



Formulation and Antioxidant Testing of an Effervescent Powder Preparation Containing Ciplukan Fruit Extract Using the DPPH Method

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Keywords:

Physalis angulata L.; Ciplukan Fruit; Effervescent Powder; Antioxidant Activity; DPPH; IC₅₀

ABSTRACT

Free radicals contribute to oxidative stress and the development of degenerative diseases. Synthetic antioxidants, such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), may pose toxicity and carcinogenicity risks, prompting the search for natural alternatives. Ciplukan (*Physalis angulata* L.) fruit is rich in flavonoids, phenolic compounds, and alkaloids with high antioxidant activity; however, its potential application in modern pharmaceutical preparations remains insufficiently explored. This study aimed to formulate an effervescent powder containing ciplukan (*Physalis angulata* L.) fruit extract and evaluate its physical characteristics, stability, and antioxidant activity using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. This laboratory experimental study employed three extract concentrations: 5% (F1), 10% (F2), and 15% (F3). The fruit extract was obtained through maceration using 96% ethanol and subsequently formulated into an effervescent powder preparation. The formulations were evaluated through organoleptic testing, flow rate, angle of repose, moisture content, dispersion time, pH measurement, and antioxidant activity during a 28-day storage period. Phytochemical screening revealed the presence of flavonoids, tannins, alkaloids, saponins, steroids, phenolic compounds, glycosides, and quinones. The ciplukan fruit extract exhibited very strong antioxidant activity, with an IC₅₀ value of 17.33 ppm. All formulations met the required physical quality standards and remained stable throughout the storage period. The average IC₅₀ values of the effervescent powder formulations were 27.28 ppm (F1), 24.34 ppm (F2), and 22.65 ppm (F3), indicating very strong antioxidant activity across all formulations. Formula F3, containing 15% ciplukan fruit extract, demonstrated the strongest antioxidant activity and the best physical stability. Therefore, ciplukan fruit extract has considerable potential as an active ingredient in a stable and effective effervescent powder formulation for natural antioxidant supplementation.

INTRODUCTION

Free radicals are reactive molecules formed as byproducts of normal body metabolism and exposure to external factors, such as air pollution, cigarette smoke, ultraviolet (UV) radiation, and harmful chemicals. Excessive accumulation of free radicals can lead to oxidative stress, which contributes to premature aging, tissue damage, and the development of various degenerative diseases, including cancer, diabetes, and cardiovascular disease (Maharani et al., 2021).

Damage caused by free radicals can be reduced through the activity of antioxidants in the body. Antioxidants can be produced synthetically or obtained from natural sources. Synthetic antioxidants, such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), are effective; however, their long-term use has been associated with potential toxicity and carcinogenic risks (Kurniawati & Sutoyo, 2021). Therefore, research on natural antioxidant

sources derived from medicinal plants has increased due to their safer properties and broad biological potential (Hassan et al., 2017; Nwozo et al., 2023; Sun & Shahrajabian, 2023).

One plant with potential antioxidant activity is ciplukan (*Physalis angulata* L.). Ciplukan (*Physalis angulata* L.) contains flavonoids, phenolic compounds, and alkaloids with high antioxidant activity. Research has shown that the methanolic extract of ciplukan roots exhibits antioxidant activity of 86.81% (Imran et al., 2021), while ciplukan fruit has also been reported to demonstrate higher antioxidant activity than its leaves (Devitria, 2020). The presence of phenolic compounds and flavonoids plays an important role in antioxidant mechanisms through electron donation to neutralize free radicals. However, the antioxidant effectiveness of ciplukan fruit remains insufficiently studied in modern pharmaceutical preparations (Andriani & Murtisiwi, 2020).

In product development, the dosage form is essential for improving patient compliance and maintaining the stability of active compounds. Effervescent powder is an attractive dosage form because it dissolves easily, provides better taste acceptability, and offers convenient administration. Previous studies have focused on effervescent formulations containing other herbal extracts; however, research specifically examining effervescent powder formulations containing ciplukan fruit extract as an antioxidant remains limited (Andriani & Murtisiwi, 2020).

Based on this background, this study focused on the formulation and antioxidant activity evaluation of an effervescent powder containing ciplukan fruit extract (*Physalis angulata* L.) using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method. This research was expected to provide an alternative natural antioxidant preparation that is practical, effective, and has potential for further development in the pharmaceutical and public health fields (Bai et al., 2022; El-Saadony et al., 2025; Marino et al., 2022; Tumilaar et al., 2024).

This research was motivated by the need for antioxidant compounds to protect the body from free radical-induced damage by utilizing ciplukan fruit extract (*Physalis angulata* L.) as a natural antioxidant source formulated into an effervescent powder preparation. The study aimed to develop an effective and stable effervescent powder formulation, evaluate its antioxidant activity using the DPPH method through IC₅₀ value determination, identify the optimal formulation, and assess the physical characteristics of the three developed formulations. The results of this study were expected to contribute to the development of knowledge in the field of natural pharmaceutical formulation, provide references for future research, and increase public awareness regarding the potential of ciplukan fruit as a natural antioxidant source beneficial for health.

