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Formulation and Hedonic Test of Lemon (*Citrus limon* L.), Ginger (*Zingiber officinale*), and Porang (*Amorphophallus muelleri* Blume) Flour Health Powder Beverage

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ABSTRACT: *Health powder drinks are drinks made from powder or granules in a mixture of sugar, fruit, and spices, usually served quickly by brewing, and contain many nutritional and non-nutritional elements. Identify the physical evaluation of powder, quality requirement test (Indonesian National Standard (SNI)), and hedonic test of lemon juice (Citrus limon L.), ginger (Zingiber officinale), and porang flour (Amorphophallus muelleri Blume) health powder beverage. This study was experimental, by making lemon and ginger juice powder using a freeze-drying instrument. Lemon, ginger, and porang flour powders were formulated in 3 formulas. Then, the physical evaluation of the powder involving a quality requirement test (SNI) and hedonic test was conducted. The results of physical evaluation tests which include (organoleptic, flow time, angle of repose, specific gravity, water content, and dissolving time) and quality requirements tests which include (water content and ash content) show that powdered drinks meet the physical requirements of powders and quality requirements (SNI). Hedonic taste, color, aroma, and texture tests differ from the three formulas. Health powder drinks have a good physical evaluation of powders and quality requirements (SNI), and the most favored formula by panelists is formula 3.*

Keywords: *evaluation; formulation; ginger; hedonic; lemon*

1. Introduction

It has long been known that plants are useful in treating and preventing various diseases. Currently, research and development in Indonesia are not only focused on medicine but also on functional food. Functional food is food that has been processed with ingredients that have certain physiological qualities and improve health. One type of functional food is a health powder beverage [1]. A health powder beverage can be interpreted as a drink in powder form that contains ingredients that are beneficial for the body. Powdered drinks instant must meet several special conditions, they are dry and separate, easy to pour, not hygroscopic, not lumpy, easily wetted, and quickly dissolve [2].

Health powder beverage is a product that is quite popular among the public. In addition, to quenching thirst and dehydration, healthy beverages are also beneficial for health and can prevent or cure various diseases. To make consumers like and feel the benefits of healthy beverages, it is necessary to test the level of favorability of consumers. In increasing consumer preference, fruit juice is often added to the manufacturing process to help improve taste. The addition of fruit juice also provides health benefits [3]. In this study, the formula used contained lemon fruit, ginger rhizome, and porang tuber.

Lemon is a low-calorie, fiber-rich, and low-glycemic fruit. Lemon juice contains ascorbic acid, with a level of 0.66 mg/g sample [4]. Ginger rhizome is a pseudo-stemmed clump plant. Ginger rhizomes contain nutrients including ascorbic acid 15.21 g/100 g, crude fiber 21.90%, fat 9.89%, carbohydrates 58.21%, and protein 11.65% [5,6].

Porang tubers are plants with a large glucomannan content so they are sought after by the industry, especially the food and health (pharmaceutical) industries. The macronutrient levels of porang tuber glucomannan include average carbohydrates were mean ±SD 3.80; starch mean ±SD 2.83; fiber mean ±SD 2.07 ; glucomannan mean ±SD 12.77; protein mean ±SD 2.41; and Lipid mean ±SD 1.89 [7].

By the previous background, the researcher made a health powder beverage product of lemon juice (*Citrus limon* L.), ginger (*Zingiber officinale*), and porang flour (*Amorphophallus muelleri* Blume) with physical evaluation test, quality requirement test (SNI), and favorability test to determine the results of the best health drink product.

2. Materials and method

2.1. Material

The materials used in this research included lime fruit (*Citrus limon* L.) 3 years plant, ginger rhizome (*Zingiber officinale*) 10 months obtained from BALITTRO, Bogor (number 6929/IT1. C11.2/TA.00/2023). Porang flour (*Amorphophallus muelleri* Blume) was obtained from the Organic Foods Market, Sleman, Central Java. Other materials used were stevia and distilled water.

