Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

Formulation and Correlation of Acid-Base Concentration to Effervescent Granules of Pumpkin (*Cucurbita moschata* Duchesne) Extract with Foam Mat Drying Method

Dessy Erliani Mugita Sari[1], Anisa Ika Pramestuti[2], Endra Pujiastuti[3], Ricka Islamiyati[4], Lilis Sugiarti[5]
[1-5] Department of Pharmacy,Institut Teknologi Kesehatan Cendekia Utama Kudus, Central Java, Indonesia
***Corresponding Author:** dessyerliani3@gmail.com

(Received: October 22, 2025 Revised: December 3, 2025 Accepted: December 5, 2025)

ABSTRACT

Introduction: Free radicals trigger the emergence of various diseases. Compounds that can counteract free radicals are antioxidants. Pumpkin (*Cucurbita moschata* Duchesne) is a type of food that contains compounds that have antioxidant properties. Steps to increase people's consumption power is to make pumpkin into effervescent. The correct concentration of acid and base in the preparation of effervescent is very important. Foam mat drying method is often used in the manufacture of instant drinks.
Objective: The purpose of this study was to obtain an optimum formulation of acid and base concentrations in effervescent of pumpkin extract (*Cucurbita moschata* Duchesne) made by foam mat drying.
Methods: Pumpkin was extracted using maceration method with aquadest as solvent. The maserat were dried using the foam mat drying. The dried pumpkin extract was formulated into effervescent with the ratio of citric acid and sodium bicarbonate at F1 20:25, F2 25:25 and F3 30:25. Effervescent granules were evaluated which included organoleptic tests, moisture content, angle of repose, flow time, compressibility, pH and dissolving time.
Results: Pumpkin extract (*Cucurbita moschata* Duchesne) using foam mat drying can be formulated into effervescent. F1 has a lower water content, . The value all of formula of the angle of repose that is is between 25°-45°, F1 has the highest carr index compared to other formulations, and is followed by F2 and F3, All formulations have met the standard of good effervescent granules is < 5 minutes.
Conclusion: The higher the concentration of citric acid makes the flow time slower, lowers the pH value and slows down the dissolution time. The higher the concentration of sodium bicarbonate, the better the compressibility value

Keywords : Pumpkin, effervescent, foam mat drying, citric acid, sodium bicarbonate.

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

INTRODUCTION

In recent years the term free radicals is very popular. This highly reactive chemical molecule is touted as the cause of premature aging, and diseases such as cancer, narrowing of blood vessels (atherosclerosis), lung, liver, kidney, cataract, rheumatism and diabetes disorders are often associated with free radicals (Khaira, 2010). According to Pratama & Busman (2020) research, free radicals have an important role in tissue damage and pathological processes in living organisms.

Antioxidants are important compounds that play a role in the human body as an antidote to free radicals (Labola & Puspita, 2018). Additional antioxidants that come from outside the body (exogenous antioxidants) can come from the intake of food and beverages consumed every day (Parwata, 2016). Some examples of food with antioxidants such us vitamin A: carrots, broccoli, green vegetables, spinach, pumpkin, liver, potatoes, eggs, apricots, mangoes, milk and fish (Sayuti & Yenrina, 2015).

Pumpkin (*Cucurbita moschata* Duchesne) is one of the plant sources of food that has high nutritional content and fine fiber so it is easy to digest. This plant is a rich of carotenoids, phenolics, flavonoid polysaccharides, mineral, and vitamins, all of which are beneficial for health as revealed by Aukkanit & Sirichokworrakit (2017). The total carotenoid content in pumpkin extract was 24.64 g/g (Gumolung *et al*., 2013). The amount of beta carotene and antioxidant activity in dried pumpkin showed higher yields than fresh pumpkin. Beta carotene in 100 g of fresh pumpkin is 10.64 mg and has antioxidant activity of 77.22 mg. Meanwhile, the level of beta carotene in 100 g of dried pumpkin was 7.56 mg with antioxidant activity of 98.92 mg (Nakhon *et al*., 2017). Pumpkin has antioxidant levels with an IC_{50} from pumpkin water extract of 12.30 g/ml (Govindani *et al*., 2012).

Pumpkin is a food commodity whose utilization is still limited. Public knowledge of health foods made from pumpkin is still very low (Fitriyah & Baharuddin, 2016). One effort to increase practicality and public interest is to make pumpkin fruit in the form of extracts and then formulated in the form of effervescent (Egeten *et al*., 2016). According to Fajar *et al*. (2013) effervescent is an alternative that can be chosen in pumpkin processing because it is practical, quickly dissolves in water, provides a clear solution, and provides a refreshing effect.