METHOD

Research Design

This laboratory experimental study involved the preparation of ciplukan fruit extract (*Physalis angulata* L.) and its formulation into effervescent powder preparations containing 5%, 10%, and 15% extract. The formulations were evaluated for physical characteristics, including organoleptic properties, flow rate, angle of repose, moisture content, dispersion time, and pH. Antioxidant activity was also evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method.

Data Collection Techniques

Data collection in this study was carried out by taking primary data, because the research data was obtained directly by the researcher. The primary data were obtained by optimizing the effervescent powder formula of citrus fruit extract (*Physalis angulata* L.), evaluating preparations and testing antioxidant activity using the DPPH (2,2-Diphenyl-1-Picrylhydrazyl method).

Data Processing and Analysis

Data analysis in this study was carried out descriptively for the results of organoleptic test observations. Meanwhile, pH, flow rate, dispersion time, and antioxidant activity tests were analyzed using One-Way ANOVA to determine if there was a significant difference between the effervescent powder preparations F1, F2, and F3. To find out which formulations are different, a follow-up test, namely a Post Hoc test, can be carried out to identify significant differences between formulas.

Research Location and Time

The research was conducted at the Laboratory of Pharmaceutical Technology and Pharmaceutical Chemistry, Faculty of Pharmacy, Rajawali Health Institute Bandung. This research was carried out from February to July 2025.

RESULT AND DISCUSSION

Determination of Ciplukan Fruit Plants (*Physalis angulata* L.)

Ciplukan fruit plant (*Physalis angulata* L.) was obtained from Cikareo Village, Alamendah Village, Rancabali District, Bandung Regency, West Java Province. Plant determination was carried out at the Jatinangor Herbarium Plant Taxonomy Laboratory, Department of Biology, FMIPA UNPAD. Based on the results of the determination obtained, it has been proven that the identified sample is a citrus fruit plant (*Physalis angulata* L.). The data on the results of the determination can be seen in Appendix 4.

Sample Processing and Extraction of Ciplukan Fruit (*Physalis angulata* L.)

The results of sample processing using 3 kilograms of fresh citrus fruit (*Physalis angulata* L.) that have been washed clean. The citrus fruit is mashed and macerated with 96% ethanol solvent as much as 3 liters for 3 days by remaceration every 24 hours, producing a liquid extract of 9 liters. The liquid extract obtained was then concentrated with a rotary evaporator at a temperature of 45°C and continued with evaporation of solvent using a waterbath until a thick extract of 391 grams was obtained with a total yield of 13.03%. The results of ciplukan fruit extraction can be seen in Table 1.

Table 1. Making Ciplukan Fruit Extract (*Physalis angulata* L.)

Sample	Extraction Method	Solvents	Sample Weight	Extract Weight	Rendemen (%)
Ciplukan fruit (<i>Physalis angulata</i> L.)	Maserasi	Ethanol 96%	3 kg	391 grams	13,03%

Source: Primary data, 2025

Phytochemical Filtration of Ciplukan Fruit Extract (*Physalis angulata* L.)

Analysis of the components in ciplukan fruit extract (*Physalis angulata* L.). It is carried out through phytochemical screening to identify the group of secondary metabolite compounds using a color test with reagents. Testing was carried out on ciplukan fruit extract (*Physalis*

angulata L.) which included testing for flavonoid compounds, tannins, steroids and terpenoids, saponins, alkaloids, phenols, glycosides, quinones, and monosesquiterpenoids. The results of the phytochemical screening of ciplukan fruit extract (*Physalis angulata L.*) can be seen in table 2.

Table 2. Results of Phytochemical Filtration of Ciplukan Fruit Extract (*Physalis angulata L.*)

No.	Golongan Senyawa	Reagents	Results	Remarks
1	Flavonoid	Mg powder 0.1 g, amyl alcohol, and ethanol	(+)	Orange to reddish color is formed.
2	Tanin	FeCl ₃ 1% solution (2–3 drops)	(+)	A greenish-black color is formed.
3	Steroid	Acetic acid (5 drops) and H ₂ SO ₄ (3 drops)	(+)	There is a change in color to green.
4	Saponin	Aquades + HCl	(+)	A ±1 cm foam is formed that lasts for 1 minute.
5	Alkaloid	Mayer reagents Pereaksi Dragendorff	(+) (+)	White deposits are formed. Red-orange deposits are formed.
6	Phenol	Wagner reagents FeCl ₃ 5% (2 tetes)	(+) (+)	Brown color is formed. There is a change in color to a strong green.
7	Glikosida	FeCl ₃ (1 drop), C ₃ COOH (2 mL), and H ₂ SO ₄ (1 mL)	(+)	Brown rings are formed.
8	Kuino's	NaOH 0.1 N (6 heads)	(+)	There is a change in color to yellow.
9	Monoses Bouncers	Eter + Vanilin Sulfate	(–)	No discoloration is formed.