2.2. Instrument

The instruments used in this research were freeze dryer (Eyela®, Japan), an oven (Memmert®, German), a flow tester granule, Karl Fischer (Mettler Toledo®, Swiss), and a moisture balance (*Bel®, Italy*).

2.3. Methods

2.3.1. Lemon juice preparation

Lemon fruits were used in this study amount of 7 kg. Furthermore, lemons were sorted. The lemon fruit used was still good and not rotten, then 6.3 kg of sorted lemons were washed under running water and drained. The lemon was splited into 2 halves and squeeze. The lemon juice was then strained and let stand for half an hour. Clear juice and precipitate were separated. 4,750 ml clear juice was then frozen and dried using a freeze drying device at a temperature below -45.2˚C until it became a powdered beverage [8].

2.3.2. Ginger juice preparation

Ginger rhizomes were used in this study amount of 6 kg. Ginger was sorted first. The se-

lected ginger was a ginger that was still good and not rotten. The sorted ginger was then peeled and washed, after which the ginger was cut into pieces and put into a blender. Next, water was added in a ratio of 1:1 (ginger: water) so that for 5 kg of ginger that has been selected, 5,000 ml of water was added, and the ginger used a blender, the pureed ginger was then filtered and precipitated to separate the ginger juice from the residue or impurities that remain. 5,000 ml of clear ginger juice was then frozen and dried using a freeze drying device at a temperature below -45.2˚C until it became a powdered beverage.

2.3.3. Freeze drying

The lemon and ginger juice obtained were dried below -45.2˚C using freeze-drying equipment. The freeze-drying process was carried out at the Natural Products Laboratory, Faculty of Pharmacy, Muhammadiyah A.R. Fachruddin University.

2.3.4. Formula of the powder beverage

The powder beverage formula was made into 3 formulas, but formula 3 in this study was not shown (due to patent purposes). The first step was to weigh all the ingredients according to each formula to be made. Next, lemon powder, ginger powder, and porang flour were put into a plastic container then stirred the mixture until homogeneous. 0.4 g of stevia as a sweetener was added to the mixture and homogenized, after which the beverage powder was baked for half an hour at 50˚C so as not damage the vitamin C stability of the lemon powder, then sifted the powder with a mesh sieve no.60, so that the fineness of the powder drink obtained was the same [9]. Then, the physical evaluation were tested of granules including organoleptic, flow time, angle of repose, tapped density, water content, moisture content, and dissolution time, then continued with the quality requirements (SNI), and hedonic test. After tested, 20 grams of powder beverage were packed into hygienic aluminum foil.

2.3.5. Physical evaluation of health powder beverage

2.3.5.1. Organoleptic test

Organoleptic testing was done by observing the external appearance of the health powder beverage. Physical examinations were carried out include textures, taste, colors, and aroma.

2.3.5.2. Flow time test

A total of 25 grams of granules was put into the flow tester. The unit was used to indicate the flow rate of granules is gram/second [10]. A good flow time was 4-10 seconds for 25 granules [11]

2.3.5.3. Angle of repose

Amount of 25 grams of powder was added to the measuring device, formed between the cone particle group and the horizontal plane. A good angle of repose is 25 to 40˚ [12]. The formula for determining the angle of repose is Tan $\alpha = h/r$, where α is the angle of repose, h is the height of the cone and r is the radius of the cone.

2.3.5.4. Tapped density test

A 100 ml measuring cup was filled with 50 grams of sample (Vo). The measuring cup containing the sample was then tapped 100 times

Table 1. Health powder beverage formula

Materials	Total % (b/b)		Function
	F1	F2	
Lemon powder	0,5	0,5	Active ingredient
Ginger powder	1	1	Active ingredient
Porang flour	7	7	Active ingredient
Stevia	8	8	Sweetener
Total	100	100	

Table 2. Organoleptic test results of powdered drinks

Parameter	Formula	Characteristics	Result
Organoleptic	1	Shape	Powder
		Aroma	Typical ginger
		Taste	Bitter acidity
		Color	Dark brown
	2	Shape	Powder
		Aroma	Typical ginger
		Taste	Pseudo bitter acidity
		Color	Greenish brown
	3	Shape	Powder
		Aroma	Typical ginger
		Taste	Sour
		Color	Creamy brown

and a constant volume (Vt) was obtained. Condition obtained should less than 20% as a % T.

$$Density = \frac{Granule\ weighti}{Compressible\ volume}$$

$$\%\ T = \frac{Vo - Vt}{Vo}\ x\ 100\%$$

2.3.5.5. Moisture content test

1 gram of granules was put into the aluminum foil, then, the moisture content of granules was measured with the moisture balance. The moisture content was then displayed as a percentage. A good moisture content is 1-5% [13].

