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FORMULATION OF GRANULES EFFERVESCENT OF TOMATO FRUIT (*Solanum lycopersicum*) AS NUTRITIONAL SUPPLEMENT

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ABSTRACT

Tomato (*Solanum lycopersicum*) is one of the many plants contains nutrients and minerals that can meet the needs of the body. One of lycopene content of tomatoes is functioning as an antioxidant. Lycopene levels increased if it is done processing. This study aims to granule formulate tomato juice (*Solanum lycopersicum*) as one of the supplements and the dosage can be accepted by community. Formula is made to five formulations with variations in the amount of acid and base. Method for making effervescent granules by dry granulation. Granule physical properties testing including moisture content, angle of flow, density, solubility, pH, and then performed the hedonic test. The results obtained that respondents most preferred formula V with a composition of 20 g of tomato powder, citric acid monohydrate 1 g, sodium bicarbonate 27.5 g, 101 g sucrose, 0.5 g aerosil. Result testing water content 0.39%, 31.02 angle of rest, the density of 8.77%, solubility 2.78 minutes, pH 7.9.

Key words: tomato (Solanum Lycopersicum), effervescent granule.

Introduction

Vitamin s are found mainly in fruits and vegetables such as tomatoes, one plant is known by the people of Indonesia. In the everyday life of tomato consumption is still very minimal and has not become an essential requirement for health in the community. Tomato is a fruit that is relatively inexpensive

and easy to obtain because it does not depend on the season. In addition, their utilization is still simply and without knowledge of the proper processing of tomatoes in order to obtain the content of tomatoes that are not optimal.

Tomatoes contain lycopene compounds that act as antioxidants. Tomatoes are processed into juice and pastes have a higher lycopene content than in fresh form. For example, the

amount of lycopene in tomato juice can reach five times more than fresh tomatoes. Based on the research Agarwal and Rao [1999] that the public are advised to consume an average of 1.86 mg of lycopene per day and below the stated lack of lycopene. In 100 grams of tomatoes contain lycopene, an average of 3-5 mg [Giovannucci, 1999] Until now, the use and consumption of tomatoes in Indonesian society is still low, to increase domestic consumption of tomatoes is done by modifying the tomatoes in the stocks an attractive and desirable community. In this study dosage formulation effervescent granules juice tomato (*Solanum lycopersicum*) that can be consumed as a supplement so that the community is easier to use.

Materials and Methods

1. Materials

Materials used in this study is the fruit of tomato, citric acid, sodium bicarbonate, sucrose, Aerosil, silica gel.

2. Preparation

2.1. Preparation of tomato powder

The tomatoes used in this study is the fruit of fresh red tomatoes that are taken in the market area Banjarbaru. The manufacturing process is 1 kg of tomatoes are cut and added water 50 ml and then smoothed by using a blender and squeezed using a flannel cloth. Tomato juice were added 2 kg of sucrose and then dried with heated using medium heat while in stir.

2.2. Preparation of effervescent granules

In this research, made five tomato formula effervescent granules with different levels of citric acid and sodium bicarbonate. The formula can be seen in the following table.

Table 1. Formula effervescent granules

Ingredient	Formula (gram)				
	I	II	III	IV	V
Tomato powder	20	20	20	20	20
Citric acid	0,5	1,0	2,0	1,0	1,0
Sod. bicarbonate	30	30	30	32,5	27,5
Sucrose	99	98,5	97,5	96	101
Aerosil	0,5	0,5	0,5	0,5	0,5
Jumlah	150	150	150	150	150

Tomato effervescent granule is made by dry granulation method. The steps undertaken were as follows:

1. Considering all the ingredients.
2. Mixing tomato powder, citric acid in a container until homogeneous.
3. Sift mixture 2 with 12 mesh sieve and then dried granules obtained in an oven at a temperature of 45°C for 5 hours.
4. Sift again granule which is dry with mesh sieve 20. Further sifting is called acid component.
5. In another container, mix the remaining sodium bicarbonate and sucrose as to be clenched.
6. Sift mixture of 5 with 12 mesh sieve and then dried granules obtained in the oven at a temperature of 45°C for 5 hours.
7. Sift again granule which is dry with mesh sieve 20. Further sifting is called a base component.
8. Mixing the acid component, base component and the outer phase (Aerosil) and then stirred until homogeneous. The result is effervescent granule tomato juice.
9. Packaging.

