第 55 卷 第 1 期 农 业 机 械 学 报 Vol. 55 No. 1
2024 年 1 月 Transactions of the Chinese Society of Agricultural Machinery Jan. 2024

Research article
Agricultural product health and safety: Post-harvest
DOI：10.62321/issn.1000-1298.2024.01.01

Effect of Temperature and Substitution of Jack Bean (*Cannavalia Ensiformis*) Flour on the Chemical Properties of Seasoned Flour

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Abstract: Jack beans are potential local legumes rich in nutrients yet limited in use. The current form of use is mostly tempeh and tofu production. Another use that seems promising is to make flour. Flour making can increase shelf life and eliminate anti-nutrients and bad smells. This study aims to determine the effect of temperature and substitution level of Jack bean flour on the chemical properties of seasoned flour. The research design was a completely randomized design (CRD) consisting of 2 factors: variations in drying temperature (A) of three levels, 60°C, 70°C, and 80°C. The second factor is the variation in the substitution level of added Jack bean flour (B), which consists of three levels: 10%, 15%, and 20%. The research results show that drying temperature influences ash, protein, and reduced and total sugar contents but has no effect on fiber content. A drying temperature of 80°C gave the best result, with an ash content of 4.31%, protein content of 14.75%, fat content of 0.94%, sugar content of 12.02%, reduced sugar content of 1.23%, and crude fiber content of 10.36 %. The substitution of 20% jack bean flour showed the best result (ash content of 4.99%, protein content of 22.17%, fat content of 1.02%, total sugar content of 11.75 %, reduced sugar content of 1.32%, and crude fiber content of 10.23%).
Keywords: jack beans; sword koro; drying temperature; flour substitution; seasoned flour

Received: November 16, 2023 / Revised: December 5, 2023 / Accepted: January 14, 2024 / Published: January 31, 2024
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温度和刀豆粉替代量对调味粉化学性质的影响

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摘要:刀豆是潜在的当地豆类，营养丰富，但用途有限。目前的使用形式主要是豆豉和豆腐生产。另一种似乎很有前途的用途是制作面粉。制粉可以延长保质期并消除抗营养物质和难闻的气味。本研究旨在确定杰克豆粉的温度和取代水平对调味面粉化学性质的影响。研究设计是完全随机设计(CRD)，由2个因素组成：干燥温度(A)的三个级别的变化：60oC、70oC和80oC。第二个因素是添加的刀豆粉（B）的替代水平的变化，其由三个水平组成：10%、15%和20%。研究结果表明，干燥温度影响灰分、蛋白质、还原糖和总糖含量，但对纤维含量没有影响。干燥温度80℃效果最佳，灰分4.31%，蛋白质14.75%，脂肪0.94%，糖分12.02%，还原糖1.23%，粗纤维含量10.36%。以20%刀豆粉替代效果最好（灰分4.99%，蛋白质含量22.17%，脂肪含量1.02%，总糖含量11.75%，还原糖含量1.32%，粗纤维含量10.23%）。

关键词：杰克豆；剑科罗；干燥温度；面粉替代品；调味面粉

1 Introduction

Jack beans (*Cannavalia ensiformis*), also known as sword koro beans, are among the legume's genetic diversity. Jack beans are among the unveiled local genetic resources of protein. There is still a lack of use of the Jack bean, and it is necessary to explore this legume further to make better use of it and preserve its presence within communities. Jack beans (*Cannavalia ensiformis*) "Bugel" were registered as a local genetic resource from Kulon Progo, Yogyakarta, Indonesia, which was officially acknowledged by the Indonesian Center for Plant Variety Protection and Agricultural Licensing with No. 737/PVL/2018 [1].

Local crop genetic resources are promoted to support the food diversification program. Local food products are typically developed according to the preferences of local consumers, thereby establishing a strong connection with the local culture [2]. Jack beans are a potential local food source, especially with carbohydrates and protein content, and they can also be used as food ingredient substitutes.

To date, the utilization of jack bean is still limited to tempeh and tofu production. Unfortunately, there are some drawbacks: the unpleasant smell of jack beans and the anti-nutrient content of the jack bean (phytic acids

and cyanides). However, pre-processing methods can eliminate these drawbacks [3–5]. Because phytic acid is soluble in water, the immersion method may be helpful to lower the amount of phytic acid in jack beans [6]. Furthermore, if the jack beans are well cleaned, the foul smell can be eliminated [7].