2.3.5.6. Dissolving time test

20 grams of sample was weighed. The weighed sample was then dissolved in 200 ml of water. Next, a stopwatch was used to calculate the dissolving time. The time requirement is less than five minutes [14].

2.3.6. Water content test

The sample was weighed as much as 0.5 g. Then put into the Karl Fischer, waited 15 minutes, and the results was then read. The maximum water content of a good powder beverage is 3.0% [15].

2.3.7. Ash content test

2 grams of powder was weighed and put it in a porcelain cup that has heated at 600°C, cooled, then tared. The sample was heated in the crucible until the charcoal ran out, then allowed to cool before weighed again to ensure the weight remained. The maximum ash content of a good powder drink is 3.0% [15]. Total ash content was calculated against the initial powder weight in % w/w, which is calculated by the following formula:

$$ash\ weight = \frac{(crucible\ weight + ash) - Empty\ crucible}{(crucible\ weight + Sampel) - Empty\ crucible} x\ 100\%$$

2.3.8. Taste test (hedonic)

The favorability test is something that is done to find out whether the panelists like or dislike the product under study. The parameters tested in this study were taste, aroma, color, and texture, and the level of respondents' liking for each formula. Numerical value scale with a value of 1-5, where the value: 1. Strongly dislike; 2. Dislike; 3. Neutral; 4. Like; 5. Very like.

Selection of panelists as many as 20 students of Muhammadiyah A.R. Fachruddin University were asked to fill out a google form related to panelist selection. The characteristics to become a panelist were: a. Women or men who are students of Universitas Muhammadiyah A.R. Fachruddin; b. Age of 18-60 years old; c. Not an active smoker; d. Body condition was in a good health.

2.3.9. Data analysis

Analysis of research data was processed using Analysis of Variance (ANOVA) SPSS version 25. The results of the study were statistically ana-

lyzed by the normality test and homogeneity of variance test. Post hoc analysis were performed if the data were normally distributed. However, if the data were found to be not normally distributed and not homogeneous, then the data would be subjected to Kruskal Wallis and Mann-Whitney tests to ascertain important variations between each treatment group.

3. Result and discussion

3.1. Plants determination

The determination results showed that the plants used in this study were lemon (*Citrus limon* L.) from the *Rutaceae* tribe, ginger rhizome (*Zingiber officinale*) from the *Zingiberaceae* tribe, and porang flour (*Amorphophallus muelleri* Blume) from the Araceae tribe.

3.2. Organoleptic

The results of organoleptic tests on F1 obtained a powder shape, distinctive aroma of ginger, bitter acidity, and dark brown color. F2 obtained a powder shape, distinctive aroma of ginger, pseudo-bitter acidity, and greenish-brown. F3 obtained a powder shape, distinctive aroma of lemon, sour taste, and beige brown color. The results can be observed in Table 2 and Figure 1.