Description :

(+) Positive = Contains active compounds

(-) Negatives = Contains no active compounds

Source: Primary data, 2025

Antioxidant Activity Test of Ciplukan Fruit Extract (*Physalis angulata L.*) Using the DPPH Method

The results of the antioxidant activity test of ciplukan fruit extract (*Physalis angulata L.*) using the DPPH method obtained an IC₅₀ value of 17.33 ppm, which means that ciplukan fruit extract has very strong antioxidant activity. The results of the antioxidant activity test from vitamin C as a positive control obtained an IC₅₀ value of 1.54 ppm, which means that vitamin C has very strong antioxidant activity. The results of the antioxidant activity test of citrus fruit extract and vitamin C can be seen in Table 3.

Table 3. Results of Antioxidant Activity Test of Ciplukan Fruit Extract (*Physalis angulata* L.) Using the DPPH Method

Sample	Concentration (ppm)	Absorb	% Inhibisi	IC50 (ppm)	Remarks
Extracts	10	0,349	43,7%	17,33	Very Powerful
Fruit	20	0,296	52,25%		
Squirrels	30	0,245	60,48%		
(Physalis Angulata L.)	40	0,162	73,87%	1,54	Very Powerful
	50	0,109	82,41%		
	1	0,320	48,38%		
	2	0,305	50,8%		
	3	0,241	61,12%		
Vitamin C	4	0,147	76,29%		
	5	0,098	84,19%		

Source: Primary data, 2025

Formulation and Evaluation of Effervescent Powder Base

The formulation of effervescent powder base was made based on the results of the study (Kurniaty et al., 2021). Evaluation of effervescent powder bases was carried out by performing stability including organoleptic tests, dissolution time tests, flow time and idling angle tests, moisture content tests, and pH tests during 28 days of storage at room temperature ($25^{\circ}\text{C} \pm 2^{\circ}\text{C}$). Observations were made on days 1, 7, 14, 21, and 28. The evaluation of effervescent powder bases aims to assess whether the bases used for the formulation of the preparation have met the predetermined requirements. The effervescent powder-based formula can be seen in Table 4.

Table 4. Effervescent Powder Base Formulation Results

Material Name	Concentration	Function
Citric Acid	7,5	Acid components
Asam Tartrat	15	Acid components
Sodium Bicarbonate	18,75	Components of the language
Sucrose	8	Sweeteners
Dextrin	Ad 100	Filler

Source: Primary data, 2025

The results of the evaluation of the physical characteristics of the effervescent powder base showed that the preparation had good stability during 28 days of storage. Organoleptic testing showed no significant changes in the color, smell, taste, or shape of the powder. The flow time and idle angle values still meet the quality requirements, although there is a slight increase during storage which is thought to be due to the hygroscopic properties of dextrin, thereby increasing particle cohesiveness and the tendency to clump formation. The moisture content also increased, but it was still below the required limit ($<5\%$), which indicates that the preparation remained stable despite moisture absorption. These conditions also affect the dissolution time, which shows a slight increase during storage due to the reduced surface area of the powder's contact with water due to clumping, but the entire formulation still meets the dissolving time requirement of less than 5 minutes. In addition, the pH test results are in the range of 4.5–5 so that they are still in accordance with the quality standards of effervescent

powder. Overall, the whole evaluation parameters show that the effervescent powder base has good physical characteristics and still meets the quality requirements during the storage period.

Formulation of Effervescent Powder Preparation of Ciplukan Fruit Extract (*Physalis angulata* L.)

Based on the results of the effervescent powder base evaluation, 3 effervescent powder preparation formulas were made with the addition of ciplukan fruit extract (*Physalis angulata* L.) with concentration variations of 5%, 10%, and 15%. The formulation of effervescent powder preparations can be seen in Table 5.

Table 5. Formulation Results of Ciplukan Fruit Extract Effervescent Powder Preparation (*Physalis angulata* L.)

Material Name	Concentration (% w/b)		
	F1	F2	F3
Ciplukan Fruit Extract	5	10	15
Citric Acid	7,5	7,5	7,5
Asam Tartrat	15	15	15
Sodium Bicarbonate	18,75	18,75	18,75
Sucrose	8	8	8
Dextrin	ad 100	ad 100	ad 100

Description:

1. F1: Effervescent powder formula 5% citrus fruit extract concentration
2. F2: Effervescent powder formula 10% ciplukan fruit extract concentration
3. F3: Effervescent powder formula 15% citrus fruit extract concentration

Source: Primary data, 2025

Evaluation and Stability of Ciplukan Fruit Extract Effervescent Powder Preparation (*Physalis Angulata* L.)

The results of the evaluation of the effervescent powder preparation of citrus fruit extract (*Physalis angulata* L.) showed that the entire formula had good physical characteristics during storage for 28 days at room temperature. Organoleptic testing showed no significant changes in shape, color, smell, or taste, indicating good physical stability. The flow time test produces values ranging from 7.6–8.2 seconds, while the idle angle test is in the range of 26°–28°, which indicates that the whole formula meets the requirements of good powder flow properties. Small differences between formulas are influenced by the distribution of particle size, moisture content, and extract concentration, where formulas with higher moisture content tend to have slightly decreased flow properties due to increased cohesiveness between particles.

