



Composite Jackfruit Seed Flour: Impact on the Preferences and Nutritional Value of Almond Crisps

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Abstract. Almond crisps are classified as cookies or pastries that are round and crunchy in texture. Typically, almond crisps are made from wheat flour. However, Indonesia does not produce wheat flour domestically. The average cookie consumption in Indonesia is 0.40 kg per capita per year. To reduce the reliance on wheat flour, it is important to increase the use of local ingredients as alternatives. Jackfruit seeds are a natural resource that remains underutilized. This experimental study formulated almond crisps using a blend of jackfruit seed flour and wheat flour in ratios of 50%:50%, 60%:40%, and 70%:30%. The study aimed to identify differences in consumer preferences and the nutritional content, including calcium, phosphorus, and protein. Data collection methods included subjective assessment, preference testing, objective assessment, and laboratory analysis. The Kruskal-Wallis's test was used for analysis, followed by the Mann-Whitney test to determine preference differences between the various formulations. Results indicated significant differences in taste, color, smell, and texture preferences. Laboratory tests revealed that higher proportions of jackfruit seed flour increased calcium, phosphorus, and protein content. In conclusion, almond crisps made with jackfruit seed flour and wheat flour are nutritious and suitable for all ages, offering a viable alternative to reduce wheat flour use in Indonesia.

Keywords: Jackfruit seed flour, preferences, nutritional value, almond crisps.

INTRODUCTION

Gunawan et al., (2015) describe almond crisps as a light pastry widely recognized as a typical souvenir from Surabaya. Almond crisps are made from wheat flour, eggs, butter, milk, and sugar, and are topped with almonds and grated cheese. Paran (2008) notes that flour is a critical component that gives almond crisps their structure, texture, and crunchiness. Typically, wheat flour is the primary ingredient in almond crisps. However, Indonesia does not produce wheat, the key ingredient for wheat flour, leading to potential food dependency as wheat flour consumption increases (Andyarini & Hidayati, 2017). Data from the Indonesian Wheat Flour Producers Association shows that wheat flour consumption in Indonesia rose by 5.3% from 2015 to 2016 (APTINDO, 2016). To address this, it is important to increase the use of local food ingredients as alternatives to wheat flour. Jackfruit seeds are one such natural resource that has not yet been fully utilized.

Jackfruit seeds or concrete (*Artocarpus heterophyllus*) is a plant from the Mulberry Moraceae family (Biworo et al., 2015). 2017 Indonesia produced 656,583 thousand tons of jackfruit (BPS, 2017). Jackfruit seeds comprise about 10-15% of the total fruit weight and are rich in high carbohydrates and protein, dietary fiber, vitamins, and minerals (Abraham & Jayamuthunagai, 2014). Jackfruit seeds are nutrient-rich, including carbohydrates, proteins, vitamins, minerals, and phytochemicals (Ranasinghe et al., 2019). Not only that, jackfruit seeds also have calcium, phosphorus,

and zinc levels. Jackfruit seeds are suitable for use as food diversification ingredients because they also contain lignans, isoflavones, and saponins, which are included in antioxidants that can help prevent cancer (Muljawan & Pradana, 2016). According to (Santoso et al., 2014), jackfruit seeds have a relatively high nutritional content, so it is the potential to be made into flour.

Seeing the above phenomenon, efforts must be made to reduce dependence on wheat flour. Producing food with the use of wheat flour can be reduced with other ingredients that are expected to ensure sustainable production and, at the same time, increase local potential, such as jackfruit seeds. The utilization of jackfruit seeds is still relatively low. People need to learn how to process jackfruit seed waste properly, where people only consume fresh meat, and jackfruit seeds are only processed simply like boiled. Jackfruit seeds can be developed into more diverse and exciting processed products.