3.3. Flow time

The result of the F1 flow time test was 5.66 seconds, F2 was 6.84 seconds, and F3 was 8.12 seconds. The results of the three formulas showed

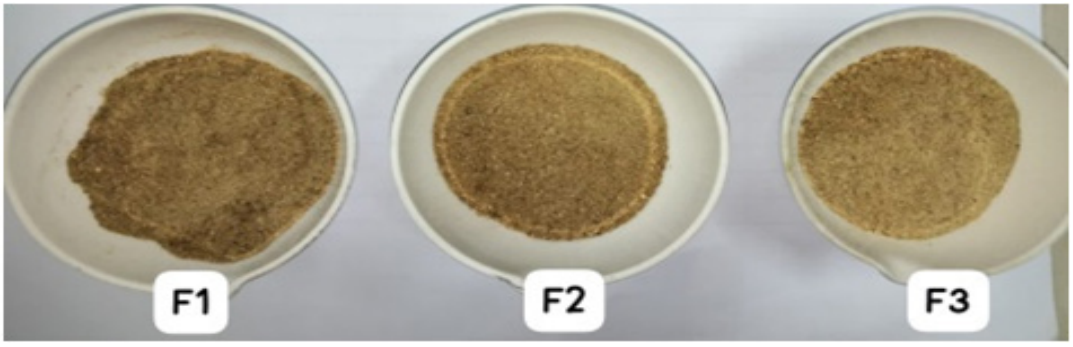

Figure 1. Health powder drink formulation results

Table 3. Powder drink flow time test results

Formula	Result	Description
F1	5,66 seconds	According to the requirement
F2	6,84 seconds	
F3	8,12 seconds	

Table 4. Results of the angle of repose of powdered beverages

Formula	Result	Description
F1	29,0˚	According to the requirement
F2	30,6˚	
F3	31,8˚	

Table 5. Tapped density test results of powdered beverages

Formula	Result	Description
F1	10%	According to the requirement
F2	15%	
F3	18%	

Table 6. Moisture content test results of powdered beverages

Formula	Result	Description
F1	1,6%	According to the requirement
F2	2,1%	
F3	3,2%	

Table 7. Dissolving time test results of powdered beverages

Formula	Result	Description
F1	03:17 minutes	According to the requirement
F2	03:47 minutes	
F3	03:53 minutes	

that the flow time of F1 is faster than F2 and F3, this is because F2 and F3 have higher moisture content than F1. Moisture or high water content will increase the surface contact, so that the attraction between particles also increases, and the powder is slower to fall [16]. It can be observed in Table 3.

3.4. Angle of repose

The F1 angle test was 29˚, F2 was 30.6˚, and F3 was 31.8˚. The results of the three formulas show that the stationary angle of F1 was smaller than F2 and F3, this was because F2 and F3 had a longer flow time and high water content, so the stationary angle of F2 and F3 were greater than F1. Moisture content has an impact on the stationary angle of the powder. An increase in moisture content and humidity result in a larger angle of repose, and can be observed in Table 4 [16].

3.5. Tapped density

The test results of the F1 density test was 10%, F2 was 15%, and F3 was 18%. The density index of F2 and F3 had a greater value than F1, because F2 and F3 had a high water content value so that the tapped density obtained was greater. The result can be observed in Table 5.

3.6. Moisture content

The results of the F1 moisture content test was 1.6%, F2 was 2.1%, and F3 was 3.2%. The results of the three formulas showed that the moisture content in F1 is lower in contrast to F2 and F3, this was because F2 and F3 contained high water content compared to F1, if the water content was high, the moisture content was high. Mouisture content result can be observed in Table 6.

3.7. Dissolving time

The results of the F1 solubility test was 03:17 minutes, F2 was 03:47 minutes, and F3 was 03:53 minutes. The results of the three formulas showed that the dissolving time in F1 was faster, because the water content in F1 was lower. In contrast to F2 and F3, so F1 dissolved faster than F2 and F3. Moisture content in the material is an element that affects dissolving time. The greater the water content in the material, the longer it takes to dissolve [17]. It can be observed in Table 7.

3.8. Water content

In this test, replication was carried out three times. It can be observed in Table 8, that the test results of the water content contained in the three health powder beverage formulas were F1 averaging 0.8%, F2 averaging 1.4%, and F3 averaging 2.1%. The water content of F3 is higher than F1 and F2 because the percentage of lemon juice in F3 is higher than F1 and F2, where lemon juice contains citric acid which can bind water. The water content of the material increases as the concentration of citric acid increasment [18].

