**TRANSPUBLIKA INTERNATIONAL RESEARCH IN EXACT SCIENCES (TIRES)**

# FEASIBILITY TEST OF JACKFRUIT SEED FLOUR

**Wildan Seni[1*], Samsuddin[2], Pasyame Rambune Kala[3]**
[1]Occupational Safety and Health Study Program, Faculty of Health Sciences, Universitas Abulyatama
[2,3]Public Health Study Program, Faculty of Health Sciences, Universitas Abulyatama
E-mail: [1)] wildansenist@gmail.com

***Abstract***

*Indonesia, being a tropical country, is home to a wide variety of plants, one of which is the jackfruit plant (Artocarpus heterophyllus Lamk). However, the utilization of jackfruit waste, particularly the seeds, still remains limited. With the increasing demand for food and advancements in technology, there is a growing interest in transforming jackfruit seeds into flour. In order to understand the nutritional value of jackfruit seed flour, researchers have conducted a proximate analysis on the flour. This analysis involved testing the levels of protein, carbohydrates, fat, and calories in the jackfruit seed flour using experimental design. The protein content was measured using the Kjeldahl method, carbohydrates were determined using the Deference method with Soklet, and fat and calories were calculated manually. The research findings revealed that the jackfruit seed flour contained 12.19 grams of protein, 56.21 grams of carbohydrates, 1.12 grams of fat, and a moisture content of 12.4 grams. These results highlight the potential of utilizing jackfruit seeds as flour, not only to reduce waste but also due to its high nutrient content.*

***Keywords:*** *Jackfruit Seed Flour, Nutritional Levels, Proximate Analysis*

## 1. INTRODUCTION

Wheat in Indonesia has become the main raw material in processed food. widely used for processing noodles, biscuits, and bakery products. Based on the National Social Economic Survey, the average consumption of wheat flour per capita in 2013 increased to 1.251 kg/capita compared to 2012 of 1.199 kg/capita. The high consumption of flour should be accompanied by an increase in its availability. Agronomically, Indonesia cannot meet its wheat needs independently, so it must import wheat (Setiawan, 2015).

If wheat import activity continues to increase, it will result in a decrease in foreign exchange. Therefore, food diversification efforts are needed to reduce wheat imports as a substitute material. One way that can be used to reduce wheat imports is the utilization of local food ingredients. One of the potential local food ingredients in Indonesia is jackfruit seeds. Jackfruit (Artocarpus heterophyllus) produces fruits with seed content between 100 to 500 grains or about 8-15% of the fruit weight (Maharani et al., 2023).

Indonesia is a tropical country with many types of plants, one of which is jackfruit. Jackfruit plant is also known as Artocarpus heterophyllus Lamk. The utilization of jackfruit plants has been widely in the food industry. However, not all parts of this jackfruit plant can be optimally processed as a high-value commodity. One of them is jackfruit seeds, which are often wasted and only become waste. Only a small number of people consume jackfruit seeds by boiling, frying, roasting, or steaming. Not many people

know the utilization of jackfruit seeds and the nutritional content contained therein. This jackfruit seed waste is usually wasted or only as animal feed (Sari et al., 2021).

Jackfruit production in Indonesia reached 720,208 tons. From the production of jackfruit, the seeds produced reached 57,600 to 108,000 tons. But all this time, jackfruit seeds are just wasted. Advances in food technology encourage people to optimally utilize jackfruit seeds by making jackfruit seed flour. With proper processing of jackfruit seed flour, it is expected to increase the consumption of more varied nutrition for the community (Setiawan, 2015).

The best jackfruit seeds are used as the basic ingredients for making jackfruit seed flour, namely old jackfruit seeds, with light yellow outer skin, large and unpeeled seeds. Grain flour can be produced from several stages of the process, namely soaking (sulfurization), blanching, drying and milling. The soaking process is carried out by immersing the material in a sodium bisulfite solution with a concentration of 730 ppm at a constant temperature (28-30 $^{0}$C) for no more than 72 hours (Andyarini & Hidayati, 2017).

Jackfruit seeds are known to contain a lot of carbohydrates, proteins, and minerals (calcium and phosphorus) that are not inferior to the nutrition of the fruit. The potential of jackfruit seeds mentioned above encourages the utilization of jackfruit seeds in various processed products. The utilization of jackfruit seeds so far is still limited as a side dish. Usually, people process jackfruit seeds only by boiling, roasting, roasting, and frying, resulting in less economic value. Based on its chemical composition, especially carbohydrates, jackfruit seeds have the potential to be processed into semi-finished materials in the form of flour (Rahman, 2018). Processing jackfruit seeds into flour will increase the economic value of jackfruit seeds. However, the processing of jackfruit seeds into flour still has shortcomings. These disadvantages include the low functional properties of flour. The processing of jackfruit seed flour that can improve the functional properties of flour is fermentation. In fermentation, the fermentation duration factor will determine the characteristics of the resulting product (Sari et al., 2021).