There are a few criteria why we chose jack beans (*Cannavalia ensiformis*) as our research object: 1) Usage, their usage is still limited; 2) Origins, they originated from Indonesia; 3) Nutritional content, they have carbohydrates and proteins content.

The Food and Agriculture Organization (FAO) states that less than ten parts per million (ppm) of HCN compounds are acceptable and safe for human ingestion [8]. One way to reduce HCN levels is drying [9]. Drying methods vary depending on what is dried. Some common techniques include air drying (letting something dry naturally) or using specialized machinery for industrial purposes. Oven drying is suitable for a variety of foods. Set the temperature and place the food on a baking sheet. This method is faster than sun drying.

Jack beans can also be processed into flour. Jack bean flour can be used in mixed/batter flour. In various meal preparation techniques, flour made from jack beans can be used as a substitute for wheat flour in seasoned flour. Seasoned flour combines a few types of flour mixed with spices and seasoning. Seasoned flour is popular in Indonesian dishes to give fried foods extra flavor.

Adding jack bean flour to seasoned flour can provide extra nutrients to gluten-free flour as well and reduce the use of wheat flour, which is not locally sourced. This study examines the effect of the drying process and the substitution of jack bean flour on the chemical properties of seasoned flour.

This innovation is anticipated to be utilized by those with celiac disease, an autoimmune condition that is produced by the consumption of gluten. In addition, it aims to decrease reliance on wheat flour, which is not locally sourced.

2 Materials and Methods

2.1 Material

The study used white jack bean (*Canavalia ensiformis* L.) flour in concentrations of 10%, 15%, and 20%, together with wheat flour (50%), sago flour (30%), refined salt, garlic powder, egg white powder, seasoning, and baking powder. The analytical materials consisted of water, sodium hydroxide (NaOH), sulfuric acid (H2SO4), copper sulfate (CuSO4), 2% sodium bisulfite, petroleum ether, filter paper, and aluminum foil.

2.2 Tools

This investigation used an analytical scale, basin, sieve, cabinet drier, oven, and blender. In contrast, measuring cups, test tubes, stirrers, beaker cups, the Erlenmeyer flask, water handles, pipettes, a distiller, spectrophotometer, Schottlet kit, buret, and static were used in the analysis.

2.3 Research Location

This study was conducted in the INSTIPER laboratory of Yogyakarta's Faculty of Agricultural Technology.

2.4 Experimental Design

The study employed a completely randomized design [23] with two factors: variation in drying temperature (A1 60°C, A2 70°C, and A3 80°C) and variation in flour replacement (B1 10%, B2 15%, and B3 20%), with two replications. Drying is carried out on the jack beans at the treatment temperature (A1, A2, and A3) until dry, and then, the jack beans are dried and floured using a blender. Jack bean flour was substituted with other flour in the composition treatment (B1, B2, and B3). The final product is mixed flour, which is then analyzed for water, ash, fat, protein, total sugar, reduced sugar, and crude fiber contents.

2.5 Proximate Analysis

2.5.1 Water Content

Analysis of food moisture content is critical to minimize damage caused by errors during the processing process [10]. Water content analysis can be categorized into direct and indirect methods. This study uses a direct method, namely air-oven drying analysis [11].

2.5.2 Ash Content

One of the inorganic components in food is ash, which is a small amount. Ash content is the residue of food obtained from the combustion process at very high temperatures. Ash content analysis was performed according to the method [12].

2.5.3 Fat Content

Fats are fatty acids belonging to the group of carboxylic acids that are solids at room temperature. These highly unstable acids react actively with oxygen and form reactive aldehydes. Fat content analysis was carried out according to [13].

2.5.4 Protein Content

Protein structures are categorized into primary, secondary, tertiary, and quaternary. Drying foodstuffs at high temperatures results in denaturation of the protein structures. Protein content analysis was performed as described in [14,15].

2.5.5 Total Sugar Content

Total sugar content is the overall sugar content in a food, which consists of reducing and non-reducing sugars. Total sugar content comprises four types: monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Total sugar content analysis was conducted as described in [16].

