Journal of Applied Agricultural Science and Technology **E-ISSN: 2621-2528**
7(2): 119–129 (2023) **ISSN: 2621-4709**

CHARACTERISTICS OF COMPOSITE FLOUR MADE OF KIDNEY BEAN AND SOYBEAN

Merynda Indriyani Syafutri*, Friska Syaiful, Eka Lidiasari, Parwiyanti, Sugito, Erlita Indah Astari, Jery Mega Saputra

Agricultural Technology Study Program, Faculty of Agriculture, Universitas Sriwijaya, Ogan Ilir, Indonesia

*Corresponding author
Email: merynda@fp.unsri.ac.id

Abstract. *Kidney beans and soybeans have the potential to be developed because they contain good nutrient. Kidney beans and soybeans are sources of vegetable protein. One form of development of legume products is composite flour. The aim of this study was to analyze the physical and chemical characteristics of composite flour made of kidney beans and soybeans. The experiment was designed using Completely Randomized Design with nine treatments and each treatment was replicated three times. The factor investigated was formulation of composite flour made from kidney bean and soybean (90%:10%; 80%:20%; 70%:30%; 60%:40%; 50%:50%; 40%:60%; 30%:70%; 20%:80%; and 10%:90%). The swelling power, solubility, color, white degree, moisture content, ash, protein, fat, and carbohydrate content were analyzed. The results showed that the higher percentage of soybean flour caused a decrease on swelling power, white degree, and redness of composite flour, but it increased the value of solubility, lightness and yellowness of composite flour. Composite flour with higher percentage of kidney bean flour had higher carbohydrate level, while composite flour with higher percentage of soybean flour had higher protein and fat content. The moisture contents of composite flour made of kidney bean and soybean were in accordance with the standard for beans flour products.*
Keywords: composite flour; kidney bean; soybean

1. Introduction

Kidney beans and soybeans are types of legumes that have the potential to be developed. Kidney beans production in 2020 was 66,210 tons (Badan Pusat Statistik, 2020), while soybean production in 2019 was 424,190 tons and the number increased to 613,300 tons in 2020 (Setyawan & Huda, 2022). The production of kidney beans and soybeans was quite high, but it was unbalanced with the amount of consumption. According to Badan Ketahanan Pangan (2021), the consumption of nuts in Indonesia has decreased from 26.5 g/capita/day in 2019 to 25.0 g/capita/day in 2020. Setyawan and Huda (2022) stated that the average consumption of soybeans in 2015-2020 was 2,953,022 tons. One attempt to increase the use and consumption of kidney beans and soybeans is processing the kidney beans and soybeans into food products.

Kidney beans and soybeans contain good nutrients, especially protein and fiber. Kidney beans and soybeans contain 22.47% and 36.38 to 40.00% of protein, respectively (Sahasakul *et al*., 2022; Krisnawati, 2017). The fiber content of kidney beans and soybeans were 6.23 to 6.82%

Received December 29, 2022; Accepted April 13, 2023; Published May 27, 2023
https://doi.org/10.55043/jaast.v7i2.132

(Hayat *et al.*, 2014; Sari *et al.*, 2020) and 5.56 to 8.58% (Ratnaningsih *et al.*, 2017), respectively. It is higher than fiber content of peanuts (2.4 to 2.9%), mung beans (5.7 to 7.5%), and bogor beans (2.5%), but lower than peas (10.3%) (Direktorat Gizi Masyarakat, 2018). Singh *et al*. (2021) stated that kidney beans and soybeans have a low glycemic index value. The values are 15,6 and 22,72, respectively.

Processing legumes product into flour is one way to increase the use of kidney beans and soybeans as food products because flour is more practical to use and has a longer shelf life. Moreover, kidney bean flour and soybean flour can be processed into composite flour. Composite flour is a mixture of various types of flour (two types of flour or more), which is done with the aim to get flour with better characteristics and higher nutrient content (Sitanggang, 2016). Composite flour could be made from a mixture of tubers flour, legumes flour, cereals flour, fruit, and vegetable flour with or without wheat flour (Astuti *et al*., 2014; Yuniarsih *et al*., 2019; Ardiyani *et al*., 2021; Kambabazi *et al*., 2022). The mixing of flour is conducted with the same mesh size (Hernawan, 2017).

