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FORMULATION AND PHYSICAL EVALUATION OF EFFERVESCENT GRANULES OF MINT LEAF EXTRACT (*Mentha x piperita* L) AS STIMULANSIA

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ABSTRACT

Indonesia is a country with a diverse biodiversity spread across various regions. Several types of plants in Indonesia can be utilised as herbal medicines. One such plant suitable for medicinal purposes is mint leaves (Mentha x piperita L.). The chemical content found in mint leaves includes essential oils that serve as stimulants. This research aims to determine whether mint leaf extract can be used to create an effervescent granule formulation. Effervescent granules are produced using the wet granulation method, incorporating the active ingredient of mint leaf extract with different concentrations: F0: without the addition of mint leaf extract; F1: mint leaf extract added with a concentration of 15%; and F2: mint leaf extract added with a concentration of 17%. The effervescent granule formula is then evaluated based on its physical characteristics. Phytochemical screening of mint leaves yielded positive results, indicating the presence of essential oils. All mint leaf extract formulations tested for physical evaluation met the specified criteria. Flow properties and angle of repose testing resulted in values between 2-3 seconds for flow properties and 35°-36° for the angle of repose. Compressibility testing produced results ranging from 5% to 15%, pH testing yielded results between 5 and 6, and dissolution time results ranged from 40 to 41 seconds.

Keywords*: Mint leaves, extraction, wet granulation, effervescent granules*

INTRODUCTION

Indonesia, known for its diverse ecosystems, possesses a wide range of plant species that have the potential to serve as herbal remedies, contributing to the healthcare industry, enhancing health-related benefits, and boosting the well-being of its citizens (KKRI, 2018). One type of plant that can be used as a medicinal plant is mint leaves (*Mentha x piperita* L.) (Singh R. et al. 2015). Mint leaves are mainly used in the form of essential oil, often also called mint oil, which has a distinctive odor. Peppermint oil inhibits the growth of *S. mutans* bacteria (Golestannejad, 2017). The main components of mint leaf oil (*Mentha x piperita*) are essential oils, menthol, menthone, and methyl acetate, with a high menthol content (73.7–85.8%) (Hadipoetyanti, 2012; Padalia et al. 2013).

Mint leaves are widely used in the pharmaceutical, cigarette, and food industries, including for making toothpaste, wind oil, balm, confectionery, and others (Hadipoetyanti, 2012). Oleum menthae piperita has a number of useful properties including being a strong diffusible stimulant, antispasmodic, and anti-emetic. Oleum menthae piperita is used to soothe flatulence, gastrodynia, nausea, stomach cramps, and mask the taste of other medications (Wulandari, 2020). Stimulant drugs include a class of drugs that can stimulate the *central nervous system* (CNS) to increase alertness and focus. And certain types of drugs are often abused. The currently circulating stimulant preparations are tablets. Therefore, it is necessary to develop products that make it easier for consumers to use. One type of product

is effervescent granule preparations.

Effervescent formulations have their own advantages, apart from being preferred because they are easy, because they have a foaming effect like in fizzy drinks due to the presence of carbon dioxide (CO_2) produced from the reaction between sodium bicarbonate and citric acid. Examples of effervescent products that are already on the market are Extra Joss, Jesscool, Adem Sari, and Vegeta Herbal (Rosmala et al. 2014). From the description above, researchers are interested in conducting research on making effervescent granule formulations using active ingredients from mint leaf extract, and this study aims to determine whether mint leaves can be formulated into effervescent granule preparations and meet the physical quality of effervescent granule preparations (Sari Intan, 2012).

RESEARCH METHODS

The type of research to be carried out is experimental research in the laboratory by making several effervescent granule formulas containing mint leaf extract (*Mentha piperita* L) and then examining the quality of the preparation by conducting a physical evaluation test.