Increasing the length of fermentation will increase the breakdown of complex compounds in the material. Fermentation of food ingredients can be done spontaneously or in a controlled manner. Spontaneous fermentation occurs by utilizing wild or polluting microbes, while controlled fermentation can use certain microbes as inoculum. Microbial groups that are widely used in food fermentation include lactic acid bacteria (Setiawan et al., 2018). The utilization of jackfruit seed flour needs to be optimized in people's lives because of the nutritional content contained therein. This is the main basis for efforts to process jackfruit seeds into jackfruit seed flour. The resulting jackfruit seed flour is intended to extend the shelf life of the product and increase the economic value and facilitate the use of product applications (Andyarini & Hidayati, 2017).

Based on the background above, the author is interested in researching the feasibility of this product with the substance of jackfruit seed flour. From the background, it is known that jackfruit seeds have carbohydrate, protein, and mineral content (calcium and phosphorus) that are not inferior to the nutrients of its fruit. Whereas jackfruit seeds have the potential to be processed into a semi-finished product in the form of flour.

## 2. RESEARCH METHODS

To conduct protein content testing, a small sample size of approximately 3-10 ml is required. The sample is transferred into a 30ml Kjeldahl flask containing HCL (0.01 N or 0.02 N). Subsequently, 1.9 ± 0.1 g of K2SO4, 40 ± 10 mg of HgO, and 2.0 ± 0.1 ml of H2SO4 are added to the flask. If the sample exceeds 15 mg, 0.1 ml of H2SO4 is added for every 10 mg of organic matter above 15 mg. Boiling stones are added to the mixture, which is then boiled for 1-1.5 hours until the liquid becomes clear. After cooling, a small amount of water is slowly added, followed by refrigeration. The contents of the flask are then transferred into a distillation apparatus. The flask is washed and rinsed 5-6 times with 1-2 ml of water, and this wash water is transferred into the distillation apparatus. A 125 ml Erlenmeyer flask containing 5 ml of H3BO3 solution and 24 drops of indicator (a mixture of 2 parts methyl red 0.2% in alcohol and 1 part methylene blue 0.2% in alcohol) is placed under the condenser. The condenser tube is submerged under the H3BO3 solution, and 8-10 ml of NaOH-NaS2O3 solution is added before distillation. Approximately 15 ml of distillate is collected in the Erlenmeyer flask, and the condenser tube is rinsed with water, with the rinse collected in the same flask. The contents of the flask are diluted to approximately 50 ml and titrated with 0.02 N HCl until the color changes to gray. Additionally, blank determination is carried out as part of the analysis.

### 2.1. Carbohydrate Content Testing of Liquid Samples

Weigh exactly the amount of sample that when dissolved in water will give reducing sugars with a concentration of not more than 200 mg/25 ml (usually 29 g of sample is used in 500 ml of solution). Transfer the sample to a 600 ml beaker, add 200-300 ml water and 2 g CaCO3, boil for 30 minutes. During boiling add enough water to keep the volume. Cool the above solution, transfer it to a 500 ml volumetric flask, then slowly add saturated Pb-acetate solution until the solution is clear (generally 3-5 ml of Pb-acetate is needed). Adjust the volume of solution to the mark with water, mix thoroughly and filter through Whatman No2 filter paper. Add enough dry sodium oxalate (approximately 1 g) to precipitate all the Pb, mix thoroughly and filter again. Phitrate is ready to be used for carbohydrate determination. If not used immediately, then add a little benzoic acid can be stored in the refrigerator with a certain time limit (long time will damage).

### 2.2. Solid Sample

Weigh a number of samples (20-30 grams), add 80% alcohol at a ratio of 1:1 or 1:2. Crush the sample using a waring blender until all the sugar is extracted. Quantitatively transfer all the crush into a glass goblet. Filter the sample using cotton wool, place the filtrate in 80% until all the sugar is dissolved in the filtrate. The pH of the filtrate is measured, if it is acidic add CaCO3 until it is sufficiently alkaline.