Therefore, this research aims to utilize jackfruit seed flour to make almond crisps. This study aims to determine (1) the difference in public liking for the almond crisps composite of jackfruit seed flour with wheat flour 50%: 50%, 60%: 40%, and 70%: 30% in terms of taste, color, aroma, and texture (2) The level of public preference for the almond crisps composite of jackfruit seed flour with wheat flour 50%: 50%, 60%: 40% and 70%: 30% in terms of taste, color, aroma, and texture (3) Nutritional content in the form of calcium, phosphorus and protein of almond crisps composite jackfruit seed flour 50%: 50%, 60%: 40% and 70%: 30 %.

TABLE 1. Composition of almond crisps composite of jackfruit seed flour with wheat flour.

Material	50%: 50%	60%: 40%	70%: 30 %
Jackfruit seed flour	127 gr	153 gr	178 gr
Wheat flour	128 gr	102 gr	77 gr
Butter	150 gr	150 gr	150 gr
Icing Sugar	225 gr	225 gr	225 gr
Vanilla Extract	8 gr	8 gr	8 gr
White Egg	210 gr	210 gr	210 gr
Almond Powder	24 gr	24 gr	24 gr
Cheese	120 gr	120 gr	120 gr
Almond Slice	130 gr	130 gr	130 gr

METHOD

This research is experimental in the field of food and nutrition, focusing on the development and product innovation of almond crisps made from a composite of jackfruit seed flour and wheat flour. The experiment was conducted at the Culinary Education Laboratory, Faculty of Engineering, Universitas Negeri Semarang.

The research type was experimental, employing a treatment-based approach. The experimental design used was the Posttest-Only Control Design. The study's objective was to evaluate almond crisps made from various compositions of jackfruit seed flour and wheat flour.

Data collection involved both subjective and objective assessments. The subjective assessment, or liking test, aimed to determine public preference and the degree of liking for the almond crisps based on taste, color, aroma, and texture. This assessment was conducted using a questionnaire given to 80 untrained panelists. The objective assessment included laboratory tests to measure the nutritional content of calcium, phosphorus, and protein in the almond crisps. These tests were performed at the UKSW Chemistry Laboratory in Salatiga and the Center for Food and Nutrition Studies at UGM in Yogyakarta.

The process of making almond crisps uses the creaming method, a common baking technique. This method involves beating fat (such as butter) with sugar until the mixture becomes paler in color. Then, vanilla extract is added. During the second mixing, egg whites are incorporated until well blended. Finally, the dry ingredients—wheat flour, jackfruit seed flour, milk powder, and almond powder—are mixed in until the batter is smooth and uniform. This process is illustrated in **FIGURE 1**.