Equipment and Materials

The equipment used in this research includes an analytical balance (Newtech), pH paper (Suncare), sieves, a flow tester, a blender (Philips), an oven (Memmert), and a stopwatch. The materials used in this study are mint leaf extract (Mentha x piperita L), citric acid (Bratachem), tartaric acid (Bratachem), sodium bicarbonate (Bratachem), lactose (Merck), polyvinyl pyrrolidone (PVP) (Merck), and 70% ethanol (Merck). The materials used in the formulation meet pro-analysis specifications.

Research Procedure

1. **Preparation of Mint Leaf Powder**

   Mint leaf simplicia is made by taking mint leaves, and then drying them at 40°C until dry, which is characterised by constant weight. The simplicia was crushed and then sieved using sieve number 60 until the sifted powder was used up (Depkes RI, 1985).

2. **Making Mint Leaf Extract**

   Extraction was carried out using the maceration method. By using 70% ethanol solvent. As much as 1000 grams of mint leaf powder is put into the container. The maceration container is tightly closed and stored in a place protected from sunlight and then kept for 3 x 24 hours while occasionally stirring once every 4 hours to remove the active substance.The filtrate is then collected in an Erlenmeyer (Engineering et al., 2019).

3. **Identification of Essential Oil Compounds**

   0.5 g of condensed mint leaf extract was diluted with 1 mL of 70% ethanol, then put into a test tube and evaporated. The positive results of essential oils are indicated by the characteristic odor produced by the residue (Padmasari et al., tt).

4. **Effervescent Granule Formulation**

Table I. Effervescent Granule Formulation

Material	Concentration			Utility
	F0 (%)	F1 (%)	F2 (%)	
Mint Leaf Extract	-	15	17	Active substance
Citric acid	6.9	6.9	6.9	Source of Acid
Tartaric acid	13.9	13.9	13.9	Source of Acid
Sodium bicarbonate	23.65	23.65	23.65	Base Source
Aspartame	1	1	1	Sweetener
PVP	1.5	1.5	1.5	Fastening
Lactose	53.05	38.05	35.05	Filler
Ethanol 96%	qs	qs	Qs	Solvent

5. Making Effervescent Granules

The method used in making granules is the wet granulation method. Weigh all the ingredients that have been calculated, separate the acid components from the base components. Put it in a mortar and then dry it with some lactose; stir until dry. Add citric acid, tartaric acid, some aspartame, and PVP that has been moistened with 96% 1401tanol until it can be clenched (the acid component). The sodium bicarbonate is ground in a mortar and lactose is added; the remaining aspartame and PVP are ground until the mass can be clenched (base component). Afterward, the acid and base components are heated in an oven for 1 hour and 30 minutes, or until the granules are completely dry at a temperature of 40°C. Then it was sieved using mesh sieves numbers16 and 18. The same procedure was carried out for F0, F1, and F2 (Windah, A. et al. 2021).

6. Evaluations Test

a. Organoleptic Test

1) Odor Test
Effervescent granules, are placed on the palms of the hands and smelled.

2) Shape Test
The resulting forms are as similar as possible to one another.

3) Color Test
Effervescent granules, with their color directly visible by looking at the physical shape of the granules, look homogeneous. The result of a combination of acidic and basic compounds that when added to water (H_2O), will react to release carbon dioxide (CO_2), so that this effect will produce foam in the preparation (BPOM RI, 2019).

4) Taste Test
The effervescent granules were tried directly.

b. Flow Time

Weigh the dried granules as much as 20 grams. Place them in a funnel with the bottom hole closed, then level the surface. At the bottom of the funnel, there is a base. The lower lid of the funnel is opened so that the granules can flow onto the table, which has been covered with graph paper. The flow time of the granules is determined when the granules start to flow until the powder stops flowing using a "seconds" stopwatch. A good flow time has the characteristic of a flow time of ≤ 10 seconds (Sulastri & Rizkiyan, 2017).

c. Angle of Repose

The angle of repose test is carried out after testing the flow time by measuring the height heap of printed mass under the funnel earlier and measuring the radius of the cone base of the heap of printed mass. The requirement for the test angle of repose is not greater than 40º. The angle of repose is obtained by measuring the height and diameter of the pile of granules formed. If the angle of repose is <30°, it means that the product can flow freely, and if the angle is 240°, it means that the product has poor flowability (Mayefis & Bidriah, n.d.).