The results of the moisture content test showed that all formulas had a moisture content of 2–4.5%, so it was still below the maximum required limit (<5%) and reflected good storage stability. Dispersion time testing resulted in a dissolution time ranging from 127–155 seconds, which still met the quality requirements of effervescent preparations, although formulas with higher extracts concentrations required slightly longer dissolution times due to the content of secondary metabolite compounds. In addition, the pH test results are in the range of 4.5–5, which is still in accordance with the pH standard of effervescent preparations. Overall, the entire formula exhibits physical characteristics that meet quality requirements, are stable during storage, and have the potential to be developed as an effervescent powder preparation made from citrus fruit extract.

Antioxidant Activity Test of Ciplukan Fruit Extract Effervescent Powder Preparation (*Physalis angulata* L.)

The antioxidant activity test of effervescent fruit extract powder preparation (*Physalis angulata* L.) using the DPPH method was carried out on F1 (5%), F2 (10%), and F3 (15%). Antioxidant activity testing was carried out 5 times during storage, namely on days 1, 4, 14, 21, and 28 to determine the antioxidant activity of effervescent powder preparations that can reduce or inhibit free radicals during storage. The parameter used to indicate antioxidant activity is IC₅₀ (Inhibitor Consent), where the lower the IC₅₀ value, the higher the antioxidant activity. A compound is considered to have very strong antioxidant activity if the IC₅₀ value is < 50 ppm, if it is strong the IC₅₀ value ranges from 50 – 100 ppm, while if the IC₅₀ value ranges from 100 – 150 ppm is considered weak, and the IC₅₀ value ranges from 200 – 1000 ppm is considered very weak. The results of the antioxidant activity test of the effervescent powder preparation of citrus fruit extract can be seen in Table 6 and Figure 1.

Table 6. Results of Antioxidant Activity Test Preparations of Ciplukan Fruit Extract Effervescent Powder (*Physalis angulata* L.)

Erioseema Powder (Physalis angulata L.)									
Sample	1	IC50			Average ±	Description	Say.		
		(ppm)							
		7	14	21					
F1	20,96	23,07	28,07	29,74	34,57	27,28 ±	Very Powerful		
F2	20,82	21,23	21,73	28,57	29,42	24.34 ±	Very Powerful	0,000	
F3	19,71	20,14	21,71	25,53	26.13	22.65 ±2.659	Very Strong	22,65 ±	

Source: Primary data, 2025

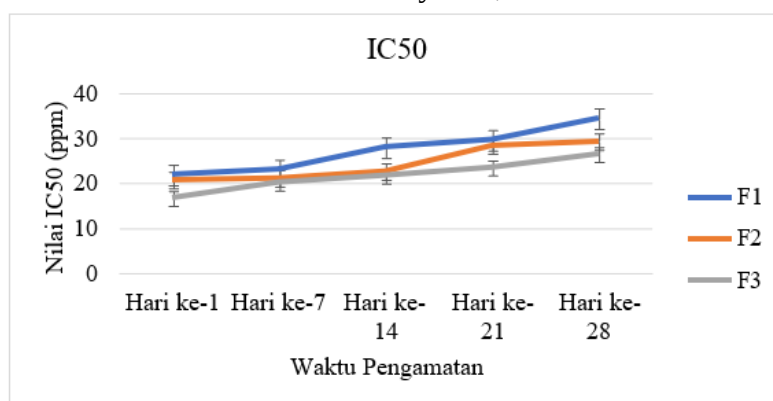


Figure 1. Graph of Antioxidant Activity Test Results of Ciplukan Fruit Extract Effervescent Powder Preparation (*Physalis angulata* L.)

Source: Primary data, 2025

The IC₅₀ value shown in Table 6 is in the range of 22 – 27 ppm. The graph in Figure 1 shows the downward trend of the IC₅₀ from F1 to F3. This decrease indicates the stronger antioxidant activity as the concentration of the extract increases. This is due to the increased content of phenolic compounds and flavonoids in formulas with higher extracts that act as electron donors to neutralize free radicals. Based on the classification (Kurniawati & Sutoyo, 2021), the IC₅₀ value < 50 ppm is included in the category of antioxidants is very strong, so

that effervescent powder of ciplukan fruit extract has the potential to be developed as a natural source of antioxidants.

Determination and Extraction of Ciplukan Fruit (*Physalis angulata* L.)

In this study, ciplukan fruit plants (*Physalis angulata* L.) were used as samples obtained from Cikareo Village, Alamendah Village, Rancabali District, Bandung Regency, West Java Province. The determination of ciplukan fruit plants (*Physalis angulata* L.) was carried out at the Jatinangor Herbarium of the Plant Taxonomy Laboratory, Department of Biology, FMIPA UNPAD. Plant determination aims to ensure the correctness of the plant used is in accordance with the research sample in question. The results of the determination showed that the sample used in this study was indeed a ciplukan fruit plant with the scientific name *Physalis angulata* L. and the solanaceae family.