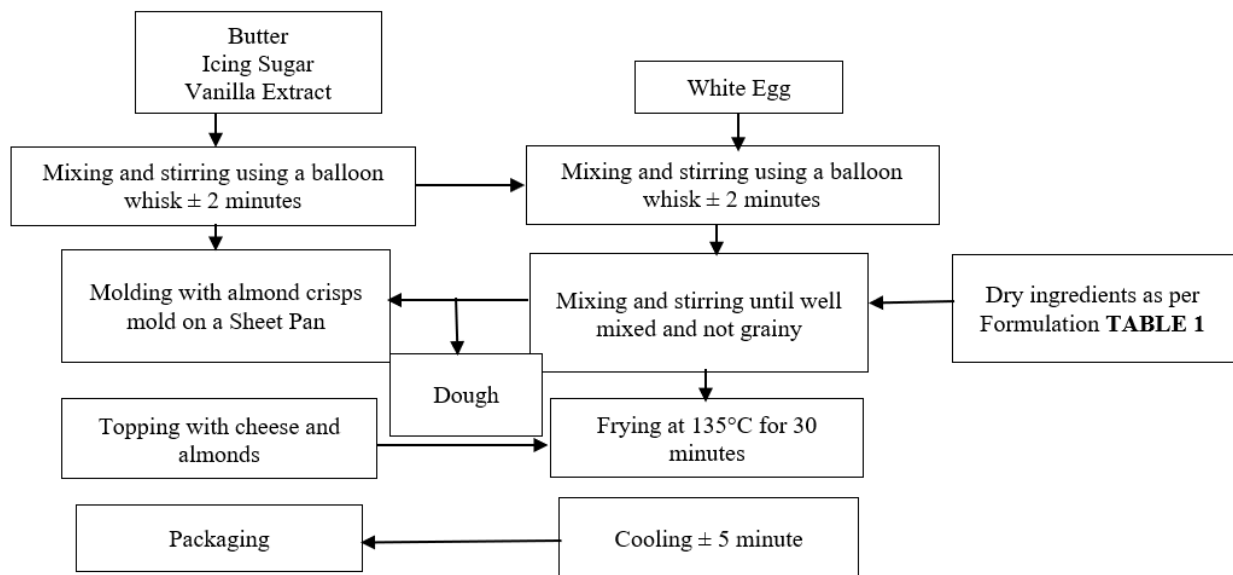


FIGURE 1. Almond crisps cooking steps.

RESULT AND DISCUSSION

Preferences Difference

Taste Aspect

The Kruskal Wallis test results show a significance value of $0.000 < 0.05$, so H_0 is rejected and H_a is accepted. So, there is a difference in taste in each sample of almond crisps composite jackfruit seed flour. Because of a difference in favorability, it is continued with the Mann-Whitney Test, presented in **TABLE 2**.

TABLE 2. Mann Whitney test results on flavor aspect.

Tested Sample Pairs	Significance	α	Description
Sample 454 and 901	0.000	0.05	Difference
Sample 454 and 615	0.000	0.05	Difference
Sample 901 and 615	0.000	0.05	Difference

Description:

454: sample 50%: 50%

901: sample 60%: 40%

615: sample 70%: 30%

Based on **TABLE 2**, it can be seen that all pairs of samples tested have an Asymp.sig value of less than 0.05. Therefore, the hypothesis is accepted, indicating that there is a significant difference in public preference for the almond crisps made with a composite of jackfruit seed flour and wheat flour in terms of taste.

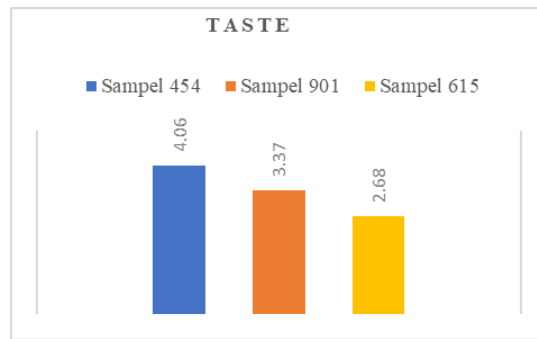


FIGURE 2. Average assessment of the level of favorability of the taste aspect.

Because there is a difference in the results of the Mann-Whitney test, the best sample among the pairs can be identified through the average results of the favorability test. The results indicate that, in the sample pair 454 and 901, sample 454 was the best almond crisps sample. Similarly, in the sample pair 454 and 615, sample 454 was preferred. However, in the sample pair 901 and 615, sample 901 was the best. This shows that people prefer the taste of almond crisps that are sweet and not bitter. The bitterness is attributed to the volatile acid compounds (saponins) present in jackfruit seed flour. Saponins, which originate from the hydrolysis of starch granules in jackfruit seed flour, contribute to the bitter taste (Hadi et al., 2017). This preference for sweetness is supported by research from Matthew Gillum (2018), who stated that the FGF21 hormone, produced by the liver, signals the brain to consume more sweet foods or drinks.

Color Aspect

The results of the Kruskal-Wallis test show a significance value of 0.000, which is less than 0.05. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted. This indicates that there is a significant difference in the liking of color among the samples of almond crisps made with a composite of jackfruit seed flour. Due to this difference in favorability, the analysis is continued with the Mann-Whitney Test, as presented in **TABLE 3**.

