Powder Drink from Banana Peel Pectin and Rice Bran Rich in Dietary Fiber

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Abstract*: Banana peel and rice bran are the food waste that can be potential sources of dietary fiber. This research aims to discover the best formula for functional beverage powder which contains high dietary fiber and which is favored by the panelist. The formulas are devised based on the ratio of kepok banana peel pectin and rice bran. The ratio for F1 is (1.5g: 2.5g), F2 (2g: 2g) and F3 (2.5g: 1.5g). After 120-minute extraction, the pectin of kepok banana peel has 5% of yield, 7.96% of water content, 8.52% of ash content, 705.08 of equivalent weight, 4.85% of methoxy level and 54.218% of esterification degree. A hedonic test indicates that the taste of the drink resulting from all three formulas is not significantly different. The color of the drink powder produced using formula 1 and formula 2 is more favored compared with that produced using formula 3 but the aroma of the drink powder produced using formula 3 is the most preferred. The soluble fiber content of pectin is 8.41% meanwhile the soluble and insoluble fiber content of rice bran is 5.28% and 23.90% respectively; the content for F1 is 7.75%,17.76%; F2 6.79%, 19.34%; F3 5.40%,21.65%.

***Index Terms*: Banana peel, Dietary fiber, Drink powder, Rice bran, Pectin.**

I. INTRODUCTION

People today start to realize that dietary fiber plays an important role in our health after experts suggest that in developed countries where the consumption of low fiber food is common the incidence of colon cancer is more frequent compared to that in developing countries where the consumption of high fiber food is common. The research proves that the average fiber intake of Indonesian people is only 9.9 - 10.7 grams/day and this intake is lower than the recommended fiber intake requirement of 25 grams/day. Dietary fiber is beneficial because it can prevent obesity, diabetes, gastrointestinal disorders, colon cancer. It can also reduce the cholesterol level and prevent cardiovascular diseases [1].

Banana peel is a waste that can be a potential source of dietary fiber. Kepok banana peel has quite high fiber content of 32.73% [2]. Pectin is part of soluble dietary fiber and is an acidic complex polysaccharide which is present in varying amounts and is widely distributed in plant tissues. Pectin can be obtained from the extraction process of one particular plant part such as kepok banana peel. When extracted with a solvent such as HC1 at the temperature of 90°C and with pH of 1.5 for 80 minutes, kepok banana peel will produce 52.1% of pectin content, 11.85% of moisture content, 0.98% of ash content and 3.72% of methoxy content [3].

Another source of food rich in fiber is the rice bran which contains 9.84% of water insoluble fiber and the flour produced from it is widely used by the community as an additional ingredient for baking or for making beverages [4].

The use of rice bran in the making of instant drink powder by mixing it with other ingredients such as pectin from kepok banana peel, which is an interesting innovation, is not a common practice in the production of foods rich in dietary fiber. This study aims to discover a formula in the making of instant drink powder from kepok banana peel pectin and rice bran which contain high fiber, have a good characteristic and are highly preferred by panelists.

II. METHODOLOGY

A. Preparation of kepok banana peel powder

About 7 kg of ripe kepok banana peels were washed using running water before they were drained. The banana peel was cut into small pieces with the thickness of 1 mm and dried in the oven at temperature of approximately 50°C. Then, the dried peel was cleaned to remove the parts that may get contaminated during the heating (dry sorting). Furthermore, the dried peel was ground and sieved using a 30-mesh sieve to obtain dried powder and then the yield was calculated.

B. Pectin Isolation

400 ml of water was poured into 80 grams of kepok banana peel samples, then 60% of citric acid was added until to allow pH to reach 2.5. After that, the extract was put on a hot plate and stirred using magnetic stirrer at 90°C for 120 minutes. Then, the extract was filtered using an 8-layer filter cloth then it was filtered one more time using a filter paper. The filtrate was evaporated at 90°C until half of the volume was reached, then it was left to cool. 96% of ethanol was added and precipitated at a room temperature for 24 hours for further separation of the filtrate and residue. The obtained residue was dried in the oven at 50°C until it was completely dried. The pectin was ground into pectin powder.

