by conducting a hedonic test. 20 panelist tested the reconstituted effervescent granule formula based on organoleptic properties (color, shape, aroma and taste). Then, the panelists assessed the formula [8]. The hedonic test was conducted using a five-point scale, where 1 = really like, 2 = like, 3 = rather like, 4 = dislike, and 5 = really dislike.

Results and Discussion

***Cyclea barbata* Miers leaf extraction**

Before the extraction process, the sample was first identified to ensure the accuracy of the plant species. The results obtained are based on the certificate from the Biology Learning Laboratory of Ahmad Dahlan University (Number 032/Lab.Bio/B/I/2025), which confirms that the plant is truly a *Cyclea barbata* Miers. The results of the sample preparation to extraction are shown in Table 2.

Tabel 2. The results of the extraction

Simplicia powder	Extract	Yield	Water content	Organoleptic	Flavonoid
550 g	43.49 g	12.64%	9.22%	Form: thick	Pew's test : presence
				Color: black	NaOH Test : presence
				Smell: typical extract	Shibata test : presence

Extraction used the maceration method. The maceration extraction method is used because it has the advantage of not damaging the active substance, as the method is without heating [17]. The yield results are in accordance with the herbal pharmacopoeia, which is >12.4% [18]. The yield shows the number of compounds that can be extracted during maceration. The water content results are in accordance with the herbal pharmacopoeia, which is <11.3% [18]The water content of the extract is used as a parameter for its stability. If the water content is high, the extract may be damaged by microbial growth. The results of phytochemical tests using 3 methods (pew's, NaOH, and shibata) showed the presence of flavonoids in the extract. The solvent (70% ethanol) is known to be able to extract flavonoids from plants [19].

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Effervescent granule formulation of *Cyclea barbata* Miers leaf extract

The formulation of effervescent granules of *Cyclea barbata* Miers leaf extract was formulated in 3 formulations. The formulation results are shown in Figure 1. Furthermore, the granule results were evaluated for the physical properties of the effervescent granules before and after reconstitution

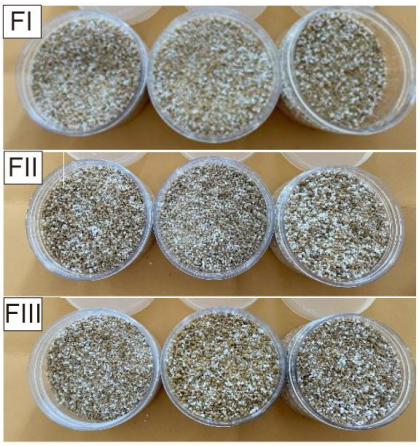

Figure 1. Effervescent granules of *Cyclea barbata* Miers leaf extract

Effervescent Granule Evaluation

The granules were evaluated before and after reconstitution. The evaluations aimed to obtain effervescent granules that meet the required standards and to identify the optimal formulation. The evaluation results are presented in Table 3, while the statistical analysis results are shown in Table 4.

Table 3. Granules evaluation before and after reconstitution

Evaluation	FI	FII	FIII
Before reconstitution			
Organoleptic	Form: granules Smell: extract Color: green and white	Form: granules Smell: extract Color: green and white	Form: granules Smell: extract Color: green and white
Flow time	13.18 ± 0.59 g/s	11.15 ± 0.13 g/s	9.91 ± 0.23 g/s
Angle of repose	26.04 ± 0.62°	29.41 ± 0.49°	33.17 ± 1.78°
Water content	0.62 ± 0.17%	1.12 ± 0.03%	1.56 ± 0.17%
Compressibility index	5.35 ± 0.56%	8.7 ± 0.60%	1 2.37 ± 0.54%
After reconstitution			
Organoleptic	Form: solution Color: clear yellow Aroma: extract Taste: sweet	Form: solution Color: clear yellow Aroma: extract Taste: sweet and sour	Form: solution Color: clear yellow Aroma: extract Taste: sour
Dissolution time	1.49 ± 0.07 minutes	2.87 ± 0.55 minutes	3.44 ± 0.22 minutes
Foam height	3.3 ± 0.15 cm	4.3 ± 0.25 cm	5.2 ± 0.49 cm
pH	5.51 ± 0.13	5.11 ± 0.05	4.3 ± 0.20
Hedonic	Really like: 65% Likes: 20% Rather like: 15% Dislikes: 0% Very dislike: 0%	Really like: 35% Likes: 40% Rather like: 15% Dislike: 10% Very dislike: 0%	Really like: 0% Likes: 0% Rather like: 0% Dislike: 40% Strongly dislike: 60%

