CARROT EXTRACT EFFERVESCENT GRANULATION FORMULATION (Daucus Carota L.) WITH THE ADDITION OF CITRIC ACID-TARTIC ACID AND SODIUM BICARBONATE ON PHYSICAL CHARACTERISTICS AND CONTENT OF B-CAROTENE

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Abstract. Carrot (*Daucus carota* L.) is a type of plant that contains β-carotene. Effervescent granules are a combination of citric acid-tartaric acid and sodium bicarbonate which when dissolved in water will produce carbon dioxide quickly to produce foam. This study aims to determine the effect of variations in levels of citric acid-tartaric acid and sodium bicarbonate on the physical properties and levels of β-carotene effervescent granule carrot extract (*Daucus carota* L.). Carrot extract was made in 4 effervescent granule formulas namely F1, F2, F3 and F4 then tested the physical properties of the granules and the β-carotene content results in F1 test, the water content was 1.43%, the flow time was 7.54 g/sec, the angle of repose 36.520 tests dissolve time of 83.59 seconds. In F2 the water content test was 1.70%, the flow time was 11.36 g/sec, the angle of repose was 35, 870 test dissolve time of 110.72 seconds. In F3 the water content test was 0.77%, the flow time was 6.40 g/sec, the angle of repose was 37.330, test dissolved time was 67.26 seconds. In F4 test the water content was 0.93%, the flow time was 10.28 g/sec, the angle of repose was 37.070, the test dissolved time was 57.51 seconds and β-carotene levels in F1, F2, F3 and F4 were 0.14 mg/g . Variations in levels of citric acid, tartaric acid and sodium bicarbonate affected the physical properties of the effervescent granules but did not affect the levels of β-carotene in the effervescent granules of Carrot Extract (*Daucus carota* L.)..

Keywords: [Carrot Extract (*Daucus carota* L.), Effervescent Granule, β-carotene]

INTRODUCTION

Carrot (*Daucus carota* L.) is one of the plants that contain β-carotene compounds (Mangunsong *et al.*, 2019). Sari dan Sari (2022) states that the order of β-carotene content from the highest several types of Indonesian local vegetables are red chilies, carrots, sweet corn, red spinach, pumpkin, tomatoes, green spinach, red beets, potatoes, purple eggplants. . β-carotene compounds have many uses, such as increasing the body's immunity against tumor disease, inhibiting the spread of cancer cells, and activating cancer-fighting enzymes, as well as carotene compounds as (pro-vitamin A) which can prevent night blindness. Carrots consist of 3 varieties, namely Imperator, Chantenay, and Nantes (Cahyono, 2002). According to (Kartika, 2021) carrots with the Chantenay variety have the highest antioxidant activity.

Effervescent can be defined as the emergence of gas bubbles from a liquid resulting from a chemical reaction (Siregar & Wikarsa, 2010). According to Ansel & Allen, (2014) effervescent is a combination of sodium bicarbonate, citric acid, and tartaric acid which when dissolved in water will release carbon dioxide quickly to produce foam. Effervescent granules were made with citric acid and tartaric acid as the acid source, and sodium bicarbonate as the base source. The combination of citric acid and tartaric acid is used to facilitate the formation of granules (Ansel & Allen, 2014).

The need for β-carotene in the body is 4000/5000 IU or 800/1000 µg retinol for women or men (Linder, 1992). According to the BPOM decision, (2004) regarding the main provisions for supervising food supplements, states that the maximum level of β-carotene allowed in supplements and food is 15 mg or 20,000 UI. Based on the description above, it is necessary to research variations in the addition of citric acid, tartaric acid and sodium bicarbonate to the characteristics and levels of β-carotene effervescent granule carrot extract (*Daucus carota* L.).

METHODS

Research Tools and Materials

The tools used in this study were an analytical balance (Ohaus), oven, mortar and stamper, 10 mesh sieve, and stopwatch. UV-Vis spectrophotometer, granule flow timer, ruler, and glassware.

The materials used were carrots (Chantenay type, Bandungan Semarang, Central Java), water (aqua dest), sodium bicarbonate (brataco), citric acid (brataco), tartaric acid (brataco), sucrose (brataco), and polyvinylpyrrolidone (brataco), lactose. (Brataco), Aspartame (Brataco), Ethanol pa, β-carotene pa (PT. phapros).

Data analysis

The data that has been obtained from the physical characteristics test of the effervescent granules that have been carried out will be analyzed in two ways, namely a theoretical approach with certain literature and statistical analysis with One Way Anova compared to certain requirements in certain libraries.

Preparation of carrot extract (*Daucus carota* L.)