3.9. Ash content

In this test, replication was carried out three times. It can be observed in Table 9, that the ash content test results obtained in the three health powder drink formulas F1 averaged 0.06%, F2 averaged 0.06%, and F3 averaged 0.05%. The ash content of F1 and F2 was higher than F2, because the percentage of ginger juice in F1 and F2 was

Table 8. Results of powdered beverages water content test

Formula	Result			Mean (%) ±SD	Description
	I	II	III		
1	0,3	1,4	0,7	0,8±0,45	According to the requirement
2	1,6	1,4	1,2	1,4±0,16	
3	2,1	1,6	2,6	2,1±0,40	

Table 9. Ash content test results of powdered drinks

Formula	Result			Mean (%) ±SD	Description
	I	II	III		
1	0,3	1,4	0,7	0,06±4,71	According to the requirement
2	1,6	1,4	1,2	0,06±4,71	
3	2,1	1,6	2,6	0,05±9,42	

Tabel 10. Panelist characteristics based on age

Age	Total	Percentage
≤ 20 years	3	15%
21-55 years	17	85%
≥ 55 years	0	0%
Total	20	100%

Tabel 11. Panelist characteristics based on gender

Gender	Total	Percentage
Male	2	10%
Famale	18	90%
Total	**20**	**100%**

higher than in F3, where ginger juice contains organic contaminants such as lead metal (Pb) and copper metal (Cu). By Taufikurrahman's research (2016), the results of Cu metal content in ginger was around 4.273 mg/kg, and Pb content in ginger was around 3.782 mg/kg [10].

3.10. Panelist characteristics

3.10.1. Age

The panelists who participated in this study were at the age of ≤ 20 years as many as 15% (3 people), age 21-55 years as many as 85% (17 people) and age ≥55 years as many as 0% (0 people). It can be observed in Table 10.

3.10.2. Gender

The panelists who participated in this study were 10% male (2 people), 90% female (18 people). In this study, most panelists were women, this is due to the inclusion requirements that must be met by panelists, who are not active smokers. It can be observed in Table 11.

3.10.3. Body condition

All panelists who were students of Muhammadiyah A.R. Fachruddin University were panelists who have a healthy body condition. It can be observed in Figure 2.

3.10.4. Smoking activity

All panelists who were students of Muhammadiyah A.R. Fachruddin University were panelists who are not active smokers. It can be observed in Figure 3.

3.11. Hedonic test

3.11.1. Taste

This health powder beverage formulation has

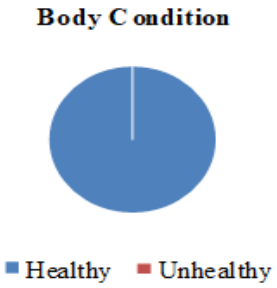

Figure 2. Panelist characteristics based on body condition

Figure 3. Panelist characteristics based on smoking activity

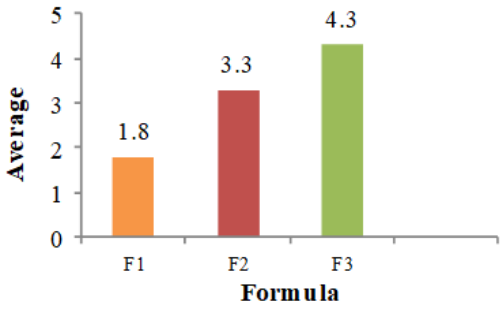

Figure 4. Hedonic test mean of health powder beverage flavor
Description: Score 1: Strongly Dislike, Score 2: Disliked, Score 3: Neutral, Score 4: Like, Score 5: Liked Very Much

a combination of sour, sweet, and bitter flavors. Formula 1 had a bitter acidity taste, formula 2 had a bitter pseudo-sour taste, and formula 3 had a sour taste. This is due to the different concentrations of ginger pollen. The greater the percentage of ginger pollen, the more bitter taste produced by the powder beverage. It can be observed in Figure 4, that the average obtained in the hedonic test of the taste of the most formula favored by panelists was formula 3, because the percentage of ginger pollen was small so that the taste in formula 3 was not bitter

3.11.2. Aroma

In this health powder beverage formulation, formula 1 had a distinctive aroma of ginger, formula 2 had a distinctive aroma of ginger, and formula 3 had a distinctive aroma of lemon. This was due to the different concentrations of ginger and lemon pollen. It can be observed in Figure 6, that the average in the hedonic test of the aroma of the formula most favored by panelists was formula 3 because a large percentage of lemon pollen produced a fresh lemon aroma in formula 3.

