Black rice flour-based choi pan as an alternative snack for people with diabetes mellitus

U P Raissa1 and S Palupi1

1Department of Culinary Engineering Education, Faculty of Engineering, Universitas Negeri Yogyakarta, Indonesia

E-mail: utari.puspa2016@student.uny.ac.id

Abstract. This study aims to: 1) develop the right recipe for an innovative Choi pan made of black rice flour, 2) examine the people’s acceptance on the developed Choi pan recipe, and 3) analyze the nutritional values contained in the black Choi pan. This study employed the R and D research design with the 4D models (Define, Design, Develop, Disseminate), while descriptive statistics were used to analyze the data. The results of this study: 1) show that according to Ayudiah Respati’s recipe, the right recipe for this black Choi pan should contain 50% black rice flour, 2) it is shown by the mean value obtained from the test (3.43), in the preference test, it is found that the product is favored by non-trained panelists (3.83), 3) the proximate analysis test results show that the developed Choi pan contains 45.62% water, 1.60% ash, 13.61% protein, 11.57% fat, 4.66% crude fiber, 22.89% carbohydrate, and 251.08 kal/100g energy.

1. Introduction

Changes in lifestyles occurring currently result in bad eating habits. Poor food choices and diets have an increasing number of generative diseases, such as diabetes mellitus, cancer, hypertension, and heart disease. Diabetes Mellitus (DM) is a condition in which a metabolic disorder affects the metabolism of carbohydrates, fats, and proteins. The number of DM cases in the world has increased year after year. According to the International Diabetes Federation, in 2012, [1] 382 adults, or 8.3% of the world population had diabetes. As many as 80% of them live in low and middle-income countries. The number of people with DM is increasing rapidly worldwide and this condition has become a global epidemic. Indonesia’s rank is among the top ten countries with the highest number of populations with diabetes. The type 2 diabetes making up 90%-95% of the cases. Wild et al (2004), [2] estimates that in 2030 the number of people with DM in Indonesia will reach 21.3 million.

Controlling glucose levels in our body can be done through both non-pharmacological and pharmacological therapies. Research shows that non-pharmacological therapy through monitoring food intake or diet is effective in controlling glucose levels, lipid profile, and blood pressure in patients with type 2 diabetes. One of the efforts to control the glucose level is by consuming food with a low glycemic index (GI). Research shows that low glycemic index food can improve insulin sensitivity and reduce the rate of glucose absorption, so it is useful in controlling glucose levels for people with DM.

Rice is an energy source of food that is high in carbs but low in protein. Its protein value is 56. The value is higher than other cereals but is still low compared to other animal-based protein sources. White rice is a staple food for most Indonesian people, but it can be substituted with black rice. Black rice has a lower glycemic index than white rice; the index is 42.3. One of the reasons why it is has a lower glycemic index is that it is rich in fiber [3] In spite of its benefit, black rice is rarely used especially as a substitute for white rice for people with diabetes mellitus.
Snacks are varied in types. It may be in the forms of dried food, porridge, and beverages. Some popular snacks are traditionally made, one of which is made from white rice, for example, *Nagasari, KueLapis, KueCucur, KueMangkok, Bubursumsu*, and *Choi pan*.

*Choi pan* is an Indonesian snack that is originated from Pontianak and is one of the snacks made from white rice flour. This flour is not a suitable food base for people with Diabetes Mellitus. Thus, this research tries to deal with DM and white rice issues by creating a food product using black rice. This research substitutes white rice as the base of a snack called *Choi pan* with black rice as an alternative to healthy food containing the low glycemic index.

2. Methods

This study employed Research and Development design or RnD. This research design is commonly associated as a process consisting of steps to develop a new product or improve an existing product [4]. States that Research and Development is a research method used to produce certain products and test the effectiveness of that method. To achieve research objectives and produce the expected products, stages conducted in research should be measured and documented [5]. This study employed a 4D research model consisting of Define, Design, Develop, and Disseminate stages [6]. Figure 1 shows methodology flow chart.