Carrots that have been obtained from Bandungan, Semarang district. Carrots are sorted to separate them from other plants. Next, the carrots are washed thoroughly with running water, drained and air-dried. Carrots are cut into thin slices to help speed up the drying. Drying is done by heating using an oven at a temperature of 400C. After the simplicial is dry, it is then blended and sieved using a 44 mesh sieve. Preparation of carrot extract using the maceration method.

The extraction process uses the maceration method because this method is simple, fast and can extract the active ingredients of simplicial to the maximum. The main advantage of this method is that it is not carried out by heating so it can prevent damage or loss of the active substance you want to extract (Sa'adah and Nurhasnawati, 2017). The maceration method is carried out by putting as much as 610 grams of carrot powder in a glass jar, then soaking it with 4.27 L solvent. The solvent used in the maceration method is distilled water. According to (Ramli *et al.*, 2015) the selection of using aquadest solvents is because apart from being cheap, easy to obtain, stable, non-toxic, non-volatile, and non-flammable, water also produces the highest yield of ethanol solvents.

According (Allali, 2012) carrot extract with water solvent has higher antioxidant activity than essential oil. Then remaceration was carried out, until a clear solution was obtained. After that, the extract was thickened using a water bath at 40ºC until a viscous extract was obtained, and a viscous extract of 111.9 grams was obtained and a yield of 18.34%. According to the Ministry of Health of the Republic of Indonesia (2010) a good yield is not less than 5%.

Effervescent Granule Formulation

In this study, carrot extract effervescent granules were prepared with varying levels of citric acid-tartaric acid and sodium bicarbonate. The variations of acids and bases used in this formula were calculated using the optimum mixture of citric acid-tartaric acid and sodium bicarbonate according to research (Purwandari, 2007) and can be seen in Table 1. The concentration of carrot extract used was according to research (Mairi, 2003) which stated that 25 mg of The extract is expected to contain 0.5 mg of β-carotene.

Table 1. Formulation of effervescent granules

Material	formulation (mg)			
	F1	F2	F3	F4
Carrot extract	25	25	25	25
Citric Acid	184	295	184	295
Tartaric Acid	316	505	316	505
Sodium bicarbonate	585	585	936	936
Lactose	884	884	884	884
PVP 3%	10	10	10	10
Aspartame	100	100	100	100

Source : (Purwandari, 2007)

Information:

Acid-Base Level	: F1	: F2	:F3	:F4
Citric Acid-Tartic Acid	: 500	: 800	: 500	: 800
Na Bicarbonate	: 585	: 585	: 936	: 936

Making Effervescent Granules

The manufacture of granules, it is carried out in 2 stages, namely by making acid granules and alkaline granules separately. This is done to avoid an early effervescent process in the manufacture of effervescent granules. Preparation of acid granules is carried out by mixing citric acid, tartaric acid and lactose into a stirred mortar until homogeneous and adding extract and 3% PVP (made using 96% ethanol with a concentration of 3%) alternately until an elastic mass is formed then granules are made using a mesh sieve. no.10, then dried in an oven at 450C until the granules are dry, then sieved again.

Making alkaline granules is done by weighing sodium bicarbonate and aspartame, stirring until evenly distributed, adding 3% PVP little by little, then making granule mass using a mesh sieve no. Acid and alkaline granules that have dried are mixed and then sieved again.

Effervescent Granule Characteristics Test

The physical properties test of the effervescent granules was carried out including the water content test of the effervescent granules, flow time test, angle of repose test and soluble time test of carrot extract effervescent granules (*Daucus carota* L.).

RESULTS AND DISCUSSION

1. Effervescent Granule Physical Properties Test

1.1 Test the moisture content

The water content test aims to ensure stability and effective preservation in storage, the lower the water content, the better the quality of the granules produced (Pribadi, 2016).

Table 2. Result of the percentage test for water content of effervescent granules

Formulation	Rep 1	Rep 2	Rep 3	Average±SD	Condition provision	Information
F1	1.47%	1.41%	1.43%	1.43±0.00	≤ 5% (BPOM, 2014)	fullfil
F2	1.63%	1.66%	1.70%	1.66±0.00		fullfil
F3	0.73%	0.71%	0.77%	0.73±0.00		fullfil
F4	0.96%	0.91%	0.93%	0.93±0.00		fullfil

Source : Primary Data (2023)

Table 2 shows that all formulations have a good water content according to the literature of the Food and Drug Supervisory Agency (2014) which states that a good water content is ≤ 5%. The next test was a one-way ANOVA test to see whether or not there was a significant difference between the formula groups. The results of the one -way ANOVA test showed a significance value of 0.00 which indicated a significant difference between the formula groups. This is influenced by variations of citric acid-tartaric acid and sodium bicarbonate. Especially on the number of variations of citric acid.