2.5.6 Reduced Sugar Content

Reducing sugar refers to a category of carbohydrates that can decrease the levels of electron-accepting molecules, such as glucose and fructose [17]. Reduced sugar content analysis was carried out according to [16,17].

2.5.7 Crude Fiber Content

Fibre can be categorized into two distinct types: soluble fiber, which includes pectin and gum, and insoluble fiber, which consists of cellulose and lignin. Both categories constitute crude fiber. Crude fiber refers to the entirety of dietary fiber, which consists of the residual plant matter that remains after being broken down by digestive enzymes. Crude fiber content analysis was carried out according to [18].

2.6 Data Analysis

Laboratory analysis data were statistically processed using the two-way ANOVA method and Duncan's significant difference test with a 5% confidence level. If this study gives significant results, then the Duncan test will give the results of significant differences between treatments. Data analysis was performed using the SAS Ver. 9.00 software.

3 Results

The analysis of variance of the effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction in the manufacture of seasoned flour on the chemical characteristics (moisture, ash, protein, fat, and dietary fiber contents) of seasoned flour is presented in Tab. 1.

Tab. 1 Analysis of variance of the effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction (Developed by the authors)

Source of diversity	Mean Square					
	Moisture content	Ash Content	Fat content	Protein content	Total sugar levels	Reducing sugar content
Temperature (A)	10.48*	0.9501*	0.001 ns	817.76*	1.377*	0.3048*
Substituting jack bean flour (B)	0.0078 ns	0.6739*	0.03*	2.097ns	0.188 ns	1.2959*
A x B	0.1401 ns	0.0794 ns	0.003 ns	31.70 ns	0.017 ns	0.025 ns

* Significant at the 5 % level; ns - not significant

The temperature treatment (A) had a significant effect on all observed variables except fat content, whereas the jack bean flour substitute treatment (B) had a significant effect on the variables of ash, fat, and reducing sugar contents; the effect was not significant for the variables of water, protein, and total sugar contents (Tab. 1). At the same time, the interaction between the two treatments was not significant for all observed variables.

3.1 Moisture Content

Moisture content is the amount of water contained in a food product or ingredient. Moisture content is an important parameter for determining the quality of a food ingredient.

The water content also determines the shelf life of food ingredients, including flour [19]. According to [20], the maximum moisture content of commercial seasoning powder is 12%.

To determine the distinctions between the treatment and temperature variables in drying sword beans, Duncan's multiple range test (DMRT) was conducted at a significance level of 5% (Tab. 2). Fig. 1 illustrates the correlation between drying temperature and substitution of spiced flour for water content.

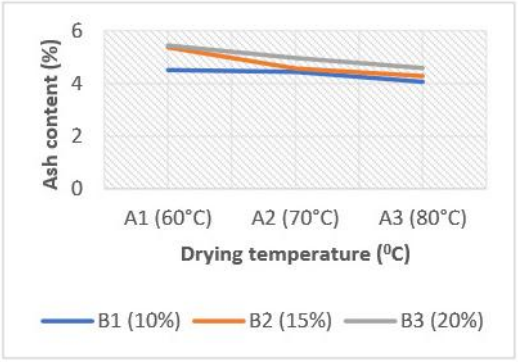

Fig. 1 Correlation between drying temperature and ash content of seasoned flour when jack bean flour is substituted

(Developed by the authors)

Tab. 2 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the moisture content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	Average
B1 (10%)	12.26	10.48	9.44	10.73 a
B2 (15%)	11.79	10.50	9.68	10.69 a
B3 (20%)	12.38	10.17	9.55	10.66 a
Average	12.14 a	10.38 b	9.56 c	

Note: Different letters in columns and lanes indicate statistically significant differences.

3.2 Ash Content

The ash content of spice powder is one of the critical quality parameters of seasoning powder, and ash content reflects mineral content of flour. According to the technical specifications described by the National Standardization Agency of Indonesia [20], the maximum ash content of seasoning powder is 15%.

To distinguish between heat treatment during drying and the variation of jack pea flour substitution, a 5% DMRT was performed (Tab. 3). Fig. 1 illustrates the correlation between the temperature at which beans are dried and the amount of flour used as a substitute for ash content.