Data collected in this study were analyzed descriptively. Descriptive data analysis techniques are analytical techniques that are used to analyze data by describing or presenting collected data as needed without any intention to generalize the results.

In this study, the researchers made panelists as the data sources. The panelists assessed the developed product texture, color, taste, aroma, and preferences. The data sources are presented in Table 1.

| Research Stage       | Data Source                  | Number (person)     |
|----------------------|------------------------------|---------------------|
| 1<sup>st</sup> validation | Expert                       | 2 person            |
| 2<sup>nd</sup> validation | Expert                       | 2 person            |
| Preference test      | Semi trained panelists       | Minimum of 30       |
| Disseminate          | Exhibition visitors          | Minimum of 60       |

Figure 1. Methodology Flow Chart
The instruments used in this study were sensory test questionnaires. The questionnaires were distributed to collect data on product color, texture, aroma, taste, and look. The initial data were collected by means of sensory test questionnaires (Validation I and Validation II). Meanwhile, data from 30 semi-trained panelists were collected using sensory test questionnaires, and then Preferences test questionnaires were used to collect data from customers.

3. Results and Discussion

*Choi pan* is a typical Pontianak traditional cake made from white rice flour. Because people with diabetes should limit white rice flour intake, black *Choi pan* made of black rice has become the alternative or innovation to substitute white rice. This product is created due to the lack of snack products with functional food ingredients with many health benefits. This innovation is aimed at providing an alternative of healthy snacks for people with or without diabetes mellitus as black rice is high in fiber.

In this research, the newly developed product is called Black *Choi pan* made from black rice flour. This product is inspired by *Choi pan's* made by Ayudiah Respatih. The recipe for this snack has been written in a book entitled Snack It Up published in 2018.

3.1. Define Stage

In this stage, researchers collect three recipes from books and magazines. The recipes are then analyzed and tried to get a reference recipe functioning as a control product. Table 2 shows product composition.

| Table 2. Product Composition |
|-------------------------------|
| Ingredient | F1 | F2 | F3 |
| White Rice Flour | 200 gr | 180 gr | 100 gr |
| Sago Flour | 60 gr | - | 20 gr |
| Cornstarch | - | 25 gr | - |
| Vegetable Oil | 90 ml | 45 ml | 45 ml |
| Water | 500 ml | 450 ml | 125 ml |
| Salt | - | 2 gr | 2 gr |

Note:  
F1 = Snack It Up book by Ayudiah Respatih, 2018.[7]  
F2 = Jajanan Pasar Favorit by Tim IdeMasak, 201,[8]  
F3 = Femina E-Magazine, May 25, 2015 edition.[9]

Based on trials and sensory tests of three reference recipes that have been carried out, one recipe selected as the reference recipe is the F1 recipe written by Ayudiah Respatih in Snack It Up book published in 2008.

3.2. Design Stage

At the define stage, a reference recipe is chosen to be developed. The product selected as a reference is made of black rice flour (Table 3). At this stage, researchers make three batches of *Choi pan* in order to find out the amount of ingredient that can substitute the reference product.

| Table 3. The Developed Product Formulation |
|-------------------------------------------|
| Ingredient | Reference Product | F1 (50%) | F2 (75%) | F3 (100%) |
| White Rice Flour | 200 gr | 100 gr | 50 gr | - |
| Sago Flour | - | 100 gr | 150 gr | 200 gr |
| Cornstarch | - | - | - | - |
| Vegetable Oil | 60 gr | 60 gr | 60 gr | 60 gr |
| Water | 90 ml | 90 ml | 90 ml | 90 ml |
| Salt | 500 ml | 500 ml | 500 ml | 500 ml |
3.3. Develop Stage
At the product development stage, the researchers determine the variety of filling and sauce used. They determine the reference recipe for filling and sauce used and determine the recipe for Choi pan filling and sauce used in the developed product. Table 4 shows Reference Product Filling and Sauce Recipe.