Evaluation Before Reconstitution

Organoleptic Test

The organoleptic test is a test conducted to assess the shape, color, and odor of effervescent granules. Testing is conducted objectively using human senses. All formulas produce the same shape, color, and odor. The resulting granules have two colors, namely green is an acid granule and white is a base granule. In the process of making granules, the acid mixture and the base mixture are separated to avoid early effervescent reactions. So that the mixture containing the active substance of *Cyclea barbata* Miers leaves will have a green

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color while the mixture that does not contain active substances in the mixture has a white color. The results of the appearance of the granules are shown in Figure 1.

Table 4. Statistical results of granules evaluation

Evaluation	P-Value	
	Anova	Post Hoc Tukey
Flow time	0.000 (significantly different)	FI against FII: 0.001 (Significantly different) FI against FIII: 0.000 (Significantly different) FII against FIII: 0.016 (Significantly different)
Angle of repose	0.000 (significantly different)	FI against FII: 0.025 (Significantly different) FI against FIII: 0.001(Significantly different) FII against FIII: 0.015 (Significantly different)
Water content	0.001 (significantly different)	FI against FII: 0.011 (Significantly different) FI against FIII: 0.001(Significantly different) FII against FIII: 0.022 (Significantly different)
Compressibility index	0.000 (significantly different)	FI against FII: 0.001 (Significantly different) FI against FIII: 0.000 (Significantly different) FII against FIII: 0.001 (Significantly different)
Late time	0.000 (significantly different)	FI against FII: 0.001 (Significantly different) FI against FIII: 0.000 (Significantly different) FII against FIII: 0.002 (Significantly different)
Foam height	0.001 (significantly different)	FI against FII: 0.025 (Significantly different) FI against FIII: 0.001 (Significantly different) FII against FIII: 0.037 (Significantly different)
pH	0.000 (significantly different)	FI against FII: 0.032 (Significantly different) FI against FIII: 0.000 (Significantly different) F II against FIII: 0.001 (Significantly different)

Flow Time Test

Flow time test is conducted to see the flowability of the granules that have been formulated. It is very important because it is a control when filling the granules into the packaging, which will greatly affect the uniformity of the weight of each package. The requirement for granule flow time is that the granules must flow >10g/second [20]. The results of the flow time test are shown in Figure 2. FI and FII meet the flow time test requirements, but not for FIII.

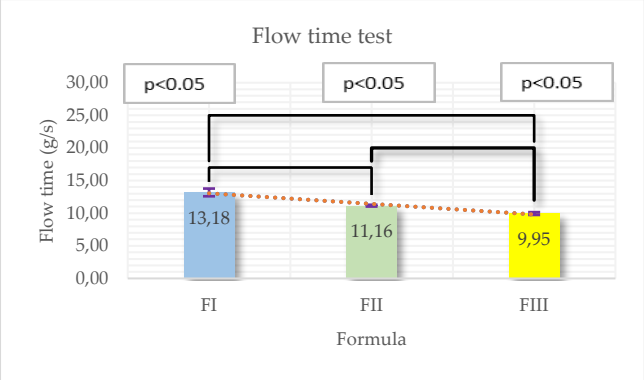

Figure 2. Flow time test of effervescent granules of *Cyclea barbata* Miers leaf extract

From the results obtained, the flow time decreased, this was influenced by variations in the concentration of citric acid and sodium bicarbonate used. Formula with higher concentrations of citric acid also have longer flow times. Citric acid has hygroscopic properties so that it easily absorbs water in the air which makes the granules moist [21]. The humidity of the granules increases the cohesiveness of the granules so that the granules will be difficult to flow [22]. Meanwhile higher concentrations of sodium bicarbonate, the granule flow time will be accelerated. This is because sodium bicarbonate has non-hygroscopic properties so that it can keep the granules dry and cohesive, then the granules will flow easily [23]. Furthermore, the flow properties are determined by factors such as particle shape, size, density, and frictional resistance. Based on

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the One Way Anova test obtained, it shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the flow time test.