The basic formula for effervescent is the reaction between acid compounds (acidulant) with carbonate or bicarbonate to produce carbon dioxide. The concentration of acid and sodium bicarbonate can affect the refreshing effect and the formation of carbon dioxide gas (effervescing). The unbalanced carbon and acid content in the product can cause the product to lose or reduce the refreshing taste effect and the formation of gas bubbles. This is because the concentration of bicarbonate salt is not right to be able to completely react with the existing concentration of citric acid (Sandrasari & Abidin, 2012).

One of the drying techniques in the manufacture of powdered drinks is foam mat drying (Minah *et al*., 2021). The advantage of this method is that the process is simple and inexpensive, the drying temperature used is not too high ranging from 50º–80ºC so that it can produce a fairly good quality of color and taste because the color of the product is not damaged and fragrance & taste substances are not lost. The product becomes more stable so that the product life will be more durable (Muliyanti, 2017).

MATERIALS AND METHODS

Type of Research

The type of research in this research is experimental research. The research was conducted to obtain the optimum acid base concentration formulation in the *effervescent* of pumpkin extract using *foam mat drying* method.

Population and sample

The population in this study was pumpkin from Sukolilo Village, Pati Regency, Central Java. The sample of this research is ripe pumpkin that ready to harvest with the characteristics of hard skin, green to yellowish color, smooth surface and looks smooth with an average weight of 3-5 kg. Pumpkin is selected fresh, not rotten, and bright yellow to *orange*.

Tools

Mixer (Philips), blender (Philips), oven (Memmert), pan, analytical balance (Ohaus), sieve mesh no 16, mesh no 18 and mesh no 40, flow tester (Local), density tester (Local), ruler , stopwatch, pH meter and practical glassware.

Ingredients

Foam mat drying pumpkin extract, citric acid (Brataco), sodium bicarbonate (Brataco), lactose (Brataco), PVP (Brataco) and aspartame (Brataco).

Research Procedures

1. Determination of pumpkin plants

   Determination of pumpkin plants was carried out at the Biology Learning Laboratory, Faculty of Applied Science and Technology, Ahmad Dahlan University. The purpose of this plant identification was to determine the true identity of the plants under study, namely that the sample was *Cucurbita moschata* Duchesne. so as to avoid the error of collecting the main material.

2. Making Pumpkin Simplicia

   Pumpkin that has been obtained as much as 3000 g will go through several processes, the first is wet sorting. Wet sorting is done to impurities or other foreign materials from simplicia materials. The second is the material washing process. This washing is carried out to remove soil or other impurities attached to the simplicia material, washing is carried out using clean water. The third process is chopping, where chopping is done to facilitate the drying process. The next process is drying, where the drying process is carried out with the aim of getting simplicia that is not easily damaged so that it can be stored for a long time. The pumpkin was dried by placing it in a simplicia drying cabinet at a temperature of 50oC for approximately 24 hours until it was dry. The dried pumpkin slices were then re-weighed for calculation of drying loss. Drying shrinkage can be calculated by the formula (Nugroho *et al*., 2019):

   $$\% \text{ Drying Loss} = \frac{\text{wet weight} - \text{dry weight}}{\text{wet weight}} \times 100\%$$

   Procedure of the moisture content of simplicia powder is carried out using a moisture balance with 3 replications

3. Making Pumpkin Extraction

   Pumpkin simplicia powder as much as 250 g was soaked in 1000 ml of distilled water or in a ratio of 1:4 and macerated for 1 day at room temperature while stirring 3 times a day for 45 minutes. This stirring aims to release the active substance in pumpkin extract. The solution is then filtered with a flannel cloth and accommodated in a container. Remaceration is not carried out in this process because it avoids the presence of microorganisms in the macerate results (Govindani *et al*., 2012).

4. Making *Foam Mat Drying* Pumpkin Extract

   Pumpkin maserate obtained from the extraction of 1000 ml was added with 100 g of dextrin (10% of the total sample) and 1 g of tween 80 (1% of the total sample). The mixture of ingredients is beaten using a mixer for 10 minutes until foam is formed. The liquid foam is then placed and flattened on a baking sheet that has been lined with aluminum foil, put the baking sheet into the oven and dried for 4 hours at a temperature of 50°C. The result of drying in the form of a slab is removed from the pan, then mashed and sieved with an 18 mesh sieve (Purbasari, 2020).

5. Pumpkin Extract Testing

   a. Phytochemical Screening Analysis

      The analysis was carried out using the tube method which included identification of flavonoids (Depkes RI, 1989):

0.5 g of pumpkin extract was dissolved in 10 ml of 70% ethanol, then flavonoid identification was carried out with the following tests:

1) Wilstater Test, 1 ml of pumpkin extract solution added 0.1 g of Mg powder and 2-4 drops of concentrated HCl. Orange to red color indicates positive containing flavonoids.
2) Bate Smith-Metchalf Test, 1 ml of pumpkin extract solution. 0.5 ml of concentrated HCl was then heated in a Bunsen. If a red color change is formed, it is positive that it contains flavonoids.