C. Pectin Characteristics Test

Pectin testing was carried out through physical analysis (color, odor and texture), starting with the obtained pectin powder. The water content was measured using moisture balance equipment. The pectin ash content was

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measured using gravimetric method.

The weight equivalent of pectin was used to determine the size of the free galactic acid group of acids in the pectin molecular chain. The weight equivalent was measured by dampening 0.5 gram of pectin with 2 ml of 70% ethanol and dissolving it in 100 ml carbonate-free distilled water containing one gram of NaCl. The resulting solution from the mixture was titrated slowly with a standardized 0.1N NaOH with phenolphthalein indicator until it turned into yellowish red (pH 7.5) and it remained so for at least 30 seconds.

Measuring Pectin Methoxy Levels: The neutral solution resulting from the BE measurement and 20 ml of 1% HCl solutionwere shaken and allowed to stand for 15 minutes at room temperature in a sealed container. Then, it was titrated with 0.1N NaOH using phenolphthalein indicator until the last point as was the case in th e weight equivalent measurement.

Galacturonate levels were calculated based on the mu (milliequivalents) of NaOH which results from the measurement of the weight equivalent and methoxy content.The degree of esterification was calculated based on the methoxy content and the levels of galacturonate obtained.

D. Instant Powder Formulation

The powder drink was packed in a 5-gram sachet. The formula is presented in Table 1.

Table 1. Instant Powder Formulation

Ingredients	F1	F2	F3
Kepok banana peel pectin	30%	40%	50%
Rice bran	50%	40%	30%
Sorbitol	16%	16%	16%
Tiramisu flavour	4%	4%	4%

E. Instant Powder Quality Testing

Instant powder quality was tested using organoleptic test, water content test and ash content, and deposition timing test and fiber test.

Hedonic test was performed to determine significant differences in preference. The samples were served to 20 panelists. The data was processed using Analysis of Variance and Duncan test.The Hedonic test used 5 scales: 1 = disliked very much; 2 =disliked; 3= moderately liked; 4=liked, 5=liked very much.

Test of Settling Time : 5 grams of instant powder was poured into 25 ml of water with temperature of 60-70°C, then the dispersing process of the powder was timed (the timing stopped when the powder was entirely dispersed in water). Next, The powder was stirred well and the precipitation process was timed (the timer stops when no more precipitate left).

Testing of Dietary Fiber (Enzymatic Method): First, some samples were turned into a 1-liter suspension by adding a few drops of isoamyl alcohol and thymol crystal. 50 mL suspension was poured into a 250-mL cup and 50 mL of 0.2 N HCl and 100 mg of pepsin were added. The mixture was stirred well then incubated at 40°C for 18 hours. Next, the mixture was neutralized with a 4N NaOH solution and 50 mL of buffer with pH of 6.8 before 100 mg of pancreatin and 300 mg of sodium dodecyl sulfate were added. After that, it was incubated one more time at 40°C for one hour and stirred. The mixture is then acidified with 4N HCl until its pH reached 3-5 before it was centrifuged for 30 minutes at 3000 rpm. The supernatant was then filtered with a glass filter containing 15 nm thick sands. The precipitate was washed with distilled water and centrifuged one more time. Next, the residue was washed and filtered with a glass filter before it was rinsed three times with water and three times with acetone. The glass filters containing residues were dried at 105°C for one night and weighed. The weight of the dry residue determines the fiber content.

III. RESULTS AND DISCUSSION

A. Characteristics And Quality Of Pectin From Kepok Banana Peel

The pectin of banana peel is a brown powder, with a slightly acidic taste. The dried pectin of kepok banana peel can be seen in Fig. 1. The yield of pectin is the percentage of pectin, which is 5%, produced after the drying process at the extraction temperature of 90°C for 120 minutes and pH of 2.5. The pectin quality test results are presented in Table 2.