Angle of Repose Test

The angle of repose test is important to see the ability of the granules to flow [24]. The angle of repose test is a series with the flow time test, the angle of repose is the angle formed during the flow time test process. Flow properties are a control when the granules go through the packaging process. The results of the angle of repose test are shown in Figure 3. FI and II have excellent flow properties because they fall within the range of 25-30º. In comparison, FIII has good flow properties because it includes the range of 31-35º [25].

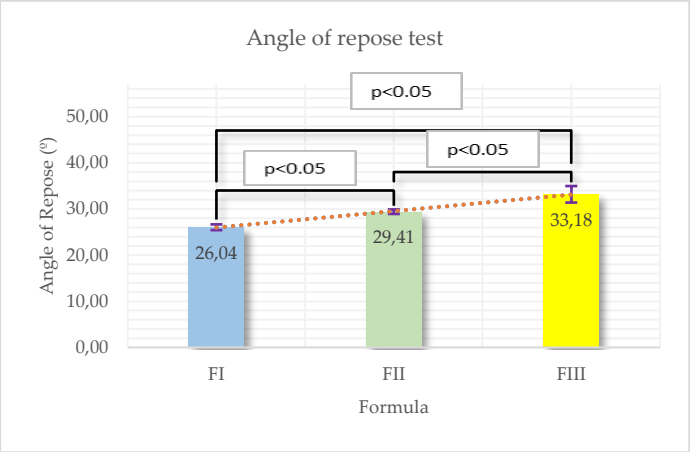

Figure 3. Angle of repose test of effervescent granules of *Cyclea barbata* Miers leaf extract

The variation influences the difference in each Formula in the concentration of citric acid and sodium bicarbonate. Citric acid has hygroscopic properties so it is easy to absorb water in the air, which can increase humidity. The humidity of citric acid will affect the cohesiveness of the granules, the more humid the granules are, the greater the cohesiveness. The granules will easy flow if the cohesiveness is small or the granules are not cohesive, so that they can produce a smaller angle of repose [22]. Meanwhile, sodium bicarbonate can cause the water content to become lower so that the granules will flow and spread to form a small angle of repose [26]. Furthermore, the angle of repose are determined by factors such as particle shape, size, density, and frictional resistanceBased on the One Way Anova test obtained, it shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the angle of repose test.

Water Content Test

The water content test aims to determine the water content in the granules [27]. Water content test is very important, because it is a quality control of granules during storage. Granules with high water content will be susceptible to microbes and can also cause early effervescent reactions that will damage the granules. The water content test results for the three formulas are appropriate requirements, as it is<5% [28]. The results of the water content test is shown in Figure 4. It shows, there is an increase in water content in Formulas II and III, also the lowest water content is at FI.

The formula with the highest concentration of sodium bicarbonate will have a lower water content because the nature of sodium bicarbonate is not hygroscopic, so it does not easily absorb water from the air [11]. The formula with a large concentration of citric acid has a higher water content in the granules. This is due to the hygroscopic nature of citric acid so that it can easily absorb water in the air, which causes the water content of the granules to be high [21]. Room humidity in the manufacturing process also affects the content of the granules because many of the excipients used have hygroscopic properties. The relative humidity of the room during the manufacturing process is 40% and the temperature is 25° [29]. Based on the One Way Anova test obtained, it shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the water content test.

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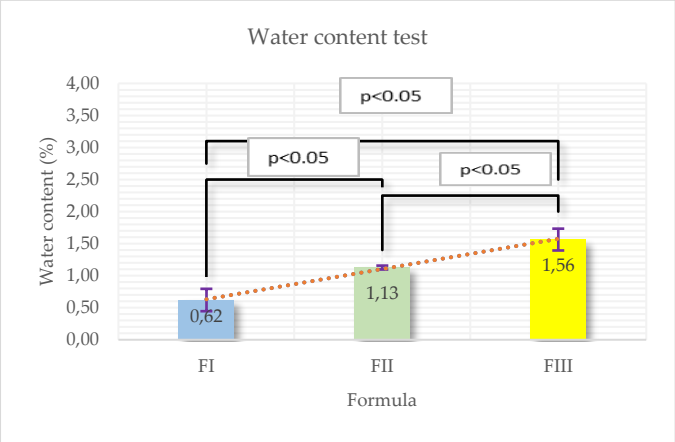

Figure 4. Water content test of effervescent granules of *Cyclea barbata* Miers leaf extract

Compressibility index test

The compressibility index test is aims to determine the flow and density properties of the granules and the decrease in each volume due to impact. [30]. It is important to carry out tapping as a control when the granules are put into the packaging. Granules that have poor flow properties will have difficulty occupying the empty space in the packaging. The results of the compressibility index test is shown in Figure 5.