NaOH 10% Test, 1 ml of pumpkin extract solution, a few drops of 10% NaOH solution then forming a thick orange or orange color, so it is positive for flavonoids.

b. Testing Moisture Content

The pumpkin extract was weighed as much as 1 g, put into the moisture balance device and then waited for the percent moisture content to appear on the screen of the device, do replications 3 times. A good water content is not more than 10% (Mubarok *et al*., 2020).

6. Making Effervescent Granules

Formulation of effervescent granules used was taken from the research formulation conducted by Mubarok *et al*. (2020) with some modifications, it can be seen in the table below:

Table 1 Formulation of effervescent granules

Ingredients	**The best concentration**	**Function**	**Formulation (%)**		
			F1	F2	F3
Foam mat drying pumpkin extract	≤35%	Antioxidant source	10	10	10
Aspartam	1-5%	Sweetener	1	1	1
Citric acid	25-40%	Acid source	20	25	30
Sodium bicarbonate	25-40%	Base source	25	25	25
PVP	0,5-5%	Binder	5	5	5
Lactose	5-80%	Filler	Add 100	Add 100	Add 100

7. Evaluation of Physical Properties *Effervescent* of Pumpkin Extrac

a. Organoleptic Test

Organoleptic test is an test to carried out with the five senses including visible color, taste, and smell (Lestari & Susilawati, 2015).

b. Moisture Test

A total of 1 g effervescent were added to the moisture balance. The granules are leveled then the tool is run, and then the water content contained in the granules will be obtained. The requirement for a good water content of effervescent is 0.4-0.7% (Lestari *et al*., 2014).

c. Angle of repose Test

Weighed 25 g of effervescent granules *and* put into a *flow tester* with the end of the stem closed then the cover was opened and the *effervescent* were allowed to flow. Measured the height of the cone and the radius of the cone formed, the angle calculated using the formula (Bangu, 2018):

$$\text{Tan } \alpha = \frac{\text{cone height}}{\text{cone radius}}$$

d. Flow Time Test

Weighed 25 g *effervescent* and then put into the *flow tester*. The flow time is calculated from the time the *effervescent* begin to flow until *effervescent* stop flowing and the time is calculated using a stopwatch (Sala, 2016).granules *effervescent* is if the time required to flow 25 g

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

effervescent is not more than 2.5 seconds (Voight, 1995).

e. Compressibility Test

Weighed 50 g *effervescent* into a measuring cup contained in the *density tester* and recorded the initial volume (V0), then run the tool. Volume changes are recorded after determination (Vn). The calculation of compressibility can be seen in the formula below (Bangu, 2018):

$$\textit{Indeks Carr} = \frac{\text{Initial volume} - \text{Final volume}}{\text{Initial volume}} \times 100\%$$

f. pH Test

Weighed as much as 2 g of *effervescent* and dissolved in 200 ml of aquadest then the pH was measured using a pH meter, and the measurement results were said to be good if the pH of the *effervescent* close to neutral, namely 6-7 (Rahmah, 2006).

g. Dissolution Time

Weighed as much as 2 g of effervescent and dissolved with the help of stirring in 200 ml of distilled water. Observations were made from the time the effervescent until the reaction ran out, where the bubbles of carbon dioxide (CO_2)had stopped. Good effervescent time of <5 minutes (Lestari *et al*., 2014).

7. Statistical Data Analysis

The parametric data on the physical properties of the granules which includes the water content test, angle of repose test, flow time test, compressibility test, and dissolution time test were analyzed by hypothesis testing, namely normality test, using the SPSS 25 program. normality shows the results are normally distributed, then using the Pearson Product Moment. However, if it is not normally distributed, it is continued with a non-parametric test using Spearman's Rank.

RESULTS

1. Determination results of pumpkin plants

The results of the determinations that have been carried out at the Biology Learning Laboratory, Faculty of Applied Science and Technology, Ahmad Dahlan University, showed that the pumpkin plant taken from Sukolilo Village, Pati Regency, Central Java, has the Latin name *Cucurbita moschata* Duchesne.

2. Results of Making Pumpkin Simplicia

From 3000 g of dried pumpkin, 270 g of simplicia was obtained and 260 g of simplicia powder was obtained. This pumpkin simplicia powder has a brownish yellow color, bland taste and has a sweet pumpkin smell.