Composite flour has been used extensively and successfully in food products production (Hasmadi *et al*., 2020), such as bakery products and pastries (bread, biscuits, cookies, and pasta) (Noorfarahzilah *et al*., 2014). Composite flour is made from legumes/nuts/beans without addition of other flour, including: composite flour from cowpea-soybean-red bean flour (Mbofung *et al*., 2002), chickpea-soybean flour (Hemeda *et al*., 2018), and soybean-mung bean-red kidney bean flour (Ratnawati *et al*., 2019). In this study, composite flour was made from soybean and kidney bean flour. Composite flour from kidney bean and soybean has the potential to be developed as a raw material for processing food products, such as cake (Astuti *et al*., 2014), nutrimat bar (Wiranata *et al*., 2017), and tortilla (Syaiful *et al*., 2022). Comparison between each flour in making of composite flour will affect the characteristics of the composite flour produced. The aim of this study was to observe the effect of kidney bean flour and soybean flour formulation on the physical and chemical properties of composite flour.

2. Methods

2.1. Materials

The materials used in this study were kidney beans, soybeans, water, electric oven, blender, sieve 80 mesh, polypropylene packaging, sealer, digital scale, and basin.

2.2. Research Design and Parameters

This study used a non-factorial completely randomized design. The treatment factor was the formulation of composite flour (F). The treatment factor consisted of 9 levels so that 9 treatments were obtained. Each treatment was repeated 3 times.

F1 = 90% of kidney bean flour:10% of soybean flour

F2 = 80% of kidney bean flour:20% of soybean flour

F3 = 70% of kidney bean flour:30% of soybean flour

F4 = 60% of kidney bean flour:40% of soybean flour

F5 = 50% of kidney bean flour:50% of soybean flour

F6 = 40% of kidney bean flour:60% of soybean flour

F7 = 30% of kidney bean flour:70% of soybean flour

F8 = 20% of kidney bean flour:80% of soybean flour

F9 = 10% of kidney bean flour:90% of soybean flour

Composite flour made of kidney bean and soybean flour were tested to study their physical and chemical characteristics. Physical characteristics consists of swelling power and solubility (Senanayake *et al.*, 2013), colors including lightness, redness and yellowness (Syafutri *et al.*, 2021), and white degrees (Mawarni & Widjanarko, 2015). Chemical characteristics consists of moisture content, ash, protein, fat, and carbohydrate content (AOAC, 2005). The data obtained were evaluated using analysis of variance (ANOVA) and honestly significant difference test at the 5% level.

2.3. Process of Making Kidney Bean Flour

The process of making kidney bean flour referred to Pangastuti *et al.* (2013). Kidney beans were soaked (24 hours) in water (1:5). Kidney beans were boiled for 90 minutes, then kidney beans were dried using an oven (55±2 ^{o}C) for 18 hours. Dry kidney beans were mashed using a blender, then sieved (80 mesh) to produce kidney bean flour.

2.4. Process of Making Soybean Flour

The process of making soybean flour referred to Syaiful *et al.* (2022). Soybeans were soaked (24 hours) in water (1:5). Soybeans were boiled for 30 minutes, then they were drained for 15 minutes andtheir skin was peeled. Soybeans were dried using an oven (55±2 ^{o}C) for 17 hours. Dry soybeans were mashed using a blender, then sieved (80 mesh) to produce soybean flour.

2.5. Process of Making Composite Flour

The process of making composite flour referred to Syaiful *et al.* (2022). Kidney bean flour and soybean flour were weighed (according to treatment; the total weight of flour was 100 g), then they were homogenized using a blender. The mixed flour was sieved (80 mesh) to produce composite flour.

3. Results and Discussion

3.1. Swelling Power and Solubility

Swelling power and solubility are functional properties of starch which are related to the quality of food products produced. According to Syafutri *et al.* (2018), swelling power indicated the hydration capacity of the starch. The swelling power of composite flour ranged from 5.64 to 10.02% (Figure 1). The highest swelling power (10.02%) found in composite flour F1 (90% of kidney bean flour: 10% of soybean flour), while the lowest swelling power (5.64%) found in composite flour F9 (10% of kidney bean flour: 90% of soybean flour). The analysis of variance showed that the formulation of composite flour had significant effect on swelling power of composite flour made of kidney bean flour and soybean flour.

The results showed that the increasing percentage of soybean flour caused the decreasing of swelling power. Based on statistical analysis, composite flour F1 (90% of kidney bean flour: 10% of soybean flour) was significantly different with F7 (30% of kidney bean flour: 70% of soybean flour), F8 (20% of kidney bean flour: 80% of soybean flour) and F9 (10% of kidney bean flour: 90% of soybean flour), but composite flour F1 was insignificantly different with others. Swelling power value of composite flour decreased significantly in the treatment F7 (30% of kidney bean flour: 70% of soybean flour). Based on preliminary research, the swelling power of kidney bean flour was 8.24%, while the swelling power of soybean flour was 6.64%.