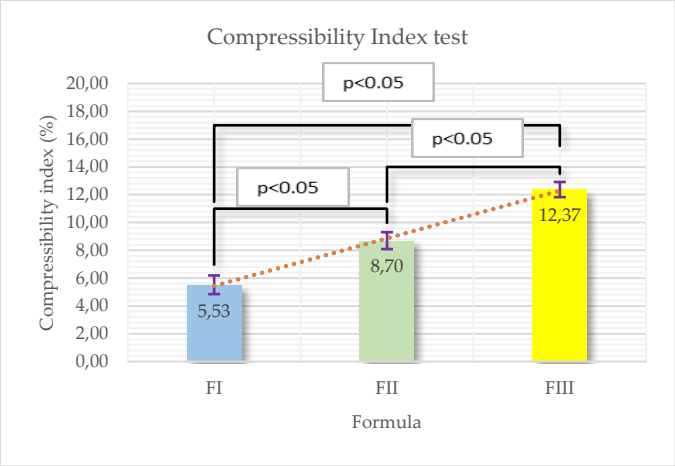

Figure 5. Compressibility index test of effervescent granules of *Cyclea barbata* Miers leaf extract

The requirement must be less than 20%, which means that the granules have good flow properties. All formulas are appropriate for the requirements. The smallest compressibility value was observed in Formula I, with an increase noted in FII and III. The formula with a higher concentration of citric acid will be more humid because citric acid has hygroscopic properties, giving it the potential to absorb water from the air. Granule moisture will increase the cohesiveness of the granules, which affects their flow properties. Poor granule flow properties will impact the compressibility value. Formulas with a large sodium bicarbonate concentration are less cohesive, resulting in good flow properties. This occurs because the nature of sodium bicarbonate is not hygroscopic, so the granules remain dry [11]. Based on the One Way Anova test obtained, shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the compressibility test.

Evaluation After Reconstitution

Organoleptic Test

Organoleptic test on effervescent granules after reconstitution is an important test to be conducted because it will determine the level of consumer preference when consuming effervescent granule products. This test is conducted by observing objectively using the five human senses related to the shape, color, taste and aroma of the preparation when it has been dissolved. The organoleptic test results after reconstitution is shown in Figure 6.

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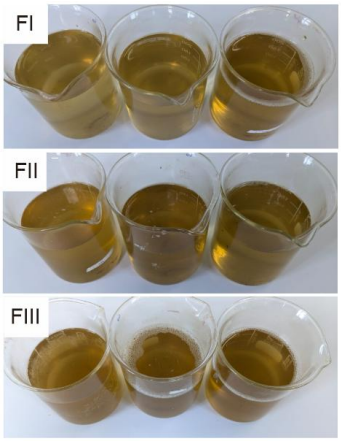

Figure 6. Organoleptic test of effervescent granules of *Cyclea barbata* Miers leaf extract

Organoleptic tests are also influenced by the excipients used in the manufacturing process. The color and aroma produced by the granules when dissolved correspond to the color and aroma of the extract used, which is yellowish brown with a distinctive aroma of the extract, while the taste is influenced by the sweetener excipient used in the formulation, namely aspartame. In addition to aspartame, the filler in the formulation also tends to have a sweet taste so that it affects when the granules are dissolved in water, the use of citric acid also affects the taste, the greater the concentration of citric acid, the more acidic the resulting solution.

Dissolve time test

The dissolution time test is one of the important tests to be carried out for granules effervescent. Because the purpose of this test itself is to see how fast it takes for the granules to dissolve completely [8]. This test is a control when the granules will be consumed, the granules must dissolve quickly. The dissolve time test results after reconstitution is shown in Figure 7.