Table 2 Yield of Yellow Pumpkin Simplicia Powder

Weight Fresh Pumpkin	Weight of Simplicia	Weight of Simplicia Powder	Drying Lost	Color
3000 g	270 g	260 g	91%	Brownish yellow

The calculation of the moisture content of simplicia powder was carried out using a *moisture balance* with 3 replications and taking samples at the top, middle and bottom. The results of the measurement of water content were 8.80%, 7.25% and 7.25% so that the average result was 7.76±0.89. According to Voight (1995) the water content of simplicia that meets the quality requirements is 10% to prevent the growth of bacteria and fungi during the storage stage

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

Table 3 Results of Testing Moisture Content of Simplicia Powder

Replication	Results Moisture Content (%)	Average (%) ± SD
1	8,80	
2	7,25	7,76±0,89
3	7,25	

3. Results of Extraction of Pumpkin Extract

250 g of pumpkin simplicia powder was soaked in 1000 ml of distilled water or in a ratio of 1:4 and macerated for 1 day at room temperature while stirring 3 times a day for 45 minutes to produce a dark brown maserate. .

Table 4 Results of Extraction of Pumpkin Extract

Weight of Simplicia Powder	Solvent	Color
250 g	Aquadest 1000 ml	Dark brown

4. Results of Making *Foam Mat Drying* Pumpkin Extract

From 1000 ml of maserate, can produce 100 g of foam mat drying powder. Foam mat drying powder has the same dark brown color as the maserat yield, a bitter taste and a distinctive sweet smell of pumpkin.

Table 5 Results of Making Foam Mat Drying Pumpkin Extract

Maserate	Dextrin	Tween 80	Foam Mat Drying Powder	Color
1000 ml	100 g	1 g	100 g	Dark brown

5. Results of Pumpkin Extract Testing

a. Phytochemical Screening Analysis

Foam mat drying powder of pumpkin extract showed positive results containing flavonoids.

Table 6 Results of Phytochemical Screening of Flavonoids *Foam Mat Drying* Pumpkin Extract

Phytochemical Screening	Color	Result
Wilstater Test	Orange	(+)
Bate Smith-Metchalf Test	Red	(+)
NaOH 10% Test	Concentrated orange	(+)

Keterangan : (+) positive contains flavonoids
(-) negative contains flavonoids

b. Water Content Testing

The water content test on foam mat drying pumpkin extract aims to determine the water content in foam mat drying which can affect its durability. Because biological damage caused by bacteria or fungi can accelerate spoilage. The results of the water content test were 5.59%, 5.49% and 5.49%, respectively. The average water content test is 5.52±0.05. Where this water content has met the requirements for powder moisture content, which is 10% (Mubarok *at al.*, 2020).

Table 7 Test Results for Moisture Content of Foam Mat Drying Pumpkin Extract

Replication	Result of water content (%)	Average (%) ± SD
1	5,59	
2	5,49	5,52±0,05
3	5,49	

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

6. Evaluation Results of Physical Properties *Effervescent* of Pumpkin Extract

a. Organoleptic Test

Table 8 Organoleptic Test Results on Effervescent Granules

Formulation	Odor	Shape	Color
F1	Sweet	Granul	White Granules with brown spots
F2	Sweet	Granul	White Granules with brown spots
F3	Sweet	Granul	White Granules with brown spots

b. Moisture Content Test

Table 9 Moisture Content Test Results on Effervescent Granules

Formulation	Moisture Content Test (%)	Standard	Description
F1	0,40±0,01	0,4-0,7% (Lestari *et al*., 2014).	Meets the standard
F2	0,50±0		Meets the standard
F3	0,50±0,10		Meets the standard

c. Angle of Repose Test

Table 10 Angle of Repose Test Results on Effervescent Granules

Formulation	Angle of Repose (^{0})	Standard	Description
F1	27±0	25^0-45^0 with lower yields show better result (Munir, 2012)	Meets the standard
F2	27±0		Meets the standard
F3	27±0		Meets the standard

d. Flow Time Test

Table 11 Flow Time Test Results on Effervescent Granules

Formulation	Uji Waktu Alir (detik)	Standard	Description
F1	2,07±0	For 25 g effervescent granule is not more than 2.5 seconds (Voight, 1995)	Meets the standard
F2	3,05±0,04		Not meets the standard
F3	3,69±0,53		Not meets the standard

e. Compressibility Test

Table 12 Compressibility Test Results on Effervescent Granules

Formulation	Indeks Carr (%)	Standard	Description
F1	7±0	11%-15% or <10% (Munir, 2012)	Meets the standard
F2	6±1		Meets the standard
F3	5,67±0,58		Meets the standard

f. pH Test

Table 13 pH Test Results on Effervescent Granules

Formulation	pH	Standard	Description
F1	7±0	Close neutral standard in 6-7 (Rahmah, 2006)	Meets the standard
F2	7±0		Meets the standard
F3	5±0		Not meets the standard

h. Dissolution Time Test

Table 14 Dissolution Time Test Results on Effervescent Granules

Formulation	Dissolving time (minute)	Standard	Description

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

F1	3±0,1	Dissolving time <5 minute (Anshory *et al*., 2007).	Meets the standard
F2	3,12±0,03		Meets the standard
F3	3,36±0,04		Meets the standard

DISCUSSION

1. Preparation Effervescent

Weighing all the ingredients and then making muchilago PVP by dissolving PVP into sufficient aquadest to make muchilago / thick solution. Make the acid part by smoothing the citric acid first by grinding it, adding part of the lactose and then homogenizing it and adding part of the muchilago PVP until the powder turns into a moist mass. The moist mass of the acid part was granulated by means of a sieve with a mesh no. 16 sieve and then in an oven at a temperature of 50ºC for 1 hour. The acid portion of the granules was then sieved with a mesh sieve no 18 (material 1).