TABLE 3. Mann Whitney test results in the color aspect.

Tested Sample Pairs	Significance	α	Description
Sample 454 and 901	0.000	0.05	Difference
Sample 454 and 615	0.000	0.05	Difference
Sample 901 and 615	0.000	0.05	Difference

Based on **TABLE 3**, it can be seen that the pairs of samples tested have an Asymp.sig value of less than 0.05. It can be concluded that the hypothesis is accepted, indicating that there is a significant difference in public liking for the almond crisps made with a composite of jackfruit seed flour and wheat flour in terms of color.

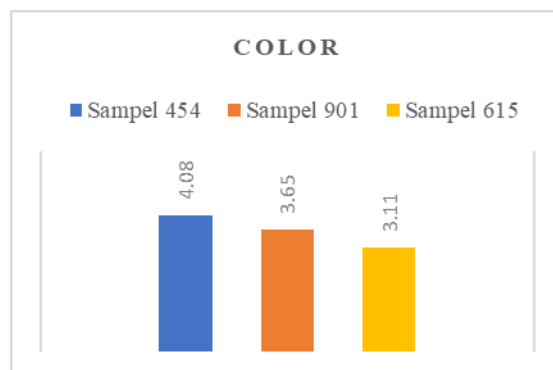


FIGURE 3. Average of color aspect liking level assessment.

Because there is a difference in the results of the Mann-Whitney test, the best sample among the pairs can be identified through the average results of the favorability test. The results indicate that, in the sample pair 454 and 901, sample 454 was the best almond crisps sample. Similarly, in the sample pair 454 and 615, sample 454 was preferred. However, in the sample pair 901 and 615, sample 901 was the best. The color of almond crisps made with jackfruit seed flour differs from those made without it, as jackfruit seeds contain phenol compounds in or on the seed tissue (Maklfoeld, 2012). This is supported by research from Dolongseda et al. (2017) on the production of tortillas with jackfruit seed flour substitution, which found that increasing the amount of jackfruit seed flour resulted in a browner color in the tortillas.

Aroma Aspect

The Kruskal Wallis test results show a significance value of $0.000 < 0.05$, so H_0 is rejected and H_a is accepted. So, there is a difference in favorability in the aroma aspect in each almond crisp composite jackfruit seed flour sample. Because of a difference in favorability, it is continued with the Mann-Whitney Test, presented in **TABLE 4**.

TABLE 4. Mann Whitney test results in the aroma aspect.

Tested Sample Pairs	Significance	α	Description
Sample 454 and 901	0.001	0.05	Difference
Sample 454 and 615	0.000	0.05	Difference
Sample 901 and 615	0.011	0.05	Difference

Based on **TABLE 4**, it can be seen that all pairs of samples tested have $Asymp.sig < 0.05$. From these results, it is stated that the hypothesis is accepted and that there is a difference in public preference for almond crisps composite jackfruit seed flour with wheat flour in terms of aroma.

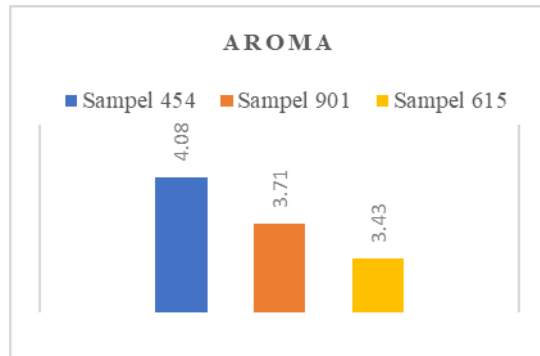


FIGURE 4. Average assessment of the level of the favorability of the aroma.