Table II. Relationship between angle of repose and angle of flow

Angle of repose (°)	flow properties
<30	Very easy to flow
30 – 40	Easy to flow
>40	Hard to flow

d. Compressibility Test

Compressibility determination is used to produce good granules. Compressibility can be seen from the Carr index, which is very dependent on the real density. as well as compressed density.

The way to determine or view the Carr index is by subtracting the actual density from the compressible density and then dividing by the compressible density. Granule compressibility is expressed in percent. The percent compressibility requirement is below 20% (Puspadina et al., 2021).

1) True Density

The granules were put into a 50 ml measuring cup, and then the initial volume and weight of the granules were recorded. The way to determine real density is by dividing the weight of the granule by the initial volume of the granule.

2) Compressed Density

The granules are put into a 50 ml measuring cup. After doing the above real density, then tap the measuring cup for 10, 50, or 100 beats until the volume of the granules is constant. The way to find compressible density is by dividing the granule weight by constant granule volume (Anshory et al. 2014).

e. Dissolution Time

The dissolution time measurement is conducted by placing a 10-gram quantity of granules per formula into 200 ml of distilled water at a temperature of 15-25°C. The dissolution time is calculated using a stopwatch, starting from the moment the granules are submerged in the distilled water until all the granules are dissolved and bubbles around the container begin to disappear. If the granules disperse well in water within 1-2 minutes, then the formulation meets the dissolution time requirement (Noerwahid, 2016).

f. pH

This is done by dissolving 5 grams of effervescent granules in 200 mL of distilled water, then measuring the pH with a pH meter. The measurement results are said to be good if the pH of the effervescent solution is close to neutral, namely 6-7 (Rahmah, 2016); the maximum pH of effervescent is around 6.4 (Sutomo et al., 2020).

RESULTS AND DISCUSSION

1. Making Mint Leaf Extract

Mint leaves were obtained from a Yogya Cijoho Kuningan department store in fresh condition. The initial weight of the mint leaves obtained was 1,2 kilograms which produced 1000 grams of simplicia powder. The leaf powder was then extracted using the maceration method using a 70% ethanol solvent. Maceration was carried out by means of 1000 grams of mint leaf simplicia powder soaked in 1500 ml of ethanol solvent in the maserator for 3 x 24 hours while occasionally stirring a maximum of 3 times so that the active substances contained in the mint leaves came out. The extraction results were 4,156 grams, and then evaporated using a water bath to obtain a thick extract. Yield is a comparison of the weight of the extract produced with the weight of simplicia as the raw material. The requirement for the yield of thick extract is that the value is not less than 10% (Indonesian Herbal Pharmacopoeia, 2017). The yield results of mint leaf extract can be seen in the table.

Table III. Mint Leaf Extract Yield

Simple initial weight	The yield weight of the thick extract	% extract yield

1000 grams	128.54 grams	12.85%

The initial weight of mint leaves obtained was 1.2 kg, and 1000 grams of simplician powder were produced as per the desired weight. The method used to extract mint leaf is the maceration method, employing a 70% ethanol solvent. Additionally, the procedures and equipment used are simple and do not involve heating, preventing the decomposition of compounds in the plant. The choice of 70% ethanol is due to its polar nature, possessing a high degree of polarity that allows it to filter non-polar and polar compounds.

Maceration involves mixing 70% ethanol with mint leaf simplicia powder and placing it in a macerator for 24 hours, with occasional stirring. Subsequently, remaceration is performed for 3 cycles of 24 hours each, utilizing a 70% ethanol solvent. The extraction results yielded 4.156 grams, which were then evaporated using a water bath to obtain a concentrated extract. As indicated in Table III, the yield of mint leaf extract is 12.85%. This value is in accordance with the Indonesian Herbal Pharmacopoeia, which specifies a minimum of 10%. The yield value in this study, at 12.85%, surpasses the 10% minimum requirement, confirming compliance with the specified yield value for the extract used (Hadipoentyanti, 2012).