Heat there is a 1000C water bath for 30 minutes. Filter again using Whatman No 2 filter paper. Remove alcohol by heating the filtrate on a water bath whose temperature is maintained ± 800C, if it will be dry add enough water. can also remove the alcohol is done with the help of vacuum. If there is still a precipitate then the sample needs to be filtered again. Perform the addition of saturated Pb-acetate and remove Pb with sodium oxalate is like the preparation of the aqueous sample.

Adjust the volume of the solution to a certain volume with water. Shake to mix evenly. The solution is ready to be used for sugar determination. If necessary, the solution can be diluted to taste. If the solution is to be used the next day, it should be stored in the refrigerator for a certain period of time (not too long, as the sample will spoil).

### 2.3. Determining Fat Content

Transfer the filtered liquid fat into a capillary tube with a diameter of 10 mm. Carefully seal the open end of the capillary tube by gently heating it over a low flame, ensuring that the fat does not burn. Subsequently, place the sealed capillary tube in a refrigerator set at a temperature range of 4-10°C and allow it to remain undisturbed for a duration of 16 hours. Next, affix the capillary tube to a mercury-filled thermometer, securing them together. Submerge the combined apparatus in a 600 ml beaker filled halfway with water, ensuring that the thermometer is immersed in approximately 30 ml of water. Employ a slow stirrer to maintain a uniform temperature distribution. Observe and record the temperature at which the fat starts to exhibit transparency, using a magnifying glass if necessary. This temperature corresponds to the liquid point of the fat.

### 2.4. Data Analysis

The information gathered from this study consists of quantitative data, encompassing details regarding the protein, carbohydrate, and fat levels found in jackfruit seed flour. The protein content was determined using the Kjeldahl method, carbohydrate content was assessed using the Carbohydrate by Difference method, fat content was analyzed through the Soklet method, and caloric values were calculated manually.

## 3. RESULTS AND DISCUSSION

The analysis of jackfruit seed flour was conducted to ascertain the protein, carbohydrate, and fat composition through proximate analysis. The Kjeldahl method was employed to measure protein levels, while the carbohydrate content was determined using the carbohydrate by difference method. The outcomes of the protein and carbohydrate content tests are presented in the subsequent table:

**Table 1. Protein Content Test Results**

| Protein Content Test | | | |
|---|---|---|---|
| **Sample Code** | **Sample Weight (Mg)** | **Hcl Volume** | **Protein Content** |
| A | B | C | D |
| Jackfruit Flour | 508 | 0,95 | 16,37 |
| Wheat Flour | 513 | 0,80 | 13,65 |

According to the data presented in table 1, it can be observed that the protein content of jackfruit flour, with a sample weight of 508 mg and an HCL volume of 0.95, is determined to be 16.37. On the other hand, the protein content of wheat flour, with a sample weight of 513 mg and an HCL volume of 0.80, is found to be 13.65.

**Table 2. Carbohydrate Content Test Results**

| Carbohydrate Content Test Using the Pass Different Method | | | | | | |
|---|---|---|---|---|---|---|
| **Sample** | **Water Content (%)** | **Ash Content (% )** | **Fat Content (%)** | **Protein Content (%)** | **Crude Fiber (%)** | **Carbohydrates (%)** |
| Jackfruit Flour | 8,10 | 0,34 | 1,69 | 16,37 | 8,89 | 64,61 |
| Wheat Flour | 10,81 | 3,15 | 0,88 | 13,65 | 3,85 | 67,65 |

According to table 2, it is evident that the water content of jackfruit flour is 8.10%, the ash content is 0.34%, the fat content is 1.69%, the protein content is 16.37%, the crude fiber content is 8.89%, and the carbohydrate content is 64.61%. On the other hand, the water content of wheat flour is 10.81%, the ash content is 3.15%, the fat content is 0.88%, the protein content is 13.65%, the crude fiber content is 3.85%, and the carbohydrate content is 67.65%.

**Table 3. Fat content test results**

| Fat Content Test | | | | | |
|---|---|---|---|---|---|
| **Sample Code** | **Wet sample weight (g)** | **Empty Gourd (g)** | **Pumpkin and fat (g)** | **Fat (g)** | **Fat content (%)** |
| A | B | c | D | e = d – c | |
| Jackfruit Flour | 5,0071 | 82,1369 | 82,2217 | 0,0848 | 1,69 |
| Wheat Flour | 5,0025 | 98,1721 | 98,2162 | 0,0441 | 0,88 |

Based on the data presented in table 3, it can be observed that jackfruit flour, with a sample weight of 5.0071 g, contains 1.69 grams of fat, whereas wheat flour, with a sample weight of 5.0025 g, contains 0.88 grams of fat.