3.11.3. Textures

This health powder beverage formulation had a texture, namely formula 1 had a thick texture, formula 2 had a slightly thick texture, and formula 3 had a liquid texture. This was due to the difference in concentration of porang flour. The greater the percentage of porang flour, the

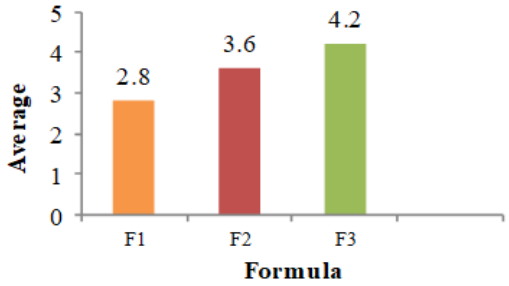

Figure 5. Hedonic test mean of health powder beverage color
Description: Score 1: Strongly Dislike, Score 2: Disliked, Score 3: Neutral, Score 4: Like, Score 5: Liked Very Much

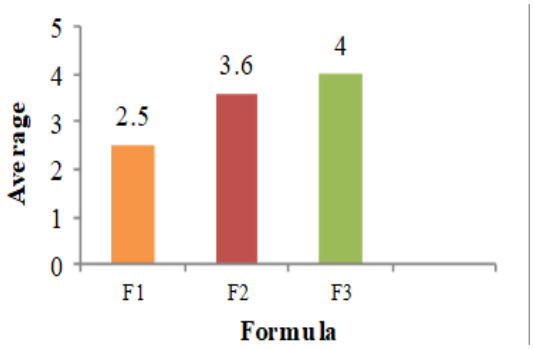

Figure 6. Hedonic test mean of aroma of health powder beverage
Description: Score 1: Strongly Dislike, Score 2: Disliked, Score 3: Neutral, Score 4: Like, Score 5: Liked Very Much

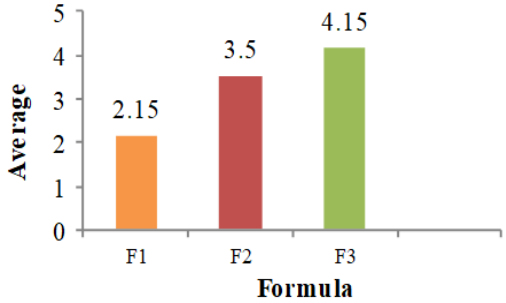

Figure 7. Hedonic test mean of texture of health powder beverage
Description: Score 1: Strongly Dislike, Score 2: Disliked, Score 3: Neutral, Score 4: Like, Score 5: Liked Very Much

thicker the health powder beverage was made. It can be observed in Figure 7, that the average in the hedonic test of the texture of the most favored formula by panelists was formula 3, because the percentage of porang flour was small so that the texture in formula 3 was not too thick.

4. Conclusion

The results of this study indicate that the lemon juice health powder drink (*Citrus limon* L.), ginger (*Zingiber officinale*), and porang flour (*Amorphophallus muelleri* Blume) from all formulas (F1, F2, and F3) have physical properties including organoleptic, flow time, angle of repose, tapped density, moisture content, and good dissolving time. So that the lowest results are in formula 1.

The powder beverage quality test also has results under the quality requirements of powder beverage, which is a maximum of 3.0% according to the provisions (SNI, 1996) including water content and ash content. Based on the hedonic test of taste, color, aroma, and texture of the three health

powder drink formulas of lemon juice (*Citrus limon* L.), ginger (*Zingiber officinale*), and porang flour (*Amorphophallus muelleri* Blume) affect the level of panelist preference. So that the results most favored by the panelists were formula 3.

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