Tab. 3 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the ash content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	A1 (60ºC)
B1 (10%)	4.51	4.44	4.06	4.34 b
B2 (15%)	5.37	4.57	4.28	4.74 ab
B3 (20%)	5.44	4.96	4.60	5.00 a
Average	5.12 a	4.66 ab	4.31 b	

Note: Different letters in columns and lanes indicate statistically significant differences.

3.3 Fat Content

The fat content of spice flour is one of the parameters of its proximity to indicate its nutritional value. Based on the fat diversity analysis, the drying temperature of the jack bean significantly affects the fat content of the spice flour produced. The substitution of jack bean flour does not affect the fat content of the flour, regardless of the degree of fluctuation. For determining the disparities between treatments, a 5% DMRT was conducted (Tab. 4). Fig. 2 illustrates the correlation between drying temperature and substitution of jack beans for fat content.

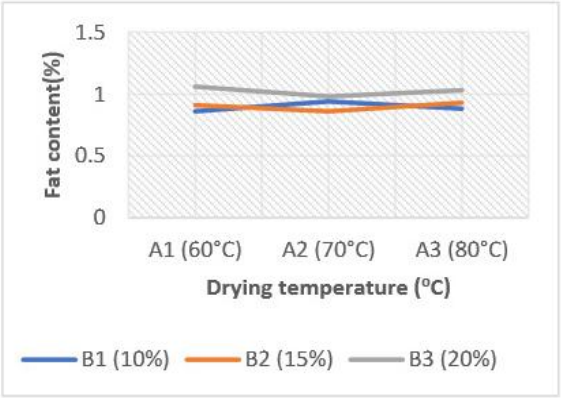

Fig. 2 Relationship between drying temperature and the substitution of jack bean flour toward the fat content of seasoned flour (Developed by the authors)

Tab. 4 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the fat content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	A1 (60ºC)
B1 (10%)	0.88	0.94	0.88	0.89 b
B2 (15%)	0.91	0.86	0.93	0.89 b
B3 (20%)	1.06	0.98	1.03	1.02 a
Average	0.95 a	0.94 a	0.92 a	

Note: Different letters in columns and lanes indicate statistically significant differences.

3.4 Protein Content

Protein content is one of the proximity parameters for determining the nutritional value of a food material. To determine the disparities in the treatments, the DMRT was conducted at a significance level of 5% (Tab. 5). The correlation between drying temperature and substitution of jack bean flour is illustrated in Fig. 3.

Tab. 5 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the protein content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	A1 (60ºC)
B1 (10%)	19.25	36.75	14.5	23.5 a
B2 (15%)	14.0	40.25	14.0	22.75 a
B3 (20%)	21.0	31.50	14.5	22.33 a
Average	11.08 b	36.17 a	14.33 b	

Note: Different letters in columns and lanes indicate statistically significant differences.

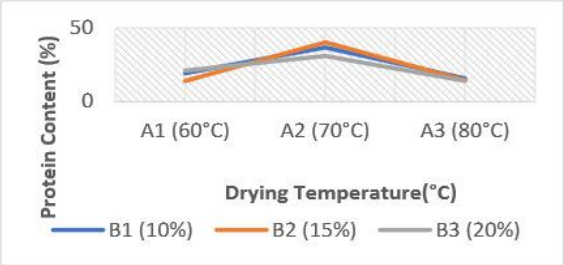

Fig. 3 Relationship between drying temperature and substitution of jack bean flour toward the protein content of seasoned flour (Developed by the authors)

3.5 Total Sugar Content

Total sugar content represents the combined amount of monosaccharides and disaccharides in spiced flour. A diversity analysis was conducted to determine the impact of treatment on the amount of sugar in spiced flour. The temperature during the drying process of the beans and the extent to which jack bean flour is used as a substitute significantly impact the spiced flour's overall sugar content. To determine the difference between treatments, DMRT was performed at a significance level of 5% (Tab. 6). The influence of drying temperature and jack bean flour substitution on the total sugar content of seasoned flour is shown in Fig. 4.