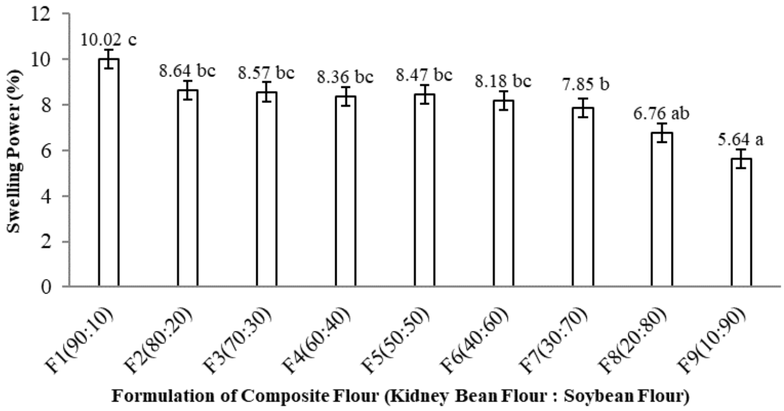

Figure 1. Swelling power (%) of composite flour made of kidney bean flour and soybean flour

Swelling power is the power of flour to expand. Some factors that influence swelling power include comparison of amylose-amylopectin, chain length and molecular weight distribution. Amylose content of starch is highly correlated with swelling power (Hidayati, 2013). High amylose content will cause a decreasing of swelling power because amylose can block the development of starch. Amylose content of soybean flour was higher than kidney bean flour. Amylose content of kidney bean flour ranged from 14.93 to 15.00% (Wani *et al.*, 2019), while amylose content of soybean flour ranged from 19 to 22% (Stevenson *et al.*, 2006). So, the composite flour with the high proportion of soybean flour had a lower swelling power value.

The solubility of composite flour ranged from 13.05 to 22.30% (Figure 2). The highest solubility (22.30%) found in composite flour F7 (30% of kidney bean flour: 70% of soybean flour), while the lowest solubility (13.05%) found in composite flour F1 (90% of kidney bean flour: 10% of soybean flour). The analysis of variance showed that the formulation of composite flour had significant effect on the solubility of composite flour made from kidney bean flour and soybean flour.

The results showed that the increasing of percentage of soybean flour caused the increasing of solubility. Based on preliminary research, the solubility of soybean flour (15.30%) was higher than the solubility of kidney bean flour (11.93%). It was due to the amylose content of each flour. According to Aulia *et al*. (2018), amylose is water-soluble, while amylopectin is water-insoluble. The amylose content of soybean (19 to 22%) is higher than kidney bean (14.93 to 15.00%) (Stevenson *et al*., 2006; Wani *et al*., 2019). Thus, an increase in the concentration of soybean flour addition led to an increase in the solubility of the composite flour. Solubility value of composite flour increased significantly in the treatment F5 (50% of kidney bean flour: 50% of soybean flour). Based on statistical analysis, composite flour F1 (90% of kidney bean flour: 10% of soybean flour) was insignificantly different with F2 (80% of kidney bean flour: 20% of soybean flour), F3 (70% of kidney bean flour: 30% of soybean flour) and F4 (60% of kidney bean flour: 40% of soybean flour), but it was significantly different with other treatments. The results also showed that treatment F5 (50% of kidney bean flour: 50% of soybean flour) was insignificantly different with F6 (40% of kidney bean flour: 60% of soybean flour), F8 (20% of kidney bean flour: 80% of soybean flour) and F9 (10% of kidney bean flour: 90% of soybean flour).

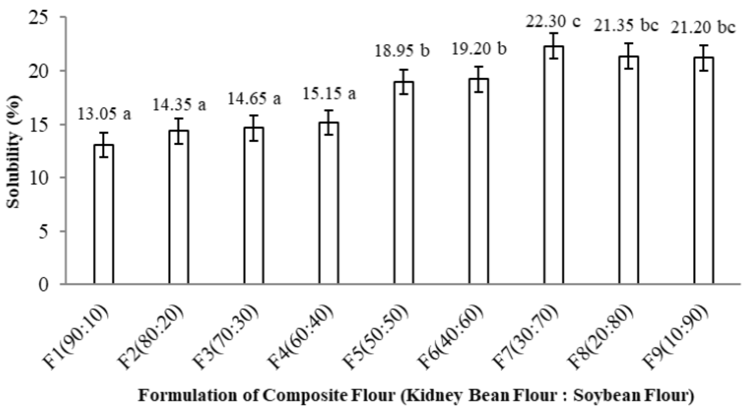

Figure 2. Solubility (%) of composite flour made of kidney bean flour and soybean flour

3.2. Color (Lightness, Redness and Yellowness)

Lightness (L*) values have a range from 0 (black) to 100 (white). The L* notation indicated the light which results in achromatic colors. The redness values (a*) show the red and green color, and yellowness values (b*) show the yellow to blue color. The red color range is 0 to +80, while the green color range is 0 to -80. The yellow color range is 0 to +70, while blue color range is 0 to

-70 (Anjani *et al*., 2015).