3. Evaluation

3.1. Measurement of Water

Entering a number of granules into the dish and put into the deksicator containing silica gel for 4 hours. The water content can be calculated using the following formula.

$$\text{Water cont} = \frac{\text{Initial weight-final weight}}{\text{Initial weight}} \times 100\%$$

3.2. Measurement of Flow Rate and Angle Rest

Flow rate is the time in seconds it takes a certain amount of granules to flow through the funnel. Tests carried out by flowing the flow rate of 50 g effervescent granules into granules with flow gauges record granules to flow all the time. The angle of rest is obtained by measuring the height and diameter of the granules are formed as a pile on the following formula.

$$\text{tg } \alpha = \frac{h}{\frac{1}{2}d} \quad \text{become} \quad \alpha = \text{arc tg } \frac{h}{\frac{1}{2}d}$$

Description:

α = angle of rest

h = height of pile

d = diameter of the granular pile

3.3. Measurements of bulk density and density incompressible

Bulk density obtained from a certain number of granules are weighed and then inserted into the measuring cup and then recorded in volume.

$$\text{Bulk density} = \frac{\text{Granule weight (g)}}{\text{Granule volume (ml)}}$$

To get the density of the incompressible, measuring cups containing granules are knock as high as 2.5 cm in intervals of 2 seconds. Every 10 beats

volume recorded until the volume is not changed.

$$\text{Density incompressible} = \frac{\text{Granule weight (g)}}{\text{Incompress volume (ml)}}$$

Results obtained from the above calculation is calculated again using Carr's index formula adjusted for tables index Consolidation Carr.

$$\text{Index Carr} = \frac{\text{Density incomp.} - \text{bulk density}}{\text{Density incompressible}}$$

3.4. Solubility Measurements

A number of effervescent granules put into water at room temperature. Time is recorded by stopwatch to dissolve all the effervescent granule.

3.5. pH measurement

pH measurements conducted to determine whether or not homogeneous granules of acid and alkaline components, the pH of the granules which had been dissolved in water is measured using a pH meter. Granule pH to be measured is weighed as much as 150 grams of granules are several places from the container and then dissolved in 200 ml of water and then after all the granules dissolve quickly measuring pH. Measurements were taken 3 times (triplo).

3.6. Hedonic test

Favorite test is basically a test using the response form whether or not glad to material tested on the public. In this study, preference test conducted on 30 adult volunteers with the parameters tested include a sense of effervescent granules of tomato juice which had been dissolved in

water. Rating scale used is a numerical scale with a value of 1 to 5. A value of 1 states is not like, the value of 2 states do not like, the value of 3 states neutral, value of 4 states like, and the 5 states really like [Puspitasari, 2007].

Results and discussion

1. Results Preparation of Tomato Fruit Extract Powder

Tomato (*Solanum lycopersicum*) is one of the horticultural products of potentially healthy and have a promising market prospect. Tomatoes, both fresh and processed form, has a nutrient composition that is quite complete and well [Tanti & Sumarmani, 2008]. Tomatoes contain compounds solanine (0.007%), saponins, folic acid, malic acid, citric acid, bioflavonoids (including lycopene, α and β -carotene), proteins, fats, vitamins (A, B1, B2, B6, C, E, niacin), minerals and histamine [Canene, 2005] so that tomatoes can be classified as a producer of a potent antioxidant [Febriansyah, 2008].

Research conducted by Tanti and Sumarmani [2008] showed that lycopene as an antioxidant that plays an important role because it is not broken or crushed cooked tomato lycopene may issue more, so easily absorbed by the body. The results are supported by Shi and Le Maguer [2000] which states that the nature of the bioavailability of lycopene increased after cooking, has more lycopene that is more easily absorbed than fresh tomatoes [Tanti & Sumarmani, 2008].