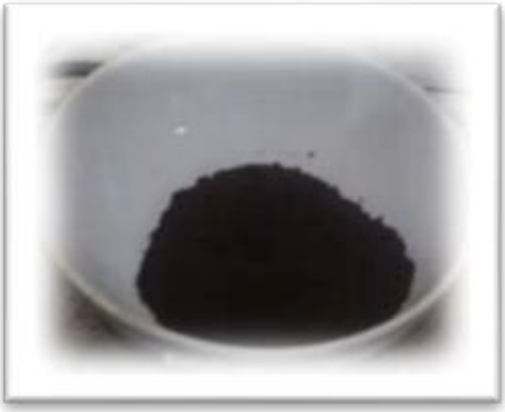

Fig. 1 Dry Pectin of Kepok Banana Peel

Table 2. Results of Pectin Quality Testing

No	Pectin test	Results	IPPA requirements (2001)
1	Water content	7.96%	< 12%
2	Ash Content	8.519%	< 10%
3	Equivalent Weight	705.080	600-800
4	Methoxy Levels	4.853%	< 7%
5	Level of Galacturonate	52.52%	min35%
6	Degree of Esterification	54.15%	< 50%

The pectin water content found in this research is still below the maximum permissible pectin water content limit, which is <12%. Water content is one of the important parameters that determines the durability of food products and is related to the activity of microorganisms during storage. Products with high moisture content are more susceptible to damage because they create a conducive medium for microorganism growth, whereas products with low moisture content are relatively more stable in long-term storage.

The amount of pectin ash produced in this research is 8.52%.

This figure is still below the allowed maximum limit of pectin ash content according to Indonesian Food Codex (1979) and according to IPPA standard (2001), which is 10.00%.

The equivalent weight of pectin generated in this research is 705.08. This figure is still within the standard limits set in IPPA quality standard (2001), which states that the equivalent weight of pectin ranges from 600-800. The equivalent weight is the content of the free galactic acid group which is not esterified in the pectin molecular chain. Pure pectate acid is pectate substance composed of polygalacturonate acids which are free from methyl ester group or non-esterification. The lower the pectin level the lower the equivalent weight.

The value of methoxy level obtained in this research is 4.85%. The pectin whose methoxy content is less than 7.12% is categorized into low-methoxy pectin. The amount of galacturonate of pectin in this study is 52.52%, and it meets the pectin quality standard set by IPPA, which is a minimum of 35% [5].

Galacturonate levels play an important role in determining the functional properties of pectin solution, which will affect the structure and texture of the pectin gel. The degree of pectin esterification found in this research is 54.15%. Low-grade pectin has an esterified degree below 50%, and the esterified pectine found in this research is high because its value is more than 50% [5].

B. Quality Of Drink Powder Made From Raw Pectin Of Kepok Banana Peel And Rice Bran

The drink powder produced using the four formulas are almost uniform in shapes, brown in color, slightly acidic, and less sour with a typical tiramisu flavor.

Fig. 2 Beverage Powder

The water content of the drink powder produced in this research is 7% . The ash content is 0.2%. This percentage of ash content still meets SNI standard, which is not more than 1.5% [6]. Thus, these results are still within the food safety limits. Formula 1 has longer precipitation time and higher precipitation rate due to the higher bran content compared with the other two formulas (Table 3).

Table 3. Test Results of Precipitate Time and Precipitate Height

Formula	Precipitate Time	Precipitate Height
1	1 minute 46 seconds	0.45 cm
2	1 minute 29 seconds	0.3 cm
3	1 minute 20 seconds	0.15 m

C. Hedonic Test

The color produced using formula 1 and formula 2 is more preferred than that produced using formula 3.