2. Mint Leaf Phytochemical Screening Test

Based on research conducted by Padalia et al, 2013 the main components of mint leaves (*Mentha piperita*) are essential oil, menthol, menthone, and methyl acetate, with a high menthol content (73.7–85.8%).

The phytochemical screening carried out in this study only tested essential oil compounds. The benefits taken from this research are that they act as stimulants, and essential oil compounds are the largest compounds in mint leaves that act as stimulants.

Table IV. Phytochemical Screening Test Results

No.	Compound Class	Observation result	Information
1.	Essential oil	Distinctive smell of mint leaves	+

Phytochemical screening is a method used to identify the chemical compounds present in plant extracts. In the screening test conducted on mint leaves, the presence of essential oil compounds was observed. The research findings, which are presented in Table IV, indicate that mint leaves contain essential oil compounds (positive). When heating the mint leaf extract with the addition of a 70% ethanol reagent, a mint-like aroma is detected. This positive aroma confirms the presence of essential oils.

3. Making Effervescent Granules

The preparation of effervescent granule preparations was carried out at the STIKes Muhammadiyah Kuningan Pharmaceutical Biology Laboratory. In making these effervescent granules, the active substance used is mint leaf extract, with additional substances of citric acid and tartaric acid as acid components. and sodium bicarbonate as a base component. You can see the results of making effervescent granules.

In the production of effervescent granules, two types of granules are created: acid granules and alkaline granules to prevent effervescent reactions. The manufacturing process of effervescent granules utilizes the wet granulation method, with the objective of improving flowability. During the granulation process, sifting is performed twice.

The first step involves using a 16-mesh sieve, and the second step employs an 18-mesh sieve to ensure uniform granule size. Between these sieving processes, the granules

undergo a drying phase, which aims to reduce moisture content and prevent effervescent reactions (Herliningsih, 2023).

The weight of the granules in each sieve is measured to determine the particle size distribution of the granules. Ideally, the granules should contain a minimal amount of fines (<10%) (Syaputri et al., nd). In the production of effervescent granule preparations, mint leaf extract is employed as a stimulant. These effervescent granule preparations are available in three formulations, each featuring a different concentration of the active ingredient. Specifically, F0 contains no active substance, F1 has an active substance concentration of 15%, and F2 boasts an active substance concentration of 17%.

Mint leaf extract is blended with the acid granules due to its inherent stability in acidic conditions, as it maintains stability at a pH level close to neutrality but not more than 7 (Rahmah, 2016). As for the basic component, it involves mixing sodium bicarbonate with the binder solution and filler. Polyvinyl pyrrolidone (PVP) serves as the liquid binder and isrecognised as the most effective binding agent for effervescent granules. PVP is a polymer derived from 1-vinyl-2-pyrrolidone and exists in the form of a white or yellowish powder with a faint or non-hygroscopic odor. It readily dissolves in water, 95% ethanol, and chloroform, with solubility dependent on its average molecular weight, while being insoluble in ether.

The initial experiment in the production of effervescent granules involved the creation of both the acid and base components according to the proposed formula. Subsequently, drying was conducted in an oven at a temperature of 40°C for 1 hour and 30 minutes for formulas F0, F1, and F2. The F0 formulation served as the control, containing no added mint leaf extract as the active ingredient, while the F1 formula included the active substance with a concentration of 15 grams, and the F2 formulation included the active substance with a concentration of 20 grams. However, during the mixing process of the F2 formulation, the acid component became excessively moist and sticky, posing difficulties in sifting. In contrast, the acid component of the F0 and F1 formulations was not as wet as that in the F2 formula, allowing for successful handling and sifting after mixing. After the oven treatment, formulations F0 and F1 yielded good results. However, in the case of the F2 preparation, the acid component still retained excessive moisture. An attempt to re-oven the acid component of the F2 formula for an additional hour resulted in minimal improvement.