The results showed that the composite flour made of kidney bean flour and soybean flour had lightness, redness and yellowness values ranged from 79.00 to 88.60, 7.40 to 9.27, and 9.63 to 19.30, respectively (Figure 3). The analysis of variance showed that the formulation of composite flour had significant effects on lightness, redness and yellowness of composite flour made of kidney bean flour and soybean flour.

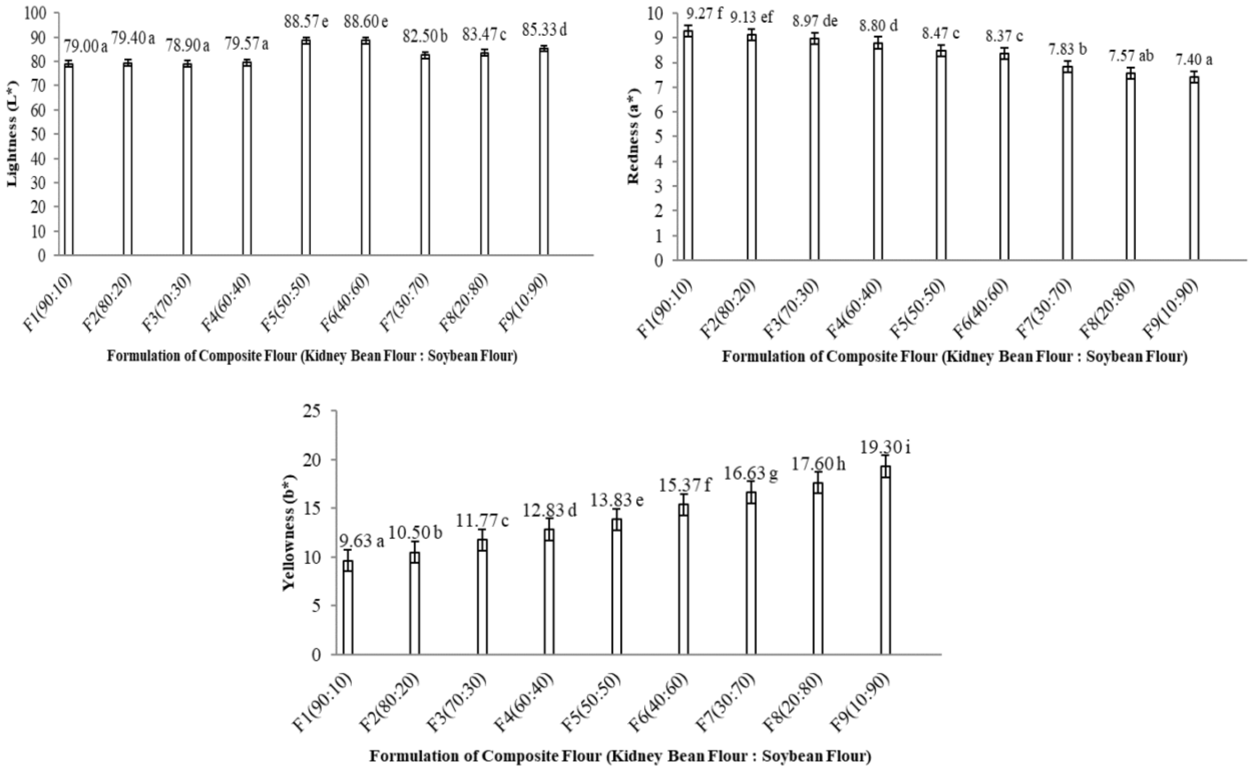

Figure 3. Color (lightness. redness. yellowness) of composite flour made of kidney bean flour and soybean flour

The results showed that the lightness value of composite flour tends to increase in line with the increasing of percentage of soybean flour. The highest lightness value was found in composite flour F5 (50% of kidney bean flour: 50% of soybean flour) and F6 (40% of kidney bean flour : 60% of soybean flour), which were 88.57 and 88.60, respectively. The decrease on lightness values occurred in the composite flour F7 to F9. It showed that composite flour with 50% of kidney bean flour and 50% of soybean flour formulation produced the highest lightness value. Lightness of composite flour with high proportion of kidney bean flour was lower than composite flour with high proportion of soybean flour. It showed that the color of composite flour was darker.