Foam mat drying of pumpkin extract pulverized using a mesh sieve no 18 (material 2). Make the base part by homogenizing sodium bicarbonate, aspartame, part lactose and part muchilago PVP until it forms a moist mass. The moist mass of the base was granulated by means of a sieve with a mesh no. 16 then put into the oven at a temperature of 50oC for 1 hour. The granules of the base are then sieved with a mesh sieve no 18 (material 3). After all the ingredients are dry, then ingredients 1, 2 and 3 are stirred together until they are homogeneous so that they become effervescent (Mubarok *et al*., 2020).

2. Evaluation Results of Physical Properties *Effervescent* of Pumpkin Extract

a. Organoleptic Test

Organoleptic of granules effervescent includes odor test, shape test and color test. This test aims to see the physical appearance of effervescent (Faradiba *et al*., 2013). The results showed that the dosage form effervescent granules was in the form of uniform granules with white color mixed with brown spots and had a characteristic sweet smell of pumpkin. All formulations have the same physical appearance, there is no significant difference.

Table 15. Organoleptic Test Results Effervescent Granules

Formula	Odor	Shape	Colour
F1	Sweet	Granule	White Granules with Brown Spots
F2	Sweet	Granue	White Granules with Brown Spots
F3	Sweet	Granule	White Granules with Brown Spots

b. Moisture Content Test

Moisture content test aims to determine the moisture content of the granules. The amount of water in the granules can affect the chemical reaction of the acidic and basic components contained in the effervescent. The requirement for a good water content is 0.4-0.7% (Lestari *et al*., 2014).

Table 16. Granule Moisture Content Test Effervescent Granules

Formula	Granule Moisture Content Test Formula (%)	Standard	Description
F1	0,40±0,01		Meets the standard
F2	0,50±0		Meets the standard

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

F3	0,50±0,10	0,4-0,7% (Lestari et al., 2014).	Meets the standard

F1 has a lower water content value than F2 and F3. Formulations that have less acidic components have lower water content than formulations that have more acidic components. Citric acid is hygroscopic so it will have the potential to absorb moisture in the air and cause the granules to become moist.

The results of the correlation test showed a value of 0.061 where the value was > 0.05 which means that the concentration of acid and base in the effervescent did not correlate with the water content test of the effervescent. The main factors that affect the moisture content of effervescent are temperature and relative humidity (RH). Room conditions in the manufacture of effervescent must be maintained, the maximum allowed RH value is 25% with a temperature of less than 25oC. A high RH value will cause a balance of moisture in the granules with water in the room.granules Effervescent which have a certain water content when placed in an environment with a certain temperature and humidity, the water content of the effervescent will change until there is a balance between water (humidity) in the granule storage environment and water in the effervescent (Andriany, 2009).

c. Angle of Repose Test

Angel of repose test aims to determine the flow properties of the granules. The powder will form a cone, the flatter the cone formed, the smaller the angle of repose will be (Voight, 1995). A good angle of repose is between 25°-45° (Munir, 2012).

Table 17. Angle of Repose Test Results Effervescent Granules

Formula	Angle of Repose Test (^{0})	Standard	Description
F1	27±0	25^0-45^0 with lower results showing increasingly better characteristics (Munir, 2012)	Meets the standard
F2	27±0		Meets the standard
F3	27±0		Meets the standard

There is no difference in the results of the angle of repose test in the three formulations, both F1, F2 and F3 have the same angle of repose. The value of the angle of repose that is formed is included in the category of a special angle of repose (Munir, 2012).

According to Ardiani, (2012) the addition of a lubricant and binder also affects the value of the angle of repose. The lubricant can accelerate the flow of granules so as to improve the flow properties of the granules, while the binder can improve the bond between large particles or have poor cohesion so as to produce a small angle of repose. Meanwhile, according to Aulton & Taylor, (2018) the factors that influence the flow properties of the granules are the shape of the granules, the size of the granule particles, surface roughness or texture and moisture.