Results of pollen production of tomato (*Solanum lycopersicum*) from 1 kg fresh tomatoes mixed with 2 kg of sucrose powder obtained as much as 2.48 kg in the formula I, 2.51 kg in the formula II; 2.49 kg in the formula III, 2, 53 kg in formula IV; 2.51 kg

at the formula V. Each formula contains 20 g of powder of tomato (*Solanum lycopersicum*) with sucrose 80 g, then that is weighed is 100 g per pack juice tomato (*Solanum lycopersicum*).

In the formula of citric acid monohydrate is used as acid. Citric acid is commonly used in pharmaceutical and food products and used as one component manufacturing effervescent granules [Kibbe, 2000]. Component base used is sodium bicarbonate which will be combined with citric acid [Kibbe, 2000]. Sucrose is used as a binder and a sweetener because it has a low price, easy to obtain. While the aerosil which is used as a lubricant material to function as binding moisture to the granule [Voight, 1995].

2. Testing Results effervescent granules Tomato Fruit

The test results effervescent granules tomato fruit (*Solanum lycopersicum*) involved testing the water content, flow velocity, flow angle, density, solubility, and pH. Data calculation result of each formula can be seen in the following table.

Table 2. Recapitulation of effervescent granules Testing Tomato Fruit

Form	Testing					pH
	Water levels (%)	Flow rate (mnt)	Angle rest (°)	Index carr (%)	Sol. test (mnt)	
I	0,90	55,33	35,46	12,69	4,00	8,3
II	0,57	49,37	36,07	9,67	2,64	8,1
III	0,52	50,89	33,18	6,56	2,43	7,6
IV	0,15	54,79	36,07	10,34	2,99	8,7
V	0,39	39,33	31,02	8,77	2,78	7,9

3. Water Levels

Results of measurement of water content obtained results on the formula I: 0.90%, the formula II: 0.57%, the formula III: 0.52%, the

formula IV: 0.15%, and the formula V: 0.39%, this indicates that the granules do not get wet because the percentage of water content in every formula effervescent granules juice tomato (*Solanum lycopersicum*) is less than 1%, but the effervescent granules of tomato fruit (*Solanum lycopersicum*) remains stored in an airtight container because the granules contain sucrose that quite a lot of more than 90 g / wrap each formula. Sucrose will experience the humidity at a temperature above 25°C and citric acid monohydrate also experience moisture to dry air or heat around 40°C [Kibbe, 2000] so that the effervescent granules having moisture when left in place an open place.

4. Flow Rate and Angle Rest

Results obtained flow velocity measurements is less good because the time required to flow long enough ie over 30 minutes in each formula, it is influenced by gravity which have uneven pressure on the mass of the top and beside it and cause the flow of an imperfect form rat hole and the bridge (as in Figure 1) [Lachman, 1994]. It is also influenced by the nature of the material making granules of sucrose and citric acid in dry air humidity and should be experienced in effervescent granules processing tomato fruit (*Solanum lycopersicum*) is done at a place set humidity / temperature below 30°C.

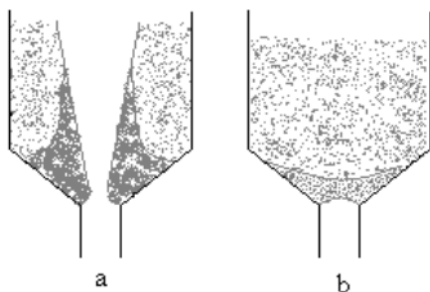


Figure 1. Causes of Flow Not Perfect (A) The Rat Hole, (B) The Bridge

The result of measurement of height and diameter of granular pile is calculated using the formula to get the angle averaged rest of formula I 35.46°, 36.07° formula II, formula III,

33.18°, 36.07° formula IV, formula V 31.02°. The results are compared with the table angle relationship break compatibility with the flow of powder which states that the angle of flow of granules all pretty good formula for being in the range between 30° - 40°.