According to (Wati and Saryanti, 2019) Citric acid is a component of effervescent granules which are still in the form of a hydrated compound (has crystalline water). Citric acid monohydrate can turn anhydrous by heating 74^0C. The water content test was carried out at 105^0C, so that the crystalline water in the citric acid evaporated and was also recorded, causing the water content of the effervescent granules to increase. According to Mohrle, (1989) effervescent should be made at a maximum relative humidity of 25% at 25^0C. In the manufacture of granules, the humidity in the room used is unstable, causing the granules to

absorb moisture from the environment, resulting in an increase in the moisture content of the granules.

1.2 Flow time test

The flow time test aims to measure the flow time to determine the flow rate of the granules. If the granules have a flow rate of more than 10 seconds, it can affect the uniformity of the granule weight (Arisanty and Daswi, 2021)

Table 3. Result of effervescent granule flow time (g/second)

				Flat mean ± SD	**Condition**	**Information**
Formulation	**Rep 1**	**Rep 2**	**Rep 3**			
F1	7.6	7.4	7.64	7.52±0.12	>10g/sec (very good); 4-10 g/sec (good); 1.6 g/sec (difficult) < 1.6 (very hard)	fullfil
F2	11.52	11.41	11.16	11.36±0.18		fullfil
F3	6.54	6.31	6.37	6.40±0.11		fullfil
F4	10.54	10.20	10.12	10.28±0.22		fullfil

Source : Primary Data (2023)

The results showed that formula 2 and formula 4 had very good flow properties (>10 gram/sec). This is because formulas 2 and 4 have levels high tartaric acid and low base so that the flow properties are faster. While formula 1 and formula 3 have flow properties in the good category (4-10 grams/second). Flow time is influenced by the shape, size, porosity, density, and frictional forces between granule particles (Anam, Setiawan & Kawiji, 2013)

Then a one-way ANOVA test was carried out to see whether or not there was a significant difference between the formula groups. The test results showed a significance value of 0.00 which indicated a significant difference between the formula groups. Then proceed with the Tukey test to determine whether there is a significant difference between the formula groups. From these results it can be seen that there is a significant difference between each group of formulas, this proves that variations in citric acid, tartaric acid and sodium bicarbonate affect the flow time of effervescent granules of carrot extract (Daucus carota L.).

This can be influenced by tartaric acid which can increase the flow time because tartaric acid can reach an equivalent concentration of acid during the effervescent reaction (Ansel & Allen, 2014). this can also be affected due to the small amount of acid and high base levels where the high amount of base will be able to absorb water so that the water content will increase, the granules will find it difficult to flow in the granule test funnel (Siregar & Wikarsa, 2010).

1.3 Test the angle of repose

The angle of repose test is another parameter of flow properties, the angle of repose can also be used as a comparison to test the physical properties of granule or powder mixtures (Fadlil & Candra, 2017). The requirements for the angle of repose test are if the granules can flow well to form an angle of repose of 25°-45° (Wadke et al., 1989).

Table 4. Test result of effervescent granule angle of repose

				Average ± SD	**Condition**	**Information**
Formulation	**Rep 1**	**Rep 2**	**Rep 3**			
F1	37.56	35.21	36.8	36.52±1.19	$25^0 – 45^0$	fullfil
F2	33.69	37.56	36.38	35.87±0.89		fullfil
F3	37.87	36.86	37.26	37.33±0.50		fullfil
F4	36.8	37.56	36.87	37.07±0.42		fullfil

Source : Primary Data (2023)

From these results it can be seen that all effervescent granule formulas meet the requirements of the literature according to Wadke et al., (1989) carry good granules, namely if the granules can flow and form a repose angle of 250 – 450. After that, a one way ANOVA test is carried out to see whether or not whether there is a significant difference between the formula groups. The results of the one way ANOVA test showed a significance value of 0.416 which indicated that there was no significant difference between the formula groups F1, F2, F3 and F4. From these results it can be seen that variations in citric acid, tartaric acid and sodium bicarbonate did not affect the angle of repose of carrot extract effervescent granules (*Daucus carota* L.).

The angle of repose can be affected by frictional forces and attractive forces between particles.The smaller the frictional and attractive forces between the particles, the faster the easier it is to flow, besides that the smaller the particle size, the higher the cohesiveness of the particles which causes the flow velocity to decrease and the greater the angle of repose that is formed (Perwitasari, 2016).

1.4 Soluble time test

In the next test, namely the soluble time test, the soluble time test was carried out to find out how long it took for the effervescent granules to dissolve in 200mL of water.