The correlation test on the angle of repose test cannot be done because the value of the angle of repose does not have variation in the data, so correlation testing is not carried out.

d. Flow Time Test

Flow time test is the time required by a number of granules to flow through the funnel (Hadisoewignyo & Fudholi, 2013).Granules effervescent is if the time required to flow 25 g effervescent is not more than 2.5 seconds (Voight, 1995).

Table18. Flow Time Test Results Effervescent Granules

Formula	Flow Time Test (second)	Standard	Description
F1	2,07±0	For 25 g granules no more than 2.5 seconds (Voight, 1995)	Meets the standard
F2	3,05±0,04		Does not Meets the standard
F3	3,69±0,53		Does not Meets the standard

The test results above are only F1 which meets the flow time requirements while F2 and F3 do not meet the flow time requirements. Factors that can affect the flow time are the shape of the granules, the specific gravity and the surface state of the granules (Balfas & Nanda, 2019). F1 has a faster flow rate than F2 and F3 because it has less citric acid component than the other two formulations. Citric acid is hygroscopic so it will absorb moisture in the air which causes the granules to become moist. Moist powder will make the flow rate slow.

Correlation test showed a value of 0.0001 where the value was <0.05, which means that the concentration of acid and base in the manufacture of effervescent granule flow time test effervescent. The concentration of acids and bases in effervescent the incorrectFormulations with high concentrations of citric acid have a longer flow time. This is because citric acid can reduce the flow response time because citric acid is hygroscopic so it will reduce the ability of the granules to flow (Andriany, 2009)

e. Compressibility Test

Compressibility test aims to determine whether the properties of the material can form a stable and compact mass when pressure is applied. The compressibility test that meets the requirements shows the percent compressibility index of less than 20% (Akbar & Febriani, 2019).

Table 19. Compressibility Test Results Effervescent Granules

Formula	Indeks Carr (%)	Standard	Description
F1	7±0	11%-15% atau <10% (Munir, 2012)	Meets standard
F2	6±1		Meets standard
F3	5,67±0,58		Meets standard

Values index carr of F1, F2 and F3 are included in the special flow rate category because the carr index < 10 (Munir, 2012). F1 has the highest carr index compared to other formulations, and is followed by F2 and F3. This is because the amount of sodium bicarbonate in the F1 preparation is more than the other formulations. Sodium bicarbonate has poor flowability and compressibility so that it affects the compressibility of effervescent. The supporting factor for the size of the carr index can be influenced by the size of the granule and the shape of the granule. The smaller the bulk density obtained, the better the flow properties (Akbar & Febriani, 2019).

Correlation test showed a value of 0.025 where the value was <0.05, which means that the concentration of acid and base in the effervescent granule compressibility test effervescent. The higher the concentration of sodium bicarbonate (base), the higher the compressibility value of the granules. This is because sodium bicarbonate has poor compressibility (Forestryana *et al.*, 2020).

f. pH Test

pH test aims to determine the degree of acidity of the effervescent granule solution. This will affect the effect of the fresh taste that will be produced, if it is too acidic it can irritate the stomach and if it is too alkaline it will cause a bitter and unpleasant taste. The measurement results are said to be good if the pH of the effervescent close to neutral, which is between 6-7 (Rahmawati *et al*, 2016).

Table20. Effervescent Solution pH Test Results

Formula	pH	Standard	Description
F1	7±0	Approaching neutral, 6-7(Rahmah, 2006)	Meets standard
F2	7±0		Meets standard
F3	5±0		Does not Meets standard

The pH value of F3 does not meet the standard because it is below 6 and is considered acidic. This is influenced by the amount of citric acid contained in F3 more than other formulations so that the pH of the solution becomes more acidic

i. Dissolution Time Test

Dissolving time test aims to determine the time it takes effervescent to dissolve completely, this process is marked by the cessation of carbon dioxide gas production in the water (Forestryna *et al*., 2020).preparation effervescent is < 5 minutes (Anshory *et al*., 2007).

Table 21. Effervescent Granule Dissolution Time Test Results

Formula	Dissolution Time (minutes)	Standard	Description
F1	3±0,1	Dissolving time <5 minutes (Anshory *et al*., 2007).	Meets standard
F2	3,12±0,03		Meets standard
F3	3,36±0,04		Meets standard

All formulations have met the standard of good effervescent granules. F1 is an effervescent granule with a faster dissolution time than the other two formulations. This can be influenced because the lactose content in F1 is more than the other two formulations. Lactose has properties that are very soluble in water so that it can accelerate the solubility of effervescent granules (Forestryana *et al*., 2020).

The correlation test showed a value of 0.0001 where the value was <0.05, which means that the concentration of acid and base in the effervescent granule formulation correlated with the effervescent granule dissolving time test. Formulations that have a higher concentration of citric acid will show a longer dissolution time. This is because citric acid which is hygroscopic will easily turn into a saturated condition because it has adsorbed moisture from the outside so as to make its solubility lower (long dissolving time) (Andriany, 2009).