Tab. 6 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the total sugar content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	A1 (60ºC)
B1 (10%)	10.89	11.38	11.95	11.41 a
B2 (15%)	11.33	11.47	12.16	11.65 a
B3 (20%)	11.31	11.69	12.26	11.75 a
Average	11.18 b	11.51 b	12.12 a	

Note: Different letters in columns and lanes indicate statistically significant differences.

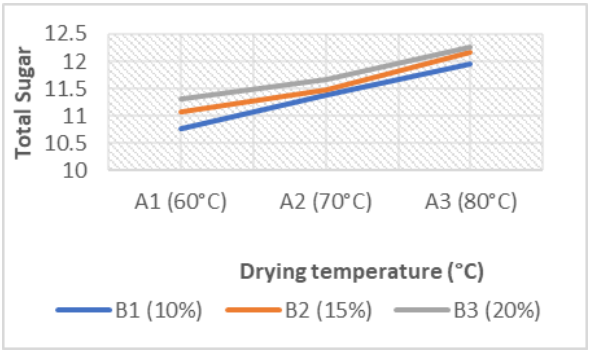

Fig. 4 Influence of drying temperature and jack bean flour substitution on the total sugar content of seasoned flour (Developed by the authors)

3.6 Reducing Sugar Content

The reduction of sugar in spiced dough is one of the dough parameters used to determine the non-enzymatic reduction reaction between amino acids and reducing sugars [21].

The diversity analysis results showed that the drying temperature and variation of the substitution of jack beans had a real influence on the sugar reduction levels of spiced flour. To determine the differences between the treatments, a DMRT was performed at a 5% real level (Tab. 7), as shown in Fig. 5.

Tab. 7 Effect of jack bean drying temperature to produce flour and substitute jack bean flour and their interaction on the reducing sugar content (Developed by the authors)

Substituting jack bean flour (B)	Temperature (A)			
	A1 (60ºC)	A2 (70ºC)	A3 (80ºC)	A1 (60ºC)
B1 (10%)	1.26	1.76	1.89	1.64 c
B2 (15%)	2.08	2.18	2.45	2.23 b
B3 (20%)	2.39	2.54	2.74	2.56 a
Average	1.91 b	2.15 a	2.36 a	

Note: Different letters in columns and lanes indicate statistically significant differences.

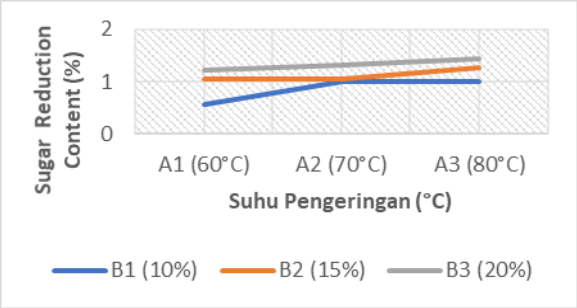

Fig. 5 Effect of drying temperature and jack bean flour substitution on lowering the sugar content of seasoned flour (Developed by the authors)

Based on the results presented in Fig. 6, it can be observed that an increase in the drying temperature of jack beans is positively correlated with a higher degree of sugar reduction in the spiced dough.

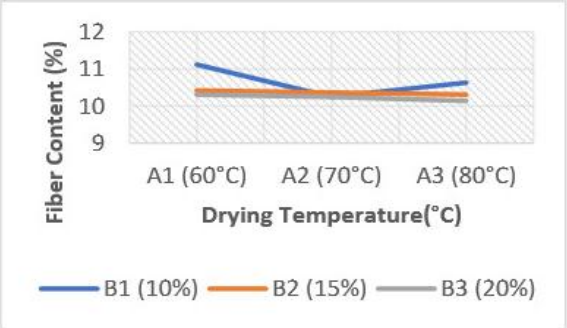

Fig. 6 Relationship between drying temperature and the substitution of jack bean flour toward the crude fiber content of seasoned flour (Developed by the authors)

3.7 Crude Fiber Content

The fiber content of spiced flour is one of the parameters of its quality because it affects the ability to bind water. According to the diversity analysis results, the drying temperature and change in the substitution of jack bean flour did not affect the crude fiber of the spiced flour produced. Fig. 6 depicts the relationship between drying temperature and jack bean flour substitution.