Table 5. Effervescent granule dissolving time test (second)

				Mean ± SD	**Condition**	**Information**
Formulation	**Rep 1**	**Rep 2**	**Rep 3**			
F1	81.56	85.43	83.78	83.59±1.94	<120 second	fullfil
F2	108.72	110.03	113.42	110.72±2.45		fullfil
F3	66.48	69.53	65.78	67.26±1.99		fullfil
F4	57.32	57.72	57.53	57.51±0.20		fullfil

Source : Primary Data (2023)

In the test, the results of the dissolution times on F1, F2, F3, and F4 were 83.59 seconds, 110.72 seconds, 67.26 seconds, 57.51 seconds. According to Mohrle, (1989) the standard time for dissolving in effervescent granules is <120 seconds. So from these results it can be seen that all formulas meet the effervescent granule dissolving time requirements. Then a one-way ANOVA test was carried out to see whether or not there was a significant difference between the formula groups. The results of the one-way ANOVA test showed a significance value of 0.00 which indicated a significant difference between the formula groups.

From these results, it can be seen that variations in citric acid, tartaric acid and sodium bicarbonate affect the solubility time of effervescent granules of carrot extract (*Daucus carota* L.). This is by research (Rahmawati, Pribadi, & Hidayat, 2016) which states that when sodium bicarbonate reacts with water it will produce CO_2, the higher the concentration of sodium bicarbonate and citric acid-tartine acid used, the more CO_2 is produced. According to (Siregar & Wikarsa, 2020) Sodium bicarbonate is the main source of CO_2 in the effervescent system and produces approximately 52% CO_2.

2. β-Carotene Levels

Determination of β-carotene levels in carrots was carried out using the UV-Vis spectrophotometer method in which β-carotene levels were determined twice, ie β-carotene level determination in the form of carrot extract and β-carotene level determination in granule form. The following is the process of determining the levels of β-carotene in carrot extract and carrot extract effervescent granules. The first step taken in determining the concentration is by determining the maximum wavelength.

The maximum wavelength was tested with a UV-Vis spectrophotometer with a wavelength range of 380-780 nm (Agustina, Hidayati, & Susanti 2019). In this test, the results were obtained at the highest peak with a wavelength of 447 nm. According to Nurrahman & Widiarnu (2013) The structure of β-carotene has conjugated double bonds. Conjugated double bonds can cause the

electronic energy level of the chromophore to become lower, so that it will absorb radiation at higher wavelengths, which causes β-carotene to be measured in the visible region.

Based on the data, a linear regression equation was obtained which states the relationship between the concentration of standard β-carotene solution (X) and absorption (Y), namely, Y = 0.0133x+ -0.0001 with a value of R2 = 0.9988. The curve of the relationship between the concentration of The standard β-carotene solution and absorbency is presented in Figure 6. According to Harmita, (2004) in Agustina, Hidayati & Susanti, (2019) that the value of the correlation coefficient (r) which is close to 1 indicates absorption has a good value.

In this study we wanted to know the levels of β-carotene in two forms, namely the levels of β-carotene in carrot extract and carrot extract effervescent granules using the UV-Vis spectrophotometry method. The results of determining the levels of β-carotene in carrot extract which was carried out with three repetitions and obtained levels of 12.68 mg/g. On Determination

β-carotene levels in effervescent granules from 4 granule formulations obtained successive results, namely 0.14 mg/g, 0.14 mg/g, 0.14 mg/g, and 0.14 mg/g, in this test it can be It can be seen that the levels in carrot extract are greater than the levels in carrot extract effervescent granules.

This indicates that there has been a decrease in β-carotene levels in each formulation. According to (Sani, Setyowati & Kadaryati, 2019) β-carotene will experience a decrease in levels after the heating process. This is in line with research (Agustina, Hidayati & Susanti, 2019) that heating can reduce β-carotene levels in carrots. One of the causes of a decrease in the levels of β-carotene in carrot effervescent granules is due to the heating process during the manufacture of effervescent granules.

CONCLUSION

Variations in the levels of citric acid-tartaric acid and sodium bicarbonate affect the physical characteristics of the granules including moisture content, flow time, and dissolution time, but do not significantly affect the granule angle of the repose test. The content of β-carotene in carrot extract (*Daucus carota* L.) was 12.68 mg/g while in carrot extract effervescent granules (*Daucus carota* L.) in F1, F2, F3 and F4 was 0.14 mg/g. This shows a decrease in levels of β-carotene in carrot extract.

Suggestion

It is necessary to carry out further research on the manufacture of tablets from effervescent granules with the best formulation and it is necessary to carry out the process of making granules at relative humidity at 250C so that quality is maintained during the manufacturing process and testing.

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