The second experiment followed the same method, involving separate granulation for both the acid and base components. However, there was a modification in the reduction of the active substance concentration in the F2 formulation, decreasing it from 20% to 17%. This adjustment aimed to mitigate particle adhesion to one another. Subsequently, the drying process for the F2 formulation's acid component was carried out in the oven for 1 hour and 30 minutes, while the granule preparations were dried in less than 1 hour and 30 minutes. As a result, the second experiment was deemed successful, indicating that the alteration in the active substance concentration can influence the physical properties of the granules.

4. Physical Evaluation

Physical evaluation tests are carried out to determine the stability of the preparation. Evaluation is carried out when the granule formulation is complete; physical evaluation testing of the effervescent granules can be carried out. Evaluation includes organoleptic, flow time, angle of repose, dissolution time, compressibility, and pH tests. The results of observations of the physical properties of effervescent granule preparations from mint leaf extract are as follows:

To ensure the product of an effervescent preparation is both high-quality and well-received by the public, it must adhere to specific criteria, as reflected in the physical properties of the effervescent granules. An exemplary effervescent preparation must meet various requirements, including those related to organoleptic characteristics, flow properties, angle of repose, compressibility, dissolution time, and pH.

a. Organoleptic Test

Organoleptic testing was carried out to determine the physical characteristics of the effervescent granules. Organoleptic tests carried out include shape, color, smell, and taste. Mint leaf extract effervescent granules are generally in the form of granules with a uniform size and have a distinctive aromatic aroma of mint leaves.

In Table V, the results of organoleptic observations for the effervescent granule preparation of mint leaf extract (*Mentha piperita* L) are presented. The control formula (F0) is characterized by its lack of odor and white color, as it does not contain the active ingredient of mint leaf extract; it possesses a sweet and sour taste. In contrast, the F1 formulation exhibits granules with a distinctive aroma of mint leaf extract, a light brown color, and a fresh, sweet, and sour taste. The F2 formulation also yields granules with a distinctive aromatic odor, a color similar to F1 (light brown), and a fresh, sweet, and sour taste. As indicated in Table 4.3, the most favorable formulation is F1.

Table V. Organoleptic Results of Effervescent Granules

Organoleptic	Observation		
	F0	F1	F2
Smell	No smell	The distinctive aromatic smell of mint leaves	Bauk has aromatic mint leaves
Form	Homogeneous fine granular small granules	Homogeneous fine granular small granules	Homogeneous fine granular small granules
Color	White	Acid Component: Chocolate Base Component: White	Acid Component: Chocolate Base Component: White
Flavor	Sweet and sour	Fresh sour	Fresh sour

b. Test Flow Properties and Angle of Repose

In this study, two funnel methods and the angle of repose method were used. The flow time of the granules is determined from the time the granules start to flow until the powder stops flowing using a stopwatch "seconds". The angle of repose test was carried out after the flow time test was carried out by measuring the height of the mass piled under the funnel and measuring the radius of the cone base of the mass piled up. Requirement of the test angle of repose is not greater than 40º. The angle of repose is obtained by measuring the height and diameter of the pile of granules formed.

1.) Funnel method

Table VI. Results of Effervescent Granule Alit Properties

Formulas	Flow Time (seconds)			Average (seconds)
	1	2	3	
F0	2.15	2.22	2.17	2.18
F1	3.97	3.79	3.79	3.85
F2	3.99	3.90	3.94	3.4

2.) Repose Angle Method

Table VII. Effervescent Granule Repose Angle

Formulas	Angle of Repose (°)			Average (°)
	1	2	3	
F0	36.86	33.75	34.42	2.18

F1	37.59	36.12	35.37	3.85
F2	36.12	36.86	36.86	3.4

This test involved the passage of 20 grams of granules through a flow time testing apparatus, which was performed in 3 replications. The average flow time results were as follows: F0, with an average of 20 grams/2 seconds; F1, with an average of 20 grams/3 seconds; and F2, with an average of 20 grams/3 seconds. Flow time is considered satisfactory when it is less than 10 seconds. Exceeding this threshold may lead to difficulties in regulation. Flow velocity is influenced by various factors, including particle shape, size, density, frictional forces, and experimental conditions (Rahmawati et al. 2016).