Table 4. Hedonic Test Table

Formula	Average		
	Color	Aroma	Taste
F1	3.30 ± 0.73^{b}	3.20 ± 0.62^{a}	3.25 ± 0.77^{a}
F2	3.40 ± 0.89^{b}	3.15 ± 0.89^{a}	3.15 ± 0.75^{a}
F3	2.45 ± 0.99^{b}	4.05 ± 0.60^{b}	3.55 ± 0.51^{a}

The identical letters on the subscript show that there is no difference between one formula and the other, based on Duncan test at 0.05 level.

The flavor of instant powder produced using formula 3 is more preferred than and significantly different from that produced using formula 1 and formula 2. The taste of instant beverage powders produced using formula 1, formula 2, and formula 3 is not significantly different.

D. Content of Dietary Fiber

Dietary fiber is the carbohydrates (polysaccharides) and lignin that cannot be hydrolyzed by human digestive enzymes and which l enter the colon in intact condition, causing them to turn into the substrate for the fermentation of living bacteria there. Dietary fiber is classified based on its molecular structure and solubility in water [7]. Dietary fiber can provide beneficial physiological effects such as laxatives, lowering blood cholesterol and blood sugar levels. One of the benefits of dietary fiber is to slow the carbohydrates absorption which helps patient suffering diabetes mellitus regulate blood sugar levels. Food fiber can also prevent digestive tract disorders, heart disease, colon and breast cancers. Its satiating effect also helps to control body weight [8].

Table 5. Insoluble Fibers and Soluble Food Fibers

Formula	Insoluble Fibers	Soluble Fibers
F1	17.76%	7.75%
F2	19.34%	6.79%
F3	21.65%	5.40%
Formula	Insoluble Fibers	Soluble Fibers

As seen in Table 5, the insoluble fiber content produced using formula 3 is higher than that produced using the other two formulas. The soluble fiber content produced using formula 1, on the other hand, is higher than that produced using formula 2 and formula 3. This is because rice bran contains 5.28% of soluble fiber and 23.90% of insoluble fiber, while the soluble fiber content of pectin is 8.41%.

Based on the solubility in water, pectin is divided into soluble fiber and insoluble fiber. Insoluble fiber in small intestine will form a high viscosity solution. Because of its nature, soluble fiber can affect lipid and carbohydrate metabolism and might have anticarcinogenic effect [9]. Fiber can also serve as a prebiotic for intestinal microbes, which is good for health. The physiological effect which is expected to affect energy regulation is that fiber has low energy content per food weight unit. The addition of fiber intake can reduce energy density, especially the soluble fiber because of its ability to bind water. Fiber also strengthens the density of

food mixture in the digestive tract, thus slowing the passage of food in the digestive tract and also slowing the enzyme movement. Slow digestion results in a low blood glucose response [10].

Consumption of insoluble fiber and soluble fiber together might reduce the risk of colon cancer. Insoluble fiber increases the stool mass and shortens the transit time. This is one of the reasons why insoluble fiber can prevent and treat chronic constipation, decrease carcinogens concentration and contact time with colonic mucosa. It is believed that insoluble fiber will shorten the transit time of the feces in the intestine, thus shortening the contact time between intestinal mucosal cells with digestive residues, including carcinogenic components which are formed during digestion. A large stool size with larger amounts of water will wrap and dilute the carcinogenic components contained in the feces. It is widely known that dietary fiber provides protection to the colon from constipation disorders, diarrhea, hemorrhoids and colon cancer. Dietary fiber also prevents metabolic disorders, obesity,the possibility of diabetes mellitus, coronary heart disease, and hypertension [11].

IV. CONCLUSION

Pectin quality of kepok banana peel meetsthe IPPA requirements and is classified as low-methoxy pectin. A hedonic test shows that the powder color produced using pectin to rice bran ratio of F1 (30:50) and F2 (40:40) is more preferable than that of F3 (50:30). Meanwhile, the aroma of the powder produced using formula 3 is more preferable compared with that produced using formula 1 and formula 2 but the taste of powder produced using the three formulas is not significantly different. Insoluble and soluble dietary fiber content from each formula is F1 (17.76%, 7.75%); F2 (19.34%; 6.79%) and F3 (21.65%; 5.40%).

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