The ciplukan fruit (*Physalis angulata* L.) used as a sample is ripe and fresh fruit so it has a higher content of active compounds (Ade Chandra Iwansyah et al., 2019). Ciplukan fruit is known to contain phenolic compounds - flavonoids that contribute to antioxidant activity so that in the extraction process fresh fruit is used to avoid degradation of thermolabile compounds or oxidation. Drying has been proven to reduce the level of ascorbic acid (36-55%) compared to using fresh ingredients. Although some drying conditions can increase total phenol levels, vitamin C and other thermolabile components are reduced. The use of fresh ingredients in the maceration extraction method can further maintain the stability of thermolabile compounds such as vitamin C and flavonoids (Babaei Rad et al., 2025).

Extraction of citrus fruit (*Physalis angulata* L.) using the maceration method. The maceration method is used because it is more effectively used for the extraction of samples that are not resistant to direct heating. The solvent used in this study is 96% ethanol because ethanol is universal so it is effective in dissolving various types of secondary metabolic compounds, both polar and semipolar. In addition, ethanol is relatively non-toxic and volatile, making it easier to separate and concentrate extracts (Adriana et al., 2024). Extraction using the maceration method is carried out in stages to maximize the process of extracting chemical compounds contained in the sample of citrus fruit. Thickening is carried out at a temperature of 60°C, because bioactive components such as flavonoids cannot withstand high temperatures above 60°C (Syafriana & Puspitasari, 2024). The results of the thickening of the extract produced a thick extract of 391 grams. The total yield of ciplukan fruit extract (*Physalis angulata* L.) was obtained at 13.03%. Based on research conducted by Primadiamanti et al, in 2024, it is stated that 400 grams of ciplukan fruit produces 45.3 grams of thick extract with a total yield of 11.32%. The difference in the number of samples and the number of solvents is one of the factors in the difference in the yield results. The yield yield of ciplukan fruit extract is said to be good because the yield yield is >10%. The quality of the extract is influenced by the length of the filtering process, the longer the filtering process lasts, the more compounds are dissolved. The volume of the solvent also affects the yield of the extraction, the larger the volume of solvent used, the more groups of compounds are attracted from the simplicia.

Phytochemical Filtration and Antioxidant Activity Test of Ciplukan Fruit Extract (*Physalis angulata* L.)

Phytochemical filtration of ciplukan fruit extract (*Physalis angulata* L.) aims to determine the content of compounds contained in the extract. Based on the results of phytochemical filtration, ciplukan fruit extract (*Physalis angulata* L.) contains flavonoid

compounds, alkaloids, saponins, tannins, phenols, steroids, glycosides, and quinones. Research conducted by Primadhamanti et al in 2024 resulted in citrus fruit extract containing saponin compounds, steroids, tannins, flavonoids, alkaloids, and phenols. The presence of phenolic compounds contained in the Ciplukan plant (*Physalis angulata L.*) plays an important role in its use as an antioxidant because it has an antioxidant mechanism of action that depends on redox reactions (Andriani & Murtisiwi, 2020).

Testing of the antioxidant activity of ciplukan fruit ethanol extract (*Physalis angulata L.*) was carried out using the DPPH method with the aim of determining the free radical inhibition activity in ciplukan fruit extract. In the determination of antioxidant activity using the DPPH method, it was measured with the value of IC₅₀ (Inhibitor Concentration Ratio). IC₅₀ is a tested concentration of compounds capable of inhibiting free radical activity by up to 50%. The lower the IC₅₀ value, the higher the ability of the compound to absorb free radicals. The antioxidant activity test was carried out using a UV-Vis spectrophotometer with a wavelength of 517 nm. Before the sample was measured, its absorption was carried out with a UV-Vis spectrophotometer, incubation for 30 minutes was carried out in a dark place first. This is done to detect purple color changes in the sample. This discoloration occurs when free radicals are reduced due to a reaction between the DPPH molecule and the hydrogen atom of the antioxidant compound resulting in a stable compound and changing the color of the DPPH from purple to yellow (Hairunisa et al., 2021).

Based on the classification of IC₅₀ values, ciplukan fruit extract (*Physalis angulata L.*) and vitamin C are 17.33 µg/mL, 1.54 µg/mL respectively, so they are classified as very powerful antioxidants because they have an IC₅₀ value < 50 ppm (Toding et al., 2024). This study is in line with the results conducted by Farida et al in 2025 which examined ciplukan fruit (*Physalis angulata L.*) which has a very strong antioxidant activity of 14.99 µg/mL. Although there are differences in the parts of the plant used, both fruits and leaves contain secondary metabolite compounds of the flavonoid group, so the biological activity produced is relatively similar. The difference in IC₅₀ values can be caused by variations in the levels of the active compound between the fruit and leaves because the distribution of secondary metabolites in the plant is uneven in each section.