| Ingredient     | Filling | Sauce  |
|----------------|---------|--------|
| Red Cayenne Pepper | -       | 20 gr  |
| Boiled Water    | -       | 100 ml |
| Garlic          | 5 gr    | 10 gr  |
| Sugar           | -       | 10 gr  |
| Lime            | -       | 10 ml  |
| Salt            | 3 gr    | 2 gr   |
| Dried Shrimp    | 25 gr   |        |
| Yam             | 250 gr  |        |
| Pepper          | 3 gr    |        |
| Vegetable oil   | 45 ml   |        |

Source: Snack It Up book by Ayudiah Respatih, 2018

After determining the variation in the filling, the researchers carry out the Validation Test I. They determine the technique for presenting one developed product and one reference product simultaneously with two experts. If the results of the Validation Test I says that the product is feasible, the product development is continued with proximate testing in the Laboratory. If it still needs improvement, the Validation Test II will be conducted. Developed product and one reference product presentations were done simultaneously with two experts to obtain the selected development product presentation techniques and proceed with proximate testing in the laboratory. Table 5 shows Develop Product Filling and Sauce Recipe.

| Ingredient                  | Filling | Sauce  |
|-----------------------------|---------|--------|
| Heavy Cream Cooking         | -       | 30 ml  |
| Butter                      | 30 gr   | 10 gr  |
| Flour                       | -       | 10 gr  |
| Fresh Milk                  | -       | 250 ml |
| Cheddar Cheese              | -       | 30 gr  |
| Salt                        | 5 gr    | 2 gr   |
| Pepper                      | 5 gr    | 2 gr   |
| Whole Egg                   | -       | 60 gr  |
| Oregano                     | -       | 2 gr   |
| Onion                       | 20 gr   | 20 gr  |
| Garlic                      | -       | 5 gr   |
| Ground Chicken              | 100 gr  |        |
| Boiled Spinach              | 50 gr   |        |

3.4. Disseminate Stage
At the disseminate stage, three activities, namely validation testing, packaging, as well as diffusion and adaptation are carried out. Products that have been developed are made in real situations. The next activity is conducting a limited acceptance test by testing reference and developed products sensory traits to a minimum of 30 semi-trained panelists. Then, the last activity is product packing. Packing is done due to efficiency for delivering and distributing the products to people for acceptance tests to the community in exhibitions visited by at least 60 people.
In the Disseminate stage, the researchers collect the data through the limited acceptance test for semi-trained panelists and preference tests for untrained panelists. The limited acceptance test for semi-trained panelists is carried out by comparing the reference product with sample code of 167 and developing the product with sample code of 890. This test aims to determine whether the developed product is feasible and better or almost resembles the reference product. In this test, the researchers obtain data using 30 questionnaires for reference products (167) and 30 questionnaires for developed products (890). The obtained data are presented in the Figure 2.

![Figure 2. The Chart of Data Taken in Limited Acceptance Test](image)

Based on the results of the limited acceptance test shown in the chart, the aroma of the reference product (167) has the lowest average (2.93) and the highest mean value is in the aspect of texture (3.2). Then, the mean values obtained by the aspects of color and taste are 3.00 and 3.06 respectively. Overall, the reference product (167) obtains the main value of 3.06. This means that the reference product (167) is favored by panelists. Then, in the developed product chart (890), it is seen that the aroma has the lowest mean value (3.06) but this is better than the reference product (167) which only gets 2.93. The highest mean value in the developed product (890) is in the taste (3.53). The mean value of the color aspect is 3.43 and the texture is 3.1. The developed product (890) overall mean value is 3.43. This means that the developed product (890) is favored by panelists.

After a limited acceptance test is conducted, the preference level test is done to determine whether people like and accept the developed product. In this stage, researchers collected data from sixty questionnaires. The chart of the data is presented in Figure 3.