The angle of repose, or simply the repose angle, is a method used to assess a substance's resistance to particle movement, making it a valuable tool for predicting powder flow rates, which are more pertinent. An angle of repose of ≤30 typically suggests that the material flows freely, whereas an angle of repose of ≥40 indicates poor flowability. This angle of repose test is conducted following flow velocity assessment, involving the measurement of the radius (r) and the granule pile's height (h) from its base to calculate the angle of repose. The size of attractive forces and frictional forces between particles can influence the angle of repose of a preparation. Furthermore, particle size is another factor that impacts the angle of repose(Dianengsih, nd).

According to Table 4.5, the angle of repose results for all three formulas exceeds 30°. F0 shows a value of 35.34°, F1 records 36.36°, and F2 exhibits a measurement of 36.61°. Referring to Table 3.2, it can be concluded that the resulting effervescent granule preparations demonstrate favorable flowability characteristics. Therefore, this test establishes a clear correlation between flow properties and the angle of repose, indicating that all the formulas yield flow times that align with the specified criteria, signifying their ease of flow.

3.) Compressibility Test

The purpose of compressibility index testing is to determine the flow properties of the granules and the decrease in each volume due to impact.

Table VIII. F0 Compressibility Test Results

Formulas	Granule weight (g)	Initial volume	Compression/Condensed Volume (ml)			BJ Real (g/ml)	BJ Compressed (g/ml)		
			10x	50x	100x		10x	50x	100x
F0	20 g	50ml	48	47	45	0.4	0.41	0.42	0.44
	20gr	50ml	47	46	45	0.4	0.42	0.43	0.44
	20gr	50ml	48	47	46	0.4	0.41	0.43	0.44

Table IX. F1 Compressibility Test Results

Formulas	Granule weight (g)	Initial volume	Compression/Condensed Volume (ml)			BJ Real (g/ml)	BJ Compressed (g/ml)		
			10x	50x	100x		10x	50x	100x
F1	20gr	50ml	45	43	40	0.4	0.44	0.46	0.5
	20gr	50ml	45	43	41	0.4	0.46	0.46	0.48
	20gr	50ml	44	42	40	0.4	0.45	0.47	0.5

Table X. F2 Compressibility Test Results

Formulas	Granule weight (g)	Initial volume	Compression/Condensed Volume (ml)			BJ Real (g/ml)	BJ Compressed (g/ml)		
			10x	50x	100x		10x	50x	100x

F2	20gr	50ml	47	45	44	0.4	0.47	0.44	0.44
	20gr	50ml	48	46	45	0.4	0.41	0.43	0.5
	20gr	50ml	47	46	45	0.4	0.42	0.43	0.5

The compressibility index is a measure used to assess the ability of granules to form a stable and compact mass when subjected to pressure. The results obtained from the three formulas can be considered satisfactory, as they exhibit a compressibility index value of less than 10%. Compressibility is a specific criterion for evaluation. The average compressibility index results for the three formulas are as follows: F0 with a value of 6%, F1 with a value of 15.4%, and F2 with a value of 10%. Consequently, it can be concluded that the compressibility index values meet the requirements for formulas F0 and F2.

4.) Dissolution Time

The dissolution time test was conducted to determine the duration required for the granules to fully dissolve in water. Effervescent preparations are expected to exhibit a rapid reaction, typically completing dissolution within 1-2 minutes.