Journal of Integrated Health Research
E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

CONCLUSIONS

Pumpkin extract (*Cucurbita moschata* Duchesne) made by foam mat drying method can be formulated into effervescent granules.The concentration of acid and base in the formulation of effervescent granules correlated with several physical properties of effervescent granules. The results of the flow time test, compressibility test, pH test and soluble time test were correlated with the concentration of acid and base in the effervescent granule formulation, while the water content test did not correlate with the concentration of acid and base in the effervescent granule formulation.

Authors' contributions

DEMS, AIP, EP, RI and LS contributed to the study design. DEMS and AIP contributed to the laboratory work carried out. Further, DEMS, AIP, EP and RI contributed to the data analyses and articlewriting. All authors read and agree to the final version of the article.

Conflict of Interest

The authors have no conflicts of interest regarding this investigation.

REFERENCES

Akbar, A. K. dan Febriani, A. K. (2019). Uji kompresibilitas granul pati talas dengan metode granulasi basah. *Journal of Pharmacy UMUS*, 01 (01): 7–11.

Andriany, L. (2009). Optimasi komposisi asam tartrat dan natrium bikarbonat dalam sediaan granul *effervescent* ekstrak sambiloto (*Andrographis paniculata* (Burn. F.) Nees) dengan metode desain faktorial. *Skripsi diterbitkan*. Yogyakarta: Program Studi Ilmu Farmasi Universitas Sanata Dharma Yogyakarta

Anshory, H., Syukri, H. dan Malasari, Y. (2007). Formulasi tablet effervescent dari ekstrak ginseng jawa (Tlinium paniculatum) dengan variasi kadar pemanis aspartam. Jurnal Ilmiah Farmasi, 4 (1): 43-48.

Ardiani, W. P. (2012). Perbandingan variasi suhu pengeringan granul terhadap kadar air dan sifat fisis tablet paracetamol. Karya Tulis Ilmiah diterbitkan. Surakarta: Program Studi Farmasi Fakultas Matematika Dan Ilmu Pengetahuan Alam Universitas Sebelas Maret.

Aukkanit, N. dan Sirichokworrakit, S. (2017). Effect of dried pumpkin powder on physical, chemical, and sensory properties of noodle. International Journal of Advances in Science Engineering and Technology, 5 (1): 14–18.

Aulton, M. E., dan Taylor, K. M. G. (2018). Aulton's pharmaceutic: the design and manufacture of medicines, 5th ed. United Kingdom: Elsevier.

Balfas, R. F. dan Nanda M. D. (2019). Uji waktu alir dan uji kompresibilitas granul pati kentang dengan metode granulasi basah. Jurnal Syntax Idea, 5(1): 58-63

Bangu, A. I. (2018). Formulasi dan evaluasi granul effervescent ekstrak etanol daun jambu biji (Psidium guajava L.). Karya Tulis Ilmiah diterbitkan. Kupang: Program Studi Farmasi Kementerian Kesehatan Republik Indonesia Politeknik Kesehatan KEMENKES Kupang.

Egeten, K. R., Yamlean, P. V. Y. dan Supriati, H. S. (2016). Formulasi dan pengujian sediaan granul effervescent sari buah nanas (Ananas comosus L. (Merr.)). Jurnal Ilmiah Farmasi, 5 (3): 116–21.

Fajar, A., Wijana, S. dan Rahmah, N. L. (2013). Pembuatan tablet effervescent wortel (Daucus carota L .) pada skala ganda. Jurnal Industria, 2 (3): 141–50.

Faradiba, Hasyim, N. dan Zahriati. (2013). Formula granul effervescent ekstrak etanol daun jambu biji (Psidium guajava Linn.). Majalah Farmasi dan Farmakologi.

Fitriyah, Tenri, A. dan Baharuddin. (2016). Potensi pemanfaatan agroindustri waluh kuning sebagai peluang usaha dan makanan kesehatan. Jurnal Ecosystem, 16 (3): 407–19.

Forestryana, D., Hestiarini, Y. dan Putri, A. N. (2020). Formulasi granul effervescent ekstrak etanol 90% buah labu air (Legenaria siceraria) dengan variasi gas generating agent. Jurnal Ilmiah Ibnu