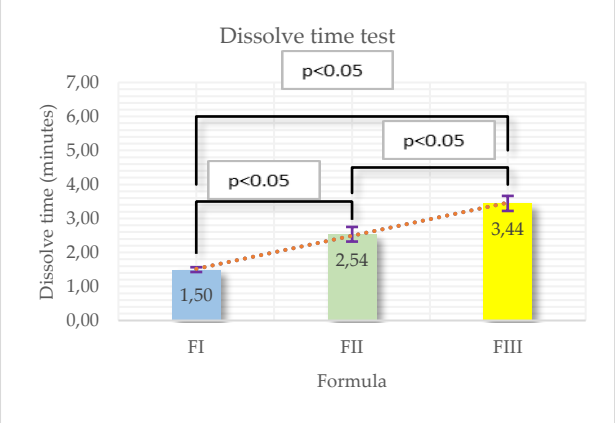

Figure 7. Dissolve time test of effervescent granules of *Cyclea barbata* Miers leaf extract

The dissolution time test requirement for effervescent granules is it must dissolve completely in approximately or equal to 5 minutes [31]. The results obtained for each formula are appropriate the dissolution time test requirements. The formula that has the highest concentration of sodium bicarbonate produces a faster dissolving time, which can happen because sodium bicarbonate acts as a disintegrant of effervescent granules so that the granules can dissolve completely without a stirring process [32]. Based on the One Way Anova test obtained, shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the dissolve time test.

Foam height test

The foam height test aims to see the foaming ability of effervescent granules after reconstitution. The carbonation effect produced is from the acid and base components in the granule formulation [22]. The foam height test results after reconstitution is shown in Figure 8.

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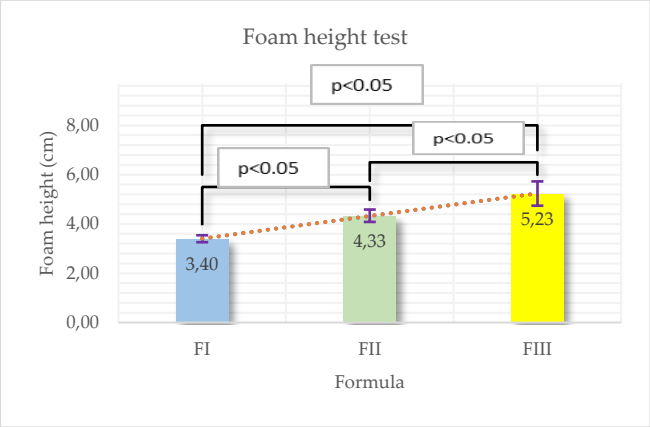

Figure 8. Foam height test of effervescent granules of *Cyclea barbata* Miers leaf extract

The requirements for the effervescent granule foam height test are 3-5 cm [33]. FI and FII meet the foam height requirements. Meanwhile, FIII does not meet the requirements because the foam height is more than 5 cm. The dissolving time of the granules is influenced by the concentration of sodium bicarbonate and citric acid. The greater the concentration of sodium bicarbonate in the formula, the easier the granules will dissolve and the less foam produced. Sodium bicarbonate in the formula acts as a disintegrant that affects the dissolution time [32]. Meanwhile, the greater the concentration of citric acid, the longer the granules will dissolve. This is because citric acid is hygroscopic so that the granules become damp [21]. Moist granules will have stronger bonds between particles, making the dissolution time longer. Long dissolution time will make the bubbles produced continue to become foam so that more foam is produced [34]. Based on the One Way Anova test obtained, shows a significant difference. Based on the Tukey post hoc test, it shows the effect of the concentration of citric acid and sodium bicarbonate in each formula on the foam height test.

pH test

The pH test aims to determine the acidity level of the effervescent granule solution after reconstitution [27]. The pH test is used as a control to ensure the granules are safe and comfortable when consumed. Granules that are too acidic will irritate the stomach. If it is too alkaline the granules will taste bitter. The results of the pH test is shown in Figure 9.