The results also showed that the redness value of composite flour F1 was higher than other treatments because the proportion of kidney bean flour on composite flour F1 was the highest among other treatments. The composite flour F9 had high yellowness value because the proportion of soybean flour on composite flour F9 was the highest. It was caused by the content of natural pigmen of kidney beans and soybeans. Kidney beans contain anthocyanins and proanthocyanidins (Pangastuti *et al*., 2013; Han *et al*., 2015; Wiranata *et al*., 2017), while soybeans contain carotenoid (Kang *et al*., 2012; Qin *et al*., 2017). Anthocyanins and proanthocyanidins are natural bioactive compounds which contributed as red pigmen color, while carotenoid is yellow-orange pigmen color. Both of pigmen colors also has a function as antioxidant. Redness value of composite flour decreased significantly in the treatment F3 (70% of kidney bean flour : 30% of soybean flour), while yellowness value increased significantly in the treatment F2 (80% of kidney bean flour : 20% of soybean flour).

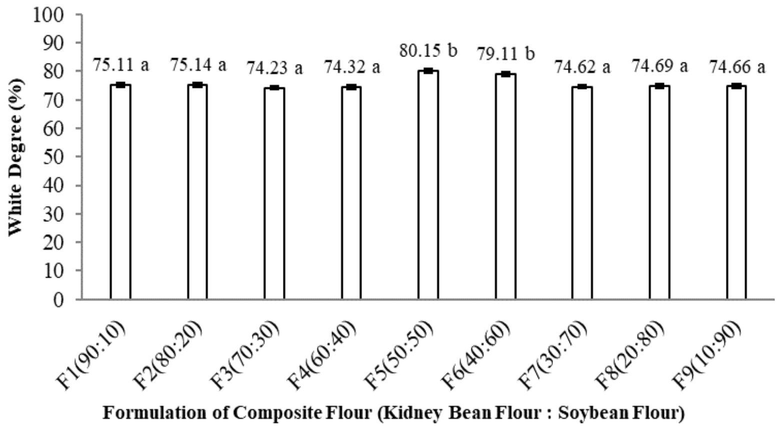

Figure 4. White degree of composite flour made of kidney bean flour and soybean flour

3.3. White Degree

White degree is one of the important physical parameters for identifying the color of flour (Pangastuti *et al*., 2013). White degree of composite flour made of kidney bean flour and soybean color ranged from 74.23 to 80.15% (Figure 4). The highest white degree (80.15%) found in composite flour F5 (50% of kidney bean flour: 50% of soybean flour), while the lowest white degree (74.23%) found in composite flour F3 (70% of kidney bean flour : 30% of soybean flour).

The results of white degree analysis were in line with the results of color analysis. According to Figure 4, white degree of composite flour F5 (50% of kidney bean flour : 50% of soybean flour) was the highest among others. The results of color analysis also showed that lightness value of composite flour F5 was the highest. It stated that the treatment F5 had brighter colors. Figure 4 also showed that white degree values of composite flour with high proportion of soybean flour were higher than composite flour with high proportion of kidney bean flour.

3.4. Chemical Characteristics

Analysis of chemical characteristics included moisture content, ash, protein, fat, and carbohydrate content (Table 1). Moisture content of composite flour made of kidney bean flour and soybean flour ranged from 6.48 to 7.94%. The moisture contents of composite flour were in accordance with the SNI 01-3728-1995 or standard for beans flour products (maximal 10%). Table 1 showed that ash content of composite flour ranged from 3.24 to 3.76%. Ash contents of composite flour made of kidney bean flour and soybean flour were higher than standard value of ash for flour products. Kidney bean and soybean were source of mineral. Direktorat Gizi Masyarakat (2018) stated that kidney beans and soybeans contained some minerals. The calcium, phosphor and iron content of kidney bean were 502 mg, 429 mg and 10.3 mg, respectively. The calcium, phosphor and iron content of soybean were 222 mg, 682 mg and 10.0 mg, respectively. According to preliminary research, ash content of kidney bean and soybean were 2.86% and 2.96%.

According to analysis variance, formulation of composite flour had significant effects on moisture content, protein, fat, and carbohydrate, but had no significant effect on ash. Protein, fat, and carbohydrate content of composite flour were 20.01 to 33.72%, 4.42 to 24.68%, and 30.59 to 63.66%, respectively. The results showed that the protein and fat content of composite flour with high proportion of soybean flour were higher than composite flour with high proportion of kidney bean flour, but carbohydrate content of composite flour with high proportion of soybean flour was lower.