4 Discussion

4.1 Moisture Content

Based on the findings from the water level study, it can be concluded that the drying temperature substantially affects the water content of spiced flour [22,23]. However, jack bean flour concentration proportion does not exhibit any discernible influence on water content. This is because the starch content of jack bean flour is low; therefore, the hydroxyl groups that influence optimal water absorption capacity are also common [24].

Tab. 1 indicates a negative association between the water content of the spiced flour and the drying temperature applied to the jack beans. According to [25], a substance will evaporate more water if the temperature is increased and the drying process is prolonged.

The water content of spiced flour is unaffected by the percentage concentration of jack bean flour in its composition because jack bean flour has lower water content than wheat flour. According to [20], the permissible water content of spiced flour is a maximum of approximately 12% on a dry basis (db). Therefore, the jack bean spiced flour is within the acceptable range of 9-12% db, which complies with the SNI standard.

4.2 Ash Content

The results of the ash study showed that the drying temperature and trevally bean powder substitution level significantly impacted the ash content of the spice powder. This is because the ash content of seasoning flour is strongly influenced by the ingredients contained therein [24].

Based on the results of the ash content analysis, the drying temperature of jack bean and jack bean flour replacement variants significantly influences the ash content of green bean fried chicken seasoning powder.

Fig. 2 shows how drying temperature influences the ash content of fried chicken seasoning powder. The greater the drying temperature of jack bean flour, the lower the ash content because the minerals in jack beans evaporate with water during the drying process. The ash content of jack bean powder at 60°C is 4. 8%, at 70°C it is 4.3%, and at 80°C it is 3.6%. This happens because the beans contain much water, so the minerals evaporate during oven drying. The minerals contained in jack bean flour are sodium, potassium, calcium, magnesium, phosphorous, zinc, iron, manganese, copper, and lead [26]. According to [27,28], some minerals, such as iron, will be oxidized (reduced) during drying, affecting their absorption capacity and biological value. Djamila et al. [29] support this by stating that the ash content depends on the type of material, ash test method, time, and temperature used in drying.

Because the ash content of the bean flour is greater than that of the wheat flour, the concentration percentage of the bean flour will affect the ash content of the seasoning powder. The ash content of the flour is 0.65%; therefore, flour with ash content of 3.4% can contribute more ash content to fried chicken seasoning flour. According to [31], high ash content in food indicates that the food is high in minerals.

4.3 Fat Content

As shown in Fig. 3, drying temperature affects the fat content of jack bean flour. Spicy bean powder contains little fat because, at a drying temperature of 60-80°C, the fat in the beans is not damaged. According to [30], the higher the temperature, the more fat is destroyed. Damage occurs at temperatures of 110-120°C. Essential fatty acids are isomerized when heated in alkaline solutions and are very sensitive to temperature and oxygen. Breaking down fat can lead to the inactivation of its biological functions and may even be toxic.

The concentration of bean powder does not affect the fat content of spice powder because jack bean powder has different fat content. According to [31], the fat content of jack bean flour is 1.6%–4.12%, whereas the fat content of wheat flour is 1.3%. Therefore, replacing it with 10%–20% red bean flour has no effect and affects the fatness of spicy powder.

4.4 Protein Content

The protein content of spiced flour is significantly influenced by the drying temperature of jack beans, as indicated by the findings of the protein content study. The protein content of jack beans was found to be lowest when dried at 80°C. This is attributed to the phenomenon of protein denaturation that occurs during the drying process at high temperatures. Denaturation leads to the degradation of amino acid compounds and the aggregation of uncertain nitrogen (N), ultimately decreasing the protein (total N) content of spice flour.

The protein content of beans dried at 60°C is relatively lower than that of beans dried at 70°C. At the above temperature, enzyme activity still exists, leading to protein decomposition and thus reducing the protein content in the spice powder. Based on [32], it was observed that the protease enzyme is altered when exposed to temperatures above 75°C. This is due to protein aggregation, in which pseudo-clusters coalesce and form clumps, leading to blood clotting. Conversely, extremely low temperatures cause enzymes to become inactive. Once an enzyme is damaged, its ability to perform its intended activity is permanently impaired, rendering it inactive even under certain conditions.