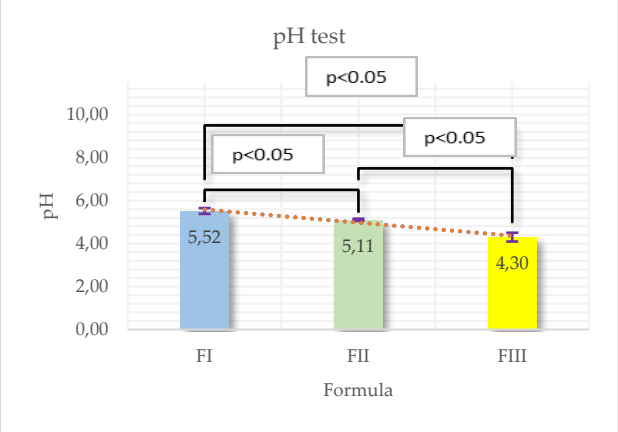

Figure 9. pH test of effervescent granules of *Cyclea barbata* Miers leaf extract

The requirements for the pH test of effervescent granules are between 5 and 7. The results of FI and FII meet the specified criteria. Increasing the concentration of citric acid in the formula will produce a more acidic solution. This occurs because the addition of a significant amount of acid affects the release of H+ ions; thus, using a high concentration of citric acid will render the effervescent granule solution more acidic. Meanwhile, a formula with a high concentration of sodium bicarbonate will create a more alkaline solution, as sodium bicarbonate is naturally alkaline. Based on the Tukey post hoc test, it illustrates the effect of the concentrations of citric acid and sodium bicarbonate in each formula on the pH test.

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Hedonic test

Hedonic test is conducted to see the level of consumer preference for the color, aroma, shape and taste of the effervecent granules. The results of the hedonic test conducted on 20 respondents obtained results at FI with level 1 (very like) of 65%, at level 2 (like) getting a percentage of 20%, at level 3 (rather like) of 15%, at level 4 (dislike) of 0% and level 5 (very dislike) of 0% with the largest percentage at level 1 (very like). The most preferred formula is FI because FI produces the best physical properties of effervescent granules with a sweet taste and provides a refreshing effect when tested so that the highest percentage obtained is level 1 (very like). The results can be seen in Figure 10.

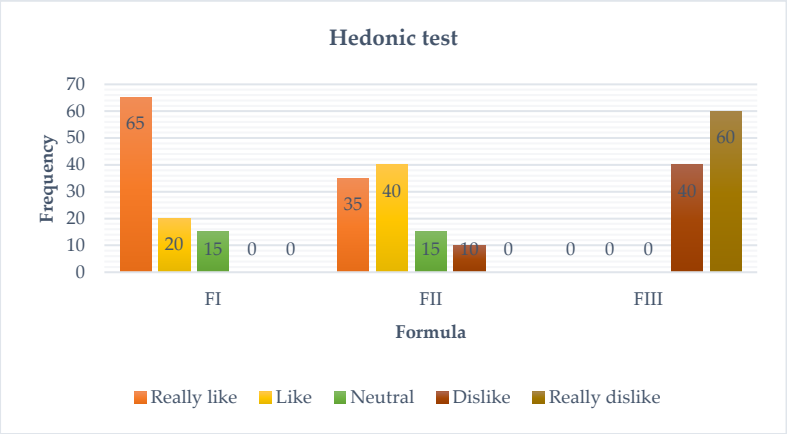

Figure 10. Hedonic test of effervescent granules of *Cyclea barbata* Miers leaf extract

Best formula analysis

The selection of the best formula is based on the results of each evaluation test of the physical properties of effervescent granules before and after reconstitution. FI is the best formula in the formulation of effervescent granules of *Cyclea barbata* Miers leaf extract. The results of the evaluation test before and after reconstitution, FI is the most dominant formula in each evaluation test. FI also meets the characteristics of effervescent granules. From the results of the statistical test, significantly different results were obtained in each granule evaluation test so that FI can be selected as the best formula. However, it is suggested that further studies, particularly in vitro testing of the effervescent granules, be conducted to provide stronger evidence of their anti-inflammatory activity.

Conclusions

Variations in citric acid and sodium bicarbonate concentrations significantly affected the physical properties of effervescent granules of Cyclea barbata Miers extract. Formula FI (17% citric acid: 30% sodium bicarbonate) exhibited the most acceptable physical properties and was most preferred by the panelists, thus considered the optimal formulation

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