Formulation and Evaluation of Effervescent Powder Base

The raw materials used in the manufacture of effervescent powder consist of an acid source and an alkaline source. Citric acid is used as one of the main sources of acid in the manufacture of effervescent powders that can produce carbon dioxide in the form of foams or bubbles when reacting with sodium bicarbonate. Tartric acid is added to complement the function of citric acid by reducing the risk of the powder experiencing dampness (caking) during storage, so that the combination of citric acid and tartric acid can create a balance of flavor, stability, and reaction speed. Sodium bicarbonate is an alkaline source that can neutralize the acidity of the solution to make it more comfortable when consumed. (Faidah & Na'imah, 2024). Sucrose is used as a sweetener to mask the acidic taste caused by effervescent reactions and plays a role in improving the consistency of the powder. The addition of dextrin serves as a binding agent and can help maintain the homogeneity of the powder (Sagala et al., 2021).

The results of the evaluation of the effervescent powder-based organoleptic test for 28 days obtained effervescent powder in the form of a fine powder, white in color, odorless and

sour taste which showed that the preparation was physically stable because it did not undergo changes in shape, color, smell, and taste during storage.

The results of the effervescent powder base flow time test in storage for 28 days showed that the effervescent powder base flow time was physically stable because based on the results of the One-Way ANOVA statistical test, a value of 0.663 (sig.> 0.05) which means there is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder base had a good flow time, which was < 10 seconds (Syaputri et al., 2023).

The results of the effervescent powder base idle angle test at storage for 28 days showed that the effervescent powder base idle angle was physically stable because based on the results of the One-Way ANOVA statistical test, a value of 0.563 (sig.> 0.05) which means there is no significant difference. Based on the results of the statistical test, it is shown that the effervescent powder base meets the criteria for the stationary angle of effervescent powder preparations, which is $\leq 40^\circ$ (Syaputri et al., 2023).

The results of the effervescent powder base moisture test in storage for 28 days showed that the moisture content of the effervescent powder base was physically stable because based on the results of the One-Way ANOVA statistical test, a value of 0.716 (sig. > 0.05) which means there is no significant difference. Based on the results of the statistical test, it shows that the effervescent powder base has met the requirements, namely the moisture content value is below 5% (Syaputri et al., 2023).

The results of the effervescent powder base dissolution time test for 28 days showed that the effervescent powder base dissolution time was physically stable because based on the results of the One-Way ANOVA statistical test, a value of 0.653 (sig.>0.05) which means there is no significant difference. Based on the results of these statistical tests, it shows that effervescent powder bases have a good dissolving time, which can dissolve in no more than 5 minutes (Sifaiya & Hasan, 2023).

The results of the effervescent powder-based pH test in storage for 28 days showed that the pH value of the effervescent powder-based was physically stable because based on the results of the One-Way ANOVA statistical test, a value of 0.680 (sig. > 0.05) was obtained, which means that there was no significant difference. Based on the results of the statistical test, it shows that the effervescent powder base has a pH that is in accordance with the requirements of effervescent powder, which is 4.5 – 6 (SNI 01-4320-1996 on Effervescent Powder Drinks).

Based on the results of the effervescent powder base evaluation and stability test during 28 days storage, the effervescent powder base has stable physical stability and has met the requirements of organoleptic test, flow time and idle angle test, moisture content test, dispersion time test, and pH test.

Formulation and Stability Test of Effervescent Powder Preparations of Ciplukan Fruit Extract (*Physalis angulata* L.)

Based on the results of the evaluation of the effervescent powder base, an effervescent powder formula was then made with the addition of ciplukan fruit extract (*Physalis angulata* L.) with concentration variations of 5%, 10%, and 15% respectively. The use of this concentration variation is based on previous research from the manufacture of antioxidant effervescent powder preparations with modification of broccoli juice extract as the active ingredient (Kurniaty et al., 2021). Based on the results of the evaluation test, effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) have different colors and odors in each

preparation formula. The addition of ciplukan fruit ekstrak to the effervescent powder base with variations in concentration can affect the color of each preparation. The higher the concentration of ciplukan fruit extract added, the more visible the color produced. The results of the stability test of the effervescent powder preparation of ciplukan fruit extract (*Physalis angulata* L.) at storage for 28 days showed that the preparation was physically stable because it did not undergo changes in shape, color, taste, and smell.

The evaluation of the flow time test of effervescent powder preparations aims to assess the ability of the powder or particles to flow. The powder flow time is measured from the moment the powder starts flowing to stop using a stopwatch. Based on the results of the flow time stability test of the effervescent powder preparation of ciplukan fruit extract (*Physalis angulata* L.) F1 (5%), F2 (10%), and F3 (15%) for 28 days showed that the flow time of the effervescent fruit extract powder preparation differed in each formula and increased after storage. There is an increase in flow time due to the physical properties of the powder caused by moisture absorption. However, effervescent powder preparations are still relatively stable physically because based on the One-Way ANOVA statistical test, an F1 value (5%) was obtained (sig. 0.646 > 0.05); F2 (10%) (sig. 0.695 > 0.05); and F3 (15%) (sig.