The ratio of bean flour does not affect the protein content of spice powder because bean flour has a protein content of 37.61%, whereas wheat flour has a protein content of 8.9%. Therefore, 10–20% of the flour must be replaced with beans in the formulation, which does not affect the content of protein produced in spiced dough [31].

4.5 Reducing Sugar Content

Based on the analysis of total sugar content, the higher the drying temperature, the greater the total sugar content in spiced flour. This is because carbohydrates in jack beans undergo breakdown into composite sugars due to heating. According to [33], total sugar is a mixture of reduction and non-reduction sugars resulting from the hydrolysis of sodium. The total sugar content in jack bean flour will increase because the starch, with heating, will undergo decomposition into glucose composers.

Increasing the proportion of jack bean powder resulted in a corresponding increase in the overall sugar content of the spice powder made from black beans. The more sugar added, the higher the overall sugar content of the spice powder, which agrees with the finding of [34], the more sword koro flour is used, the higher the total sugar content in brownies.

4.6 Total Sugar Content

Based on the results presented in Fig. 6, it can be observed that an increase in the drying temperature of jack beans is positively correlated with a higher degree of sugar reduction in the spiced dough. This phenomenon is due to the enzyme decomposing sucrose into fructose and glucose during fermentation, thereby reducing the sugar content. Accordingly, increasing the drying temperature leads to a more significant sugar reduction. According to [35], the observed increase and decrease in sugar content may be due to sucrose decomposition. The breakdown of sucrose reduces the sugar content. The degree of sucrose hydrolysis depends on the acidity level of the solution, drying temperature, and heating time. Sucrose in flour can be thermally decomposed at high temperatures, leading to the production of reducing sugars.

The higher the percentage of substitution, the higher the reduction sugar level because the jack bean flour contributes a considerable amount of reduced sugars, thus increasing the sugar reduction level of the produced spiced flour. It is supported by [7] that jack bean flour has a carbohydrate content of 50.6%.

4.7 Crude Fiber Content

The drying temperature did not affect the crude fiber content. Drying jack beans at variable temperatures (60, 70, and 80°C) cannot degrade or damage the arrangement of crude fibers. This is different from [22], which found that the

combination of drying temperature (50, 60, and 70°C) and drying time (12, 14, and 16 hours) greatly influenced the crude fiber content. According to [36], chemically insoluble fibers include cellulose, hemicellulose, and lignin. Raw fibers are decomposed by heating at 200°C and chemical and physical treatment.

The percentage of jack bean flour supplementation does not affect the crude fiber content of spiced flour. Jack bean flour has raw fiber content ranging from 4.7%±11.7%. In contrast, wheat flour has 6.3% natural fiber content; therefore, the substitution of jack bean flour with a 10-20% substitution variation has not yet affected the fiber content of spiced flour.

5 Conclusions

Variation in the temperature of jack bean flour affects the ash, protein, and reduced and total sugar contents. Variations in the substitution of jack bean flour affect the ash content and lower sugar content. The best spice flour is produced at a drying temperature of 80^0C with ash content of 4.31%, protein content of 14.75%, fat content of 0.94%, sugar content of 12.02%, reducing sugar content of 1.23%, and crude fiber content of 10.36%. The best treatment for adding jack bean flour is to increase the amount of jack bean flour by 20%, which can produce seasoned flour with ash content of 4.99%, protein content of 22.17%, fat content of 1.02%, total sugar content of 11.75%, reducing sugar content of 32%, and crude fiber content of 10.23%.

This research can provide an academic contribution by offering researchers an option regarding the use of wheat flour. This suggests the substitution of wheat flour with jack bean flour, which originates from Indonesia. This change can effectively impact the ash content while decreasing the sugar content. In the future, this may be advantageous for those with celiac disease.

In the following research, it is recommended to give the jack bean flour to about 20% and dry it at 80°C temperature to achieve the optimal quality of seasoned flour. The end product analysis can be followed by an ELISA test to provide a quantitative gluten result. The gluten content can be analyzed using the enzyme-linked immunosorbent assay (ELISA) kit method, which determines or measures the levels of protein expression using secondary antibodies labeled with enzymes [37].

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