Because there is a difference in the results of the Mann-Whitney test, the best sample among the pairs can be determined through the average favorability test results. The data shows that in the sample pair 454 and 901, sample 454 was the most preferred almond crisps sample. Likewise, in the sample pair 454 and 615, sample 454 was again the most favored. This finding aligns with the research by Wulandari et al. (2012) on the use of jackfruit seed flour in making *dodol*. Their study, which focused on sensory characteristics and storage stability, revealed that using a higher proportion of jackfruit seed flour led to *dodol* with a slightly less favorable aroma, whereas a lower proportion resulted in *dodol* with a more appealing aroma.

Texture Indicator

The Kruskal Wallis test results show a significance value of $0.000 < 0.05$, so H_0 is rejected and H_a is accepted. So, there is a difference in favorability in the texture aspect of each sample of almond crisps composite jackfruit seed flour. Because of a difference in favorability, it is continued with the Mann-Whitney Test, presented in **TABLE 5**.

TABLE 5. Mann Whitney test results texture aspect.

Tested Sample Pairs	Significance	α	Description
Sample 454 and 901	0.000	0.05	Difference
Sample 454 and 615	0.000	0.05	Difference
Sample 901 and 615	0.012	0.05	Difference

Based on **TABLE 5**, it can be seen that all pairs of samples tested have $Asymp.sig < 0.05$, so it can be concluded that the hypothesis is accepted, and it is stated that there is a difference in public preference for almond crisps composite jackfruit seed flour with wheat flour in the aspect of texture.

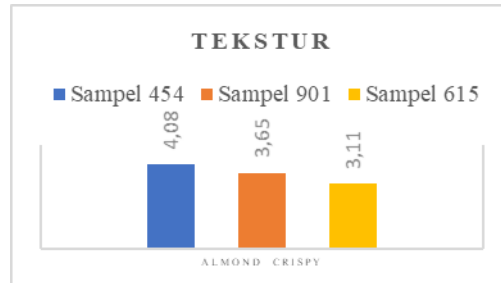


FIGURE 5. Average of texture aspect favorability rating.

Because there is a difference in the results of the Mann-Witney test, it can be known which sample is the best among the sample pairs through the average results of the favorability test. It can be seen from the results of the average favorability test that in the pairs of samples 454 and 901, sample 454 was the best almond crisps sample. In the pair of samples 454 and 615, sample 454 is the best. This shows that people prefer almond crisp with a lower composite of jackfruit seed flour. The starch content of tapioca flour is higher than that of kimpul flour, which is 36.7 g and 77.2. High starch content in the ingredients can increase the cookies' crispness (Rosida et al., 2020). According to Guilbert and Biquet (1990), high starch can maintain the compactness and stability of cookies. The more constituent starch increases the stretching strength, the more remarkable the ability to stretch and the more resistant it is to fracture.

Nutritional Content

Calcium

Based on the results of data analysis of nutritional content carried out in the Laboratory of the Center for Food and Nutrition Studies, UGM, the amount of caloric nutritional content contained in the three almond crisps samples can be known. The results of the laboratory test can be seen in **TABLE 6**.

TABLE 6. Calcium test result per 100 g.

No	Sample	Repetition I	Repetition II	Average
1	454	490 mg	500 mg	495 mg
2	901	640 mg	660 mg	650 mg
3	615	870 mg	890 mg	880 mg

To reduce errors in testing calcium nutrient content, two repetitions were made. The test results show that the calcium content will increase with more composite jackfruit seed flour in the almond crisp. This is because jackfruit seed flour's calcium content is higher than wheat flour's. It can be concluded that the almond crisps experimental results are suitable for consumption at all ages because every human body needs a high calcium content. From these results, sample 454 contributed 20.25 mg/5 gr of almond crisp. Sample 901 contributed 32.5 mg/5 gr almond crisps. Sample 615 is the sample that contributes the most calcium to the body, which is 44 mg/5 gr of almond crisps. The results of the Widya Karya Pangan dan Gizi (2004) set the Nutritional Adequacy Rate for daily calcium requirements for humans at 1100 mg/hr. Calcium is needed by the body to form and repair bones and teeth, help nerve function,

muscle contraction, and blood formation, and play a role in heart function. The high recommendation of calcium sufficiency per day is due to the significant role of calcium in the body.