0.801 > 0.05) which means there is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) had a stable flow speed and did not experience significant differences during the 28-day storage and were in accordance with the good flow time criterion of < 10 seconds. F3 (15%) is the best formula compared to F1 (5%) and F2 (10%) because it has a faster average flow time of 7.6 – 7.7 seconds. (Syaputri et al., 2023).

The evaluation of the silent angle test of effervescent powder preparations aims to assess the ability of the powder or particles in flow. The low idle angle indicates the powder has a good flow and facilitates the packaging process. Based on the results of the stationary angle stability test of effervescent fruit extract powder preparation (*Physalis angulata* L.) F1 (5%), F2 (10%), and F3 (15%) for 28 days showed that the resting angle of the effervescent fruit extract powder preparation differed in each formula and increased after storage. There is an increase in idle angle due to the physical properties of the powder caused by moisture absorption. However, effervescent powder preparations are still relatively stable physically because based on the One-Way ANOVA statistical test, an F1 value (5%) was obtained (sig. 0.629 > 0.05); F2 (10%) (sig. 0.714 > 0.05); and F3 (15%) (sig. 0.874 > 0.05) which means there is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) had stable flow power and did not experience significant differences during 28-day storage and were in accordance with the good idling angle criterion of $\leq 40^\circ$. F3 (15%) is the best formula compared to F1 (5%) and F2 (10%) because it has a smaller average idle angle (Syaputri et al., 2023).

The evaluation of the moisture content test of effervescent powder preparations aims to determine the amount of moisture contained in the preparation. The moisture content can affect the flow characteristics and solubility of the powder. Based on the results of the moisture content stability test of the effervescent powder preparation of ciplukan fruit extract (*Physalis angulata* L.) F1 (5%), F2 (10%), and F3 (15%) for 28 days showed that the moisture content of ciplukan fruit extract effervescent powder preparations differed in each formula and increased after storage. There is an increase in moisture content due to the physical properties

of the powder caused by moisture absorption. However, the effervescent powder preparation is still relatively stable physically because based on the One-Way ANOVA statistical test, an F1 value (5%) was obtained (sig. 0.672 > 0.05); F2 (10%) (sig. 0.736 > 0.05); and F3 (15%) (sig. 0.753 > 0.05) which means there is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) had a stable moisture content and did not experience significant differences during 28-day storage and were in accordance with the requirement of good moisture content, which was below 5% value. F3 (15%) is the best formula compared to F1 (5%) and F2 (10%) because it has a lower average moisture content of 2%. (Syaputri et al., 2023).

The evaluation of the dispersion time test of effervescent powder preparations aims to assess how quickly or slowly a powder or formulation can disperse or dissolve in a medium, such as water. The time is measured from the moment all the powder is dipped until it is completely dissolved and has completed its reaxis. Based on the results of the time stability test of the effervescent powder preparation of ciplukan fruit extract (*Physalis angulata* L.) F1 (5%), F2 (10%), and F3 (15%) for 28 days showed that the dispersion time of effervescent fruit extract preparations differed in each formula and increased after storage. There is an increase in dispersion time due to the physical properties of the powder caused by moisture absorption. However, the effervescent powder preparation is still relatively stable physically because based on the One-Way ANOVA statistical test, an F1 value (5%) was obtained (sig. 0.523 > 0.05); F2 (10%) (sig. 0.708 > 0.05); and F3 (15%) (sig. 0.841 > 0.05) which means there is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) had a stable dispersion time and did not experience significant differences during the 28-day storage and in accordance with the requirements of a good dispersion time, which can be completely dissolved in no more than 5 minutes. F3 (15%) is the best formula compared to F1 (5%) and F2 (10%) because it has a faster average dispersion time (Sifaiya & Hasan, 2023).

The pH test evaluation of effervescent powder preparations aims to assess the acidity level of the preparation after dissolution. The level of similarity in effervescent preparations must be as required so as not to cause irritation to the stomach. Based on the results of the pH stability test of effervescent powder preparations of citrus fruit extract (*Physalis angulata* L.) F1 (5%), F2 (10%), and F3 (15%) for 28 days showed that the pH value of the effervescent fruit extract powder preparation was different in each formula and increased after storage. There is an increase in the pH value due to unstable storage temperatures. However, the effervescent powder preparation is still relatively stable physically because based on the One-Way ANOVA statistical test, an F1 value (5%) was obtained (sig. 0.615 > 0.05); F2 (10%) (sig. 0.800 > 0.05); and F3 (15%) (sig. 0.856 > 0.05) which means

There is no significant difference. Based on the results of the statistical test, it was shown that the effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) had a stable pH value and did not experience significant differences during 28-day storage and were in accordance with the pH requirement of a good effervescent preparation which was 4.5 - 6. F3 (15%) is the best formula compared to F1 (5%) and F2 (10%) because it has an average safe pH value (SNI 01-4320-1996 on Effervescent Powdered Drinks).