Table XI. Effervescent Granule Dissolving Time Results

Formulas	Late Time (seconds)			Information
	1	2	3	
F0	38.86	40.47	41.25	M.S
F1	40.98	39.45	41.78	M.S
F2	41.57	39.86	40.74	M.S

Late time requirement is 1-2 minutes
Description: Meets the requirements (MS)

Dissolution time is the time required for granules to dissolve completely in water. Complete solubility is characterized by the cessation of CO_2 gas production in water. This test was carried out by adding 200 ml of water and 10 grams of effervescent granules, then calculating the dissolution time using a stopwatch,starting from the granules entering the water until all the granules dissolve without stirring and the bubbles around the container begin to disappear, then doing 3 repetitions. This test is to determine the dissolution time of the effervescent granules. Apart from having an impact on the uniformity of the content, particle size also affects the dissolution time of the granules. Granules with a narrow size distribution show a faster dissolving time and are easier to disperse than granules with a wide distribution of particle sizes. Uniform particle size facilitates the ability of water to penetrate more evenly throughout the granule so that the granule dissolves more quickly (Syaputri et al., nd). The desired effervescent dissolution time is less than 60–120 seconds. Based on Table XI, the average value is 38– 41 seconds. So it can be concluded that the three formulations meet the requirements because the dissolution time is less than 1-2 minutes (Noerwahid, 2016).

5.) pH

The pH test aims to see whether the pH of the effervescent granule preparation meets the requirements or not. The appropriate pH value is said to be good if the effervescent solution is not too acidic and not too alkaline. That is close to neutral 6-7, the maximum effervescent pH ranges from 6.4 (Sutomo et al., 2020).

Table XII. Effervescent Granule pH Test Results

Formulas	pH			Information
	1	2	3	

F0	6.92	6.92	6.92	M.S
F1	5.71	5.71	5.71	M.S
F2	5.86	5.86	5.85	M.S

The pH that meets the requirements is close to a neutral pH of 6-7
Information :
MS: Fulfills the requirements
TMS: Not Eligible

For the pH parameter, effervescent granule preparations of mint leaf extract should ideally maintain a pH level within the range of 6-7. This test serves the purpose of determining the pH of the effervescent mint leaf extract solution. Monitoring the pH is essential because excessively acidic solutions can irritate the stomach, while overly alkaline solutions can result in a bitter and unpleasant taste. Food ingredients are categorized based on their degree of acidity, including (1) low-acid food ingredients with a pH range of 4.5 to 5.3, (2) medium-acid foods with a pH range of 3.7 to 4.5, and (3) high-acid foods with a pH value below 3.7 (Rahmawati et al, 2016). The pH measurements, conducted with three replications, yielded average values of 6.92 for the control formula, 5.71 for the F1 formula, and 5.86 for the F2 formula (Sutomo et al., 2020).

One of the factors that can influence pH acidity is the production of CO_2 during an effervescent reaction in water, which partly dissolves to create carbonic acid. Subsequently, this carbonic acid breaks down, resulting in the release of H^+ ions into the solution, thereby increasing its acidity (Rahmawati et al. 2016).

According to the test results, it is evident that an increase in the amount of sodium bicarbonate leads to an increase in the pH value. This is attributed to the rising levels of sodium bicarbonate, which acts as a base, and this increase is not accompanied by a corresponding rise in acid levels (Puspita, 2018).

CONCLUSION

Based on the results of the conducted research, it can be concluded that all formulations of mint leaf extract meet the physical testing requirements, which encompass organoleptic tests, flow properties, angle of repose, pH, compressibility tests, and dissolution time. In the organoleptic test, the control formula (F0) appeared white with a sweet and sour taste, while Formula 1 (F1) and Formula 2 (F2) exhibited a similar color with a fresh and tangy flavor. The flow properties and angle of repose test results yielded values of 2-3 seconds for flow properties and 35°-36° for the angle of repose.

The compressibility test results range from 5% to 15%, the pH test results are in proximity to 6, and the dissolution time is 40-41 seconds, at which point the preparation completely dissolves.

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