![Figure 3. Chart of Data Collected from Preference Level Test](image)
Based on the results of the questionnaires for non-trained panelists above. It is seen that in the developed product, the aspect of color gets the lowest mean value (3.63). Then, for the reference product, the aspect of taste gets the highest mean value (3.81), followed by aroma (3.65), and texture (3.7). The overall mean value of this product is 3.83. This means that the developed product is accepted by the panelists.

The last step of this study is the Proximate Analysis Test stage. States that Proximate Analysis is a substance analysis or testing conducted for raw materials that will be further processed in the industry as a final good [10]. Proximate analysis checks the quality of the food ingredients. It especially focuses on the standard of food substances that should be contained therein. In the macronutrient content, the proximate analysis includes total ash, water, fat, protein, and carbohydrates contained in a product, while the micronutrient content is focused on provitamin A (β-carotene) [11]. Table 6 shows the results of the proximate analysis of 100gr black Choi pan.

| Analysis          | Test 1 (%) | Test 2 (%) | Average (%) |
|-------------------|------------|------------|-------------|
| Water             | 45.90      | 45.35      | 45.62       |
| Ash               | 1.76       | 1.45       | 1.60        |
| Protein           | 13.49      | 13.74      | 13.61       |
| Fat               | 11.55      | 11.60      | 11.57       |
| Crude Fiber       | 4.76       | 4.57       | 4.66        |
| Carbohydrate      | 22.51      | 23.27      | 22.89       |
| Energy (kal/100g) | 248.89     | 253.27     | 251.08      |

Note: The Proximate Test is conducted at Chem-Mix Pratama Laboratory, Yogyakarta.

Based on the results of the proximate analysis test in table 6, the developed product is tested twice. Then, after both tests, the content of water is 45.62%, ash is 1.60%, protein is 13.61%, fat is 11.57%, crude fiber is 4.66%, carbohydrates are 22.89%, and energy is 251.08 cal/100g.

4. Conclusion

Based on the observations, analysis, and tests conducted in some stages, it can be concluded that the developed black Choi pan recipe which is well accepted by people should contain 50% black rice flour. This recipe is adapted from Ayudiah Respatih’s recipe. The developed black Choi pan recipe quality is better or almost the same as the reference product. It is shown by the mean value obtained from the test (3.43). In the preference test, it is found that the product is favored by non-trained panelists (3.83). Then, in the last stage, the proximate analysis shows that developed product consists of 45.62% of water; 1.60% of ash, 13.61% of protein, 11.57% of fat, 4.66% of crude, 22.89% of carbohydrates, and contains 251.08 cal/100g energy.

5. References

[1] International Diabetes Federation (IDF) Clinical Guidelines Task Force Global Guidelines for Type 2 Diabetes. p:72-80. 2012
[2] Wild S, Roglic G & Green A, et al 2004 Global Prevalence of Diabetes Diabetes Care 27:1047-1053
[3] Widiawati Ayu 2017 Cookies Tepung Beras Hitam Dan Kedelai Hitam Sebagai Alternatif Makanan Selingan Indeks Glikemik Rendah Journal of Nutrition College, 6(2), 128-137
[4] Sugiyono 2009 Metode Penelitian Kuantitatif, Kualitatif dan R&D (Bandung: Alfabeta)
[5] Mulyatiningsih, E 2011 Metode Penelitian Terapan Bidang Pendidikan Yogyakarta: Alfabeta.
[6] Celestine P, Purwanti S. 2019 Le’eclair with the Substitution of Millet Flour as Local Foodstuffs Utilization Journal of Physics: Conference Series 1446, p. 012071
[7] Snack It Up book by Ayudiah Respatih, 2018.
[8] Jajanan Pasar Favorit by Tim IdeMasak, 2011
[9] Femina E-Magazine, May 25, 2015 edition7.
[10] Mulyono 2000 *Buku Metode Analisis Proksimat* (Jakarta: Erlangga)
[11] Sudarmadji et al 1996 *Analisa Bahan Makanan dan Pertanian* Yogyakarta: Liberty