Based on the results of the evaluation and physical stability test of the effervescent powder preparation of ciplukan fruit extract (*Physalis angulata* L.) during storage of 28 days,

it was obtained that F3 with ciplukan fruit extract (*Physalis angulata L.*) 15% is the most optimal formula because it has the most stable physical stability and has met the requirements of organoleptic test, flow time and idle angle test, moisture content test, dispersion time test and pH test.

Antioxidant Activity Test of Ciplukan Fruit Extract Effervescent Powder Preparation (*Physalis angulata L.*)

In the antioxidant activity test of effervescent powder preparations of ciplukan fruit extract (*Physalis angulata L.*) was carried out using the DPPH method against F1 (5%), F2 (10%), and F3 (15%). In determining antioxidant activity using the DPPH method, it was measured with an IC₅₀ (Inhibitor Consent) value. IC₅₀ is a tested concentration of compounds capable of inhibiting free radical activity by up to 50%. The lower the IC₅₀ value, the higher the ability of the compound to absorb free radicals. The antioxidant activity test was carried out using a UV-Vis spectrophotometer with a wavelength of 517 nm. Before the sample was measured, its absorption was carried out with a UV-Vis spectrophotometer, incubation for 30 minutes was carried out in a dark place first. This is done to detect purple color changes in the sample. This discoloration occurs when free radicals are reduced due to a reaction between the DPPH molecule and the hydrogen atom of the antioxidant compound resulting in a stable compound and changing the color of the DPPH from purple to yellow (Hairunisa et al., 2021).

The results of the antioxidant activity test of effervescent powder preparation of ciplukan fruit extract (*Physalis angulata L.*) showed an increase in the IC₅₀ value of ciplukan fruit extract, but it is still classified as a very strong antioxidant activity. The increase in IC₅₀ value is likely due to compounds contained in effervescent powder preparations that bind to the active compounds in citrus fruit extract during the formulation process, resulting in certain products that cannot function as electron donors in DPPH free radicals and cause a decrease in free radical capture activity. However, citrus fruits (*Physalis angulata L.*) are known to contain phenolic compounds that are susceptible to oxidative and hydrolytic degradation during storage, so reduced phenolic levels will raise the concentration required to achieve 50% of free radical capture (IC₅₀) (Vargas et al., 2025).

In the One-Way ANOVA statistical test, the results of the antioxidant activity test of effervescent powder preparations during 28-day storage were obtained a value of 0.000 (sig. > 0.05) which means that there is a significant difference. Then followed by a Post Hoc test to find out more about the differences that occur in each preparation formula. Based on the results of these statistical tests, it is shown that effervescent powder preparations F1 (5%), F2 (10%), and F3 (15%) have significantly different antioxidant activities. This shows that there is an effect of variations in the concentration of ciplukan fruit extract in each preparation on its antioxidant activity. The higher the concentration of extracts added, the smaller the IC₅₀ value so that the stronger the antioxidant activity in effervescent powder preparations because ciplukan fruit extract contains flavonoid compounds that function as antioxidants (Vargas et al., 2025).

Based on the results of the antioxidant activity test of effervescent powder preparations during storage for 28 days, F3 with a concentration of citrus fruit extract (*Physalis angulata L.*) of 15% is a preparation with very strong antioxidant activity compared to F1 (5%) and F2 (10%) and is the most optimal formula because it has the most stable physical stability and has

met the requirements of organoleptic test, flow time test, silent angle test, moisture content test, dispersion time test, and pH test.

CONCLUSION

Based on the results and discussion of this study, it can be concluded that the effervescent powder formulations containing ciplukan fruit extract (*Physalis angulata L.*) at concentrations of F1 (5%), F2 (10%), and F3 (15%) exhibited very strong antioxidant activity, with average IC₅₀ values of 27.28 ppm, 24.34 ppm, and 22.65 ppm, respectively. Formula F3 (15%) demonstrated the strongest antioxidant activity compared with F1 (5%) and F2 (10%) and showed the highest physical stability. Ciplukan fruit extract (*Physalis angulata L.*) could be formulated into an effervescent powder preparation, with F3 (15%) identified as the most optimal formulation due to its superior physical stability during storage. The effervescent powder formulations containing ciplukan fruit extract at concentrations of F1 (5%), F2 (10%), and F3 (15%) maintained stable physical characteristics and met the required quality standards throughout the 28-day storage period based on evaluation parameters, including organoleptic properties, flow rate, angle of repose, moisture content, dispersion time, and pH. Further research is recommended to conduct in vivo studies on effervescent powder preparations containing ciplukan fruit extract (*Physalis angulata L.*) to evaluate antioxidant bioavailability and effectiveness in biological systems. Future studies may also evaluate the antioxidant activity of ciplukan fruit extract using the ABTS method to provide additional comparative evidence.

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