Phosphor

Based on the results of the nutritional data analysis that was carried out at the UKSW Chemistry Laboratory, the amount of phosphorus content contained in the three almond crisps samples can be known. The results of the phosphorus content test can be seen in **TABLE 7**.

TABLE 7. Phosphor test result per 100 g.

No	Sample	Repetition I	Repetition II	Average
1	454	49 mg	48 mg	48.5 mg
2	901	60 mg	60 mg	60 mg
3	615	67 mg	66 mg	66.5 mg

From the two repetitions obtained, the average phosphorus content shows that the more jackfruit seed flour composite, the more phosphorus content increases. The result is that almond crisps are suitable for all ages because they have a high phosphorus content that every human body needs. Phosphorus is the main constituent mineral of teeth and bones. Phosphorus in the body is about 66% in bones as a bond with lime salts and 33% in soft tissues as organic and inorganic bonds (Martono, 2011). The daily phosphorus requirement for each individual is different, but humans generally need 1000 mg of phosphorus daily (Yuan et al., 2012). From these results, sample 454 contributed 2.4 mg/5 gr of crisps almonds. Sample 901 contributed 2.0 mg/5 gr of crisps almonds. Sample 615 is the sample that contributes the most phosphorus to the body, which is 3.3 mg / 5 gr of crisps almonds.

Protein

There are many macronutrients needed by the body, one of which is protein. Proteins are included in macromolecules formed from amino acids consisting of carbon, hydrogen, oxygen, and nitrogen elements not owned by fats or carbohydrates (Natsir, 2018). Based on the results of the nutritional data analysis that was carried out in the Laboratory of the Center for Food and Nutrition Studies, UGM, the amount of protein nutritional content contained in the three almond crisps samples can be known. The results of the laboratory test can be seen in **TABLE 8**.

TABLE 8. Protein test results per 100 g.

No	Sample	Repetition I	Repetition II	Average
1	454	12.87 mg	12.87 mg	12.87 mg
2	901	13.08 mg	13.06 mg	13.07 mg
3	615	14.78 mg	14.8 mg	14.79 mg

The average results of the protein content test conducted twice showed that the protein content increased when the composite of jackfruit seed flour increased. The increase in protein content in almond crisps experimental results is due to the higher protein content in jackfruit seed flour than wheat flour, making samples using jackfruit seed flour higher. The European Food Safety Authority (EFSA) recommends that adults consume approximately 0.8 g of protein per/kg of body weight per day (for example, 56 g/day for an adult weighing 70 kg). Based on the Table of Nutritional Adequacy for Indonesian People (2019) by the Ministry of Health, Indonesians' average protein consumption recommendation is 65 g/day. From these results, sample 454 contributed 0.64 g/5 g of almond crisp. Sample 901 contributed 0.65 g/5 g of crisps almonds. Sample 615 is the sample that contributes the most protein to the body, which is 0.74 g/5 g almond crisps.

CONCLUSION

It can be concluded that the almond crisps composite of jackfruit seed flour with wheat flour differs in public liking in the indicators of taste, color, aroma, and texture. At the level of liking in all indicators, people prefer almond crisps with less composite of jackfruit seed flour because of the sweeter taste, more yellow-brown color, the aroma of butter

typical of almond crisps, and crisper texture. However, almond crisps flour with a higher composite of jackfruit seed flour and wheat flour has higher calcium, phosphorus, and protein content. Therefore, almond crisps composite jackfruit seed flour can be used as a healthy alternative cookie for all ages because it has high calcium levels, phosphorus levels, and protein levels and does not need to be consumed in large amounts to feel complete.

This research can be the basis for further research that can examine nutritional content more deeply and be the basis for making comparative decisions in making crisp almonds. In addition, product studies can also be carried out with jackfruit seed flour as the primary ingredient so that it can bring up product variations with good nutritional content.

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