Sina, 5 (1): 220–29.
Govindani, H., Dey, Amitabha., Deb, Lokesh., Rout, S. P., Parial, S. D., dan Jain, Avijeet. (2012). Protective role of methanolic and aqueous extracts of Cucurbita moschata D. fruits in inflammation and drug induced gastric ulcer in wister rats. International Journal of PharmTech Research, 4 (4): 1758–1765.
Gumolung, D., Suryanto, E. dan Mamuaja, C. (2013). Aktivitas antioksidan dan antifotooksidasi dari ekstrak buah labu kuning (Cucurbita moschata). Jurnal Ilmu dan Teknologi Pangan, 1 (1): 23–29.
Hadisoewignyo L. dan Fudholi A. (2013), Sediaan Solida. Yogyakarta: Pustaka Pelajar.
Khaira, K. 2010. Menangkal radikal bebas dengan anti-oksidan. Jurnal Sains dan Teknologi (Sainstek,) 2 (2): 183–87.
Labola, Y. A. dan Puspita, D. (2018). 'Peran antioksidan karotenoid penangkal radikal bebas penyebab berbagai penyakit'. Farmasetika, 2 (2): 12–17.
Lestari, Radjab, N. S. dan Octaviani, A. (2014). Formulasi dan evaluasi fisik granul effervescent sari buah naga (Hylocereus undatus). Farmasains, 2 (4): 182–85.
Lestari, S. dan Susilawati, P. N. (2015). Uji organoleptik mie basah berbahan dasar tepung talas beneng (Xantoshoma undipes) untuk meningkatkan nilai tambah bahan pangan lokal Banten. Prosiding seminar nasional masyarakat biodiversitas Indonesia, Juli 2015. Banten: BPTP Banten
Minah, F. N., Aulia, Y. R. dan Rahmadani, F. (2021). Pembuatan minuman serbuk mix fruit kaya vitamin C dan antioksidan untuk meningkatkan imunitas tubuh. Jurnal Atmosphere, 2 (1): 14–22.
Mubarok, F., Indra dan Dewi, R. 2020. Formulasi sediaan serbuk efervesen dari ekstrak etanol angkak (Monascus purpureus) dengan metode foam-mat drying. Jurnal of Pharmacopolium, 3 (1): 1–7.
Muliyanti, K. (2017). Foam-mat drying : teknologi pengering busa. Jambi: BPTP Balitbangtan.
Munir, M. B. (2012). Formulasi tablet efervesen ekstrak temulawak (Curcuma xanthorrhiza Roxb .). Skripsi diterbitkan. Jakarta: Program Studi Farmasi Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Indonesia.
Nakhon, P. P. N. S., Jangchud, K., Jangchud, A. dan Prinyawiwatkul, W. (2017). Comparisons of physicochemical properties and antioxidant activities among pumpkin (Cucurbita moschata L.) flour and isolated starches from fresh pumpkin or flour. International Journal of Food Science and Technology, 1 (1): 1–9.
Nugroho, B. H., Ningrum, A. D. K., Pertiwi, D. A., Salsabila, T. dan Syukri, Y. (2019). Pemanfaatan ekstrak daun tin (Ficus carica L.) berbasis nanoteknologi liposom sebagai pengobatan antihiperglikemia. Journal of Sciences and Data Analysis, 19(02): 216–229.
Parwata, O. A. (2016). Antioksidan. Bukit Jimbaran: Universitas Udayana.
Pratama, A. N. dan Busman, H. (2020). Potensi antioksidan kedelai (Glycine max L) terhadap penangkapan radikal bebas. Jurnal Ilmiah Kesehatan Sandi Husada, 11 (1): 497–504.
Purbasari, D. 2019. Aplikasi metode foam-mat drying dalam pembuatan bubuk susu kedelai instan. Jurnal Agroteknologi, 13 (01): 52–61.
Rahmawati, I. F., Pribadi, P. dan Hidayat, I. W. (2016). Formulasi dan evaluasi granul effervescent ekstrak daun binahong (Anredera cordifolia (Tenore) Steen.). Pharmaciana, 6 (2): 139-148.
RI, Depkes. 1989. Materia medika Indonesia, jilid V. Jakarta: Departemen Kesehatan Republik Indonesia.
Sala, Y. (2016). Pengaruh penggunaan polivinil pirolidon (pvp) sebagai bahan pengikat terhadap sifat fisik dalam formulasi sediaan granul effervescent ekstrak buah asam gelugur (Garcinia atroviridis Griff. et Anders.). Skripsi diterbitkan. Surakarta: Program Studi Farmasi Fakultas Farmasi Universitas Muhammadiyah Surakarta.
Sandrasari, D. A. dan Abidin, Z. (2012). Penentuan konsentrasi natrium bikarbonat dan asam sitrat

E-ISSN 3090-448X ; Vol. 1 No.3, December 2025
https://doi.org/10.70109/jinher.v1i3.22

pada pembuatan serbuk minuman anggur berkarbonasi (effervescent). Jurnal Teknologi Industri Pertanian, 21 (2): 113–17.

Sayuti, K. dan Yenrina, R. (2015). Antioksidan alami dan sintetik, ed I. Padang: Universitas Andalas.

Voight. 1995. Buku pelajaran teknologi farmasi. Yogyakarta: Universitas Gajah Mada Press.