The analysis reveals that the protein content of jackfruit seed flour surpasses that of wheat flour by 2.72 grams. Additionally, the carbohydrate content of wheat flour exceeds that of jackfruit seed flour by 3.04 grams, while the fat content of jackfruit seed flour is higher than that of wheat flour by 0.81 grams. The disparities in the test results are minimal and are nearly on par with the nutritional composition of wheat flour. Consequently, jackfruit seed flour can serve as a viable substitute for wheat flour due to its comparable nutritional profile.

Fat is the most concentrated form of energy, providing 9 calories per gram, which is 2 ½ times the energy produced by an equivalent amount of carbohydrates and protein. Fat is present in various food items with varying compositions. Calories can be obtained from the consumption of nutrients such as carbohydrates, fats, proteins, and alcohol. Each person has a unique daily calorie requirement. The Indonesian Ministry of Health has established a general calorie requirement of 2000 kcal/day for individuals.

The calculation of carbohydrate content of a food can be calculated by the difference between the amount of water, protein, fat and ash content with the carbohydrate

formula which is 100 - (protein + fat + ash + water). The following are the results of the water content test and the results of the ash content test on the samples of jackfruit seed flour and wheat flour obtained by the researcher:

**Table 4. Water Content Test Results**

| Moisture Content Test | | | | | |
|---|---|---|---|---|---|
| **Sample Code** | **Wet sample weight (g)** | **Empty cup (g)** | **Dry cup & sample (g)** | **Dry sample (g)** | **Water content (%)** |
| A | B | c | D | e = d – c | f = 100 - (e/b*100) |
| Jackfruit Flour | 5,0108 | 13,0824 | 17,6872 | 4,6048 | 8,10 |
| Wheat Flour | 5,0084 | 18,0881 | 22,5551 | 4,4670 | 10,81 |

The information provided in table 4 indicates that the water content of jackfruit flour, with a sample weight of 5.0108 g, is 8.10%. Meanwhile, the water content of wheat flour, with a sample weight of 5.0084 g, is 10.81%. Consequently, it is established that the water content of wheat flour is 2.71% higher than that of jackfruit flour.

**Table 5. Test Results for Ash Content**

| Ash Content Test | | | | | |
|---|---|---|---|---|---|
| **Sample Code** | **Wet sample weight (g)** | **Empty cup (g)** | **Empty cup and ash (g)** | **Ash (g)** | **Ash Content (% )** |
| A | B | c | D | e = d – c | |
| Jackfruit Flour | 1,0135 | 19,9493 | 19,9527 | 0,0034 | 0,34 |
| Wheat Flour | 1,0099 | 22,5741 | 22,6059 | 0,0318 | 3,15 |

According to the data in table 5, it can be observed that the moisture content of jackfruit flour, with a sample weight of 1.0135 g, is 0.34. On the other hand, the ash content of wheat flour, with a sample weight of 1.0999 g, is 3.15. Therefore, it can be concluded that the ash content of wheat flour is 2.81 higher than that of jackfruit seed flour.

Processing jackfruit seeds into flour enhances their nutritional value compared to unprocessed jackfruit seeds. Prior to processing, the nutrient content of jackfruit seeds included: protein 4.2 (g), carbohydrate 36.7 (g), and fat 0.1 (g). However, the nutritional content of unprocessed jackfruit seeds is lower due to the various stages involved in the flour-making process, such as removing the outer skin and water, soaking, boiling, drying, and grinding. As a result, the nutritional content is higher after being processed into flour.

Jackfruit seeds that have passed the processing process into jackfruit seed flour will make the shelf life higher and can be utilized as a flexible raw material for industries that

have prospects, food processing is quite easy and then processed into various types of food snacks that are more attractive to consumers.

## 4. CONCLUSION

Based on the study findings, jackfruit seed flour contains 16.37 grams of protein, 64.61 grams of carbohydrates, and 1.69 grams of fat. The highest nutritional value in jackfruit seed flour is in carbohydrates at 64.61 grams, while the lowest is in fat at 1.69 grams. On the other hand, wheat flour contains 13.65 grams of protein, 67.65 grams of carbohydrates, and 0.88 grams of fat. The highest nutritional value in wheat flour is also in carbohydrates at 67.65 grams, and the lowest is in fat at 0.88 grams. Comparing the two, jackfruit flour has the best nutritional value due to its protein content.

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