Table 1. Chemical characteristics of composite flour made of kidney bean flour and soybean flour

Chemical Characteristics	Formulation of Composite Flour (Kidney Bean Flour : Soybean Flour)								
	90 : 10	80 : 20	70 : 30	60 : 40	50 : 50	40 : 60	30 : 70	20 : 80	10 : 90
Moisture Content	7.94^{d}	7.67^{cd}	6.81 ^{ab}	7.35^{bcd}	7.10^{abcd}	6.86^{abc}	6.48^{a}	6.55^{ab}	7.20^{abcd}
Ash	3.28	3.48	3.41	3.38	3.59	3.52	3.76	3.56	3.24
Protein	20.01^{a}	21.97^{b}	22.48^{b}	24.45^{c}	26.38^{d}	26.73^{d}	27.64^{e}	31.38^{f}	33.72^{g}
Fat	4.42^{a}	6.76^{b}	9.18^{c}	11.44^{d}	14.27^{e}	17.06^{f}	19.49^{g}	22.09^{h}	24.68^{i}
Carbohydrate	63.66^{h}	59.48^{g}	57.62^{f}	52.79^{e}	48.10^{d}	44.42^{c}	43.09^{c}	35.96^{b}	30.59^{a}

Protein and fat content of soybean flour were higher than kidney bean flour, but carbohydrate of soybean flour was lower than kidney bean flour. According to Astuti *et al.* (2014), soybean contained 47.80% of protein, 16.76% of fat and 26.28% of carbohydrate content, while kidney bean contained 26.06% of protein, 2.70% of fat and 62.61% of carbohydrate content.

4. Conclusions

Formulation of composite flour had significant effects on swelling power, solubility, color (lightness, redness, yellowness), white degree, moisture content, protein, fat, and carbohydrate, but had no significant effect on ash. Composite flour with higher percentage of kidney bean flour had higher carbohydrate level, while composite flour with higher percentage of soybean flour had higher protein and fat content. The moisture contents of composite flour made of kidney bean and soybean were in accordance with the SNI 01-3728-1995 for beans flour products.

References

Anjani, P. P., Andrianty, S., & Widyaningsih, T. D. (2015). Effect of Addition of Fragant Pandannus and Cinnamon in Herbal Tea by Peel of Snake Fruit for Diabetic. *Jurnal Pangan dan Agroindustri*, 3(1), 203-214. https://jpa.ub.ac.id/index.php/jpa/article/view/125.

AOAC. (2005). *Official Methods of Analysis*. Benjamin Franklin Station, Washington DC: Association of Official Analytical Chemists.

Ardiyani, N. P. S., Nurali, E. J. N., & Lalujan, L. E. (2021). Sensory and Chemical Characteristics of Flakes Made from Composit Flour of Goroho (*Musa acuminate* L.) Plantain, Yellow Yam (*Ipomea batatas* L.), and Red Beans (*Phaseolus vulgaris* L). *Jurnal Teknologi Pertanian*, 12(1), 18-29. https://ejournal.unsrat.ac.id/v3/index.php/teta/article/view/38856.

Astuti, S. D., Andarwulan, N., Hariyadi, P., & Agustia, F.C. (2014). Formulasi dan Karakterisasi *Cake* Berbasis Tepung Komposit Organik Kacang Merah, Kedelai, dan Jagung. *Jurnal Aplikasi Teknologi Pangan*, 13(2), 79-88. https://jatp.ift.or.id/index.php/jatp/article/view/151.

Aulia, C. L., Suryani, C. L., & Setyowati, A. (2018). Pengaruh Variasi Lama Fermentasi dan Penyangraian terhadap Sifat Fisik dan Kimia Tepung Gari. *Seminar Nasional* "*Inovasi Pangan Lokal untuk Mendukung Ketahanan Pangan*", 29-35. http://ejurnal.mercubuana-yogya.ac.id/index.php/Prosiding_IPPL/article/view/702/475.

Badan Ketahanan Pangan. (2021). *Direktori Perkembangan Konsumsi Pangan*. https://ditjenpkh.pertanian.go.id/uploads/download/3e8f561f9e61f478b634605ccf1effb4.pdf.

Badan Pusat Statistik. (2020). *Produksi Tanaman Sayuran 2020*. https://www.bps.go.id/indicator/55/61/2/produksi-tanaman-sayuran.html.

Direktorat Gizi Masyarakat. (2018). *Tabel Komposisi Pangan Indonesia 2017*. Jakarta: Kementerian Kesehatan RI. http://repo.stikesperintis.ac.id/1110.

Hemeda, H. M. E., Aly, F. M. A., Nadir, A. S., & El-Masry, H. G. (2018). Influence of Chickpea, Soy Flour and Protein Isolate on Pan Bread Quality and Biological Parameters in Experimental Rats. *Middle East Journal of Applied Sciences*, 8(2), 307-324. https://www.curresweb.com/mejas/mejas/2018/307-324.pdf.

Han, K. H., Okada, T. K., Seo, J. M., Kim, S. J., Sasaki, K., Shimada, K., & Fukushima, M. (2015). Characterisation of Anthocyanins and Proanthocyanidins of Adzuki Bean Extracts and Their Antioxidant Activity. *Journal of Functional Foods*, 14, 692-701. https://agris.fao.org/agris-search/search.do?recordID=US201700166063.

Hasmadi, M., Noorfarahzilah, M., Noraidah, H., Zainol, M. K., & Jahurul, M. H. A. (2020). Functional Properties of Composite Flour: a Review. *Food Research*, 4(6), 1820-1831. http://dx.doi.org/10.26656/fr.2017.4(6).419.

Hayat, I., Ahmad, A., Ahmed, A., Khalil, S., & Gulfraz, M. (2014). Exploring the Potential of Red Kidney Beans (*Phaseolus vulgaris* L.) to Develop Protein Based Product for Food Applications. *The Journal of Animal & Plant Sciences*, 24(3), 860-868. http://www.thejaps.org.pk/docs/v-24-3/28.pdf.

Hernawan, D. P. (2017). *Kajian Perbandingan Tepung Beras Merah (Oryza nivana), Tepung Ubi Jalar (Ipomoea batatas), dengan Tepung Kedelai (Glycine max) dan Ukuran Mesh terhadap Karakteristik Tepung Komposit*. [Thesis]: West Java: Universitas Pasundan. http://repository.unpas.ac.id/14774.

Hidayati, F. U. N. (2013). *Swelling Power Ratio of Mixture of Xanthosoma sagittifolium Flour and Wheat Flour toward the Expansion Levels and Sensory Preferences of Bread*. [Thesis]: Surakarta: Muhammadiyah University of Surakarta. http://eprints.ums.ac.id/26186.

Kambabazi, M. R., Okoth, M. W., Ngala, S., Njue, L., & Vasanthakaalam, H. (2022). Physicochemical Properties and Sensory Evaluation of a Bean-Based Composite Soup Flour. *Legume Science*, 4(4), 1-10. https://doi.org/10.1002/leg3.139.

Kang, E. Y., Kim, E. H., Chung, I. M., & Ahn, J. K. (2012). Variation of β-carotene Concentration in Soybean Seed and Sprout. *Korean J. Crop Sci*., 57(4), 324-330. http://dx.doi.org/10.7740/kjcs.2012.57.4.324.

Krisnawati, A. (2017). Soybean as Source of Functional Food. *Iptek Tanaman Pangan*, 12(1), 57-65. https://ejurnal.litbang.pertanian.go.id/index.php/ippan/article/view/7591.

Mawarni, R. T., & Widjanarko, S. B. (2015). Grinding By Ball Mill with Chemical Purification on Reducing Oxalate in Porang Flour. *Jurnal Pangan dan Agroindustri*, 3(2), 571-581. https://jpa.ub.ac.id/index.php/jpa/article/view/175.

Mbofung, C. M. F., Njintang, Y. N., & Waldron, K. W. (2002). Functional Properties of Cowpea–Soy–Dry Red Beans Composite Flour Paste and Sensorial Characteristics of Akara (Deep Fat Fried Food): Effect of Whipping Conditions, pH, Temperature and Salt Concentration. *Journal of Food Engineering*, 54(3), 207-214. https://doi.org/10.1016/S0260-8774(01)00196-0.

Noorfarahzilah, M., Lee, J. S., Shaarani, S. M., & Bakar, M. F. A. (2014). Applications of Composite Flour in Development of Food Products. *International Food Research Journal*, 21(6), 2061-2074. https://www.researchgate.net/publication/271020224.

Pangastuti, H. A., Affandi, D. R., & Ishartini, D. (2013). Physical and Chemical Properties Characterization of Red Kidney Bean (*Phaseolus vulgaris* L.) Flour by Some Processing Treatment. *Jurnal Teknosains Pangan*, 2(1), 20-29. https://jurnal.uns.ac.id/teknosains-pangan/article/view/4204.

Qin, Y., Park, S. Y., Oh, S. W., Lim, M. H., Shin, K. S., Cho, H. S., Lee, S. K., & Woo, H. J. (2017). Nutritional Composition Analysis for Beta-Carotene-Enhanced Transgenic Soybeans (*Glycine max* L.). *Applied Biological Chemistry*, 60, 299–309. https://applbiolchem.springeropen.com/articles/10.1007/s13765-017-0282-z.

Ratnaningsih, Ginting, E., Adie, M. M., & Harnowo, D. (2017). Sifat Fisikokimia dan Kandungan Serat Pangan Galur-galur Harapan Kedelai. *Jurnal Penelitian Pascapanen Pertanian*, 14(1), 35-45. http://dx.doi.org/10.21082/jpasca.v14n1.2017.35-45.

Ratnawati, L., Desnilasari, D., Surahman, D. N., & Kumalasari, R. (2018). Evaluation of Physicochemical, Functional and Pasting Properties of Soybean, Mung Bean and Red Kidney Bean Flour as Ingredient in Biscuit. *IOP Conference Series: Earth and Environmental Science*, 251, 1-10. https://iopscience.iop.org/article/10.1088/1755-1315/251/1/012026.

Sahasakul, Y., Aursalung, A., Thangsiri, S., Wongchang, P., Sangkasa-ad. P., Wongpia, A., Polpanit, A., Inthachat, W., Temviriyanukul, P., & Suttisansanee, U. (2022). Nutritional Compositions, Phenolic Contents, and Antioxidant Potentials of Ten Original Lineage Beans in Thailand. *Foods*, 11, 1-18. https://doi.org/10.3390/foods11142062.

Sari, N. M. R. E., Wisaniyasa, N. W., & Wiadnyani, A. A. I. S. (2020). Study of Nutrient, Fiber and Anthocyanin Content of Red Bean Flour and Red Bean Sprouts Flour (*Phaseolus vulgaris* L.). *Jurnal Itepa: Jurnal Ilmu dan Teknologi Pangan*, 9(3), 282-290. https://doi.org/10.24843/itepa.2020.v09.i03.p04.

Senanayake, S., Gunaratne, A., Ranaweera, K. K. D. S., & Bamunuarachchi, A. (2013). Effect of Heat Moisture Treatment Conditions on Swelling Power and Water-Soluble Index of Different Ciltivars of Sweet Potato (*Ipomea batatas* L. Lam) Starch. *ISRN Agronomy*: 1-4. https://www.hindawi.com/journals/isrn/2013/502457.

Setyawan, G., & Huda, S. (2022). Analysis of the Influence of Soybean Production, Soybean Consumption, Per Capita Income, and Exchange Rate on Soybean Imports in Indonesia. *KINERJA: Jurnal Ekonomi dan Manajemen*, 19(2), 215-225. https://doi.org/10.30872/jkin.v19i2.10949.

Singh, K. G., Kasera, S., & Priyadarshini, K. V. (2021). Effect of Nutritional Composition and Glycemic Index on Selected Varieties of Rice, Millets and Legumes. *International Journal of Pharmaceutical Sciences Review and Research*, 70(1), 131-137. https://www.researchgate.net/publication/355340539.

Sitanggang, A. B. (2016). Tepung Komposit Alternatif Produk Bakeri. *Food Review Indonesia*,

11(12), 52-55. https://www.researchgate.net/publication/314010435.
Stevenson, D. G., Doorenbos, R. K., Jane, J., & Inglett, G. E. (2006). Structures and Functional Properties of Starch from Seeds of Three Soybean (*Glycine max* (L.) Merr.) Varieties. *Starch*, 58(10), 509-519. https://onlinelibrary.wiley.com/doi/abs/10.1002/star.200600534.
Syafutri, M. I., Pratama, F., Malahayati, N., & Hamzah, B. (2018). Swelling Power and WSI of Modified Bangka Sago Starch. *Indian Journal of Natural Products and Resources*, 9(1), 66-69. http://nopr.niscpr.res.in/handle/123456789/44636.
Syafutri, M. I., Pratama, F., Syaiful, F., Sari, R. A., Sriutami, O., & Pusvita, D. (2021). Effect of Heat Moisture Treatment on Physicochemical Properties of Modified Red Rice Flour. *Pangan*, 30(3), 175-186. https://doi.org/10.33964/jp.v30i3.530.
Syaiful, F., Syafutri, M. I., Lidiasari, E., & Astari, E. I. (2022). Pengaruh Penambahan Tepung Komposit (Kacang Merah-Kacang Kedelai) terhadap Karakteristik *Tortilla Chips*. *Pasundan Food