5. Density

Results obtained in formula II, III, IV, V show that the effervescent granules of tomato juice (*Solanum lycopersicum*) has felt very good power, indicated by the results obtained for each formula is in the range of 5% - 12% of the index stated Carr very good while the formula I stated well because it is in the range 12% - 18%. This is consistent with the theory that increasing the ability to be compressed a granule then the less power flowing, instead of diminishing the ability to be compressed, the greater the power flow [Lachman, 1994].

6. Solubility Tests

The test results effervescent granule solubility tomato juice (*Solanum lycopersicum*) is less good because of all the formulas have the time to dissolve more than 2 minutes, while the effervescent good will dissolve within 1-2 minutes [Ansyori, 2007]. This is presumably because the ratio between citric acid and sodium bicarbonate which is less appropriate so that the reaction is relatively slow. In formula III is recorded the average time effervescent granules dissolved faster than most other formulas because the content of citric acid and sodium bicarbonate are quite comparable.

7. Checking pH

pH measurement is aimed to know whether or not homogeneous component of acid and base granules during mixing [Puspitasari, 2007]. The results indicate that effervescent granules juice tomato (*Solanum lycopersicum*) to be quite homogeneous. This can be seen in data obtained in the measurement of pH 3 times repetition in each formula produce measurements that are not much different between the repetition of the first, second, and third. The average pH value of formula I,

formula II and formula IV is alkaline because seen from the composition of sodium bicarbonate and a lot less comparable with citric acid monohydrate were added, whereas in formula III and formula V is almost neutral because of the composition of the formula III more citric acid, and the formula V is added sodium bicarbonate less compared with other formulas.

8. Hedonic test

Final testing is hedonic test that includes a sense of each formula on 30 respondents. Respondents were an average age of 17-23 years who tried every formula that has been dissolved into the water first. Respondents gave the rating scale of 5 really like, 4 like, 3 neutral, 2 did not like, 1 very unpleasant. The results that 56.67% of the respondents preferred formula V, 36.67% of respondents said was not like the formula III and 43.33% of the respondents did not like the formula I. Comments from respondents is a sour taste in formula III is due on this formula of citric acid monohydrate content of the highest, taste salty on some formulas for mixing acid base that produces salt, especially the number of sodium bicarbonate is added to each formula, in terms of smell is less preferred because it does not use the essence to every formula and have different colors on each formulary due to powder processing tomato (*Solanum lycopersicum*) are different. Survey results can be said that the effervescent granules of tomato juice (*Solanum lycopersicum*) to the formula V which consists of fresh tomatoes 20 g; citric acid monohydrate 1 g, sodium bicarbonate 27.5 g, 101 g sucrose, and 0.5 g of Aerosil preferred by respondents.

Table 3. Hedonic Test Results (%)

Value	Formula				
	I(%)	II(%)	III(%)	IV(%)	V(%)
1	13,33	10,00	36,67	20,00	16,67
2	43,34	23,33	33,34	26,67	13,33
3	13,33	40,00	23,33	30,00	10,00
4	23,33	20,00	03,33	23,33	56,67
5	06,67	06,67	03,33	00,00	03,33
Total	100	100	100	100	100

Conclusion

The conclusion that can be drawn from this research is

1. Formula effervescent granule is best formula for V because it is the range of granule suitability both in terms of water content, the angle of flow, density, pH, and solubility
2. Hedonic survey results, the formula V is an effervescent granule juice tomato (*Solanum lycopersicum*), the most accepted by society in terms of taste, of which 56.67% of the respondents prefer to this formula, consisting of fresh tomatoes 20 g; 1g citric acid monohydrate, sodium bicarbonate 27, 5 g, sucrose 101 g; and Aerosil 0.5 g with the test results of water content 0.39%, flow angle 31.02, density 8.77%, the solubility of 2.78 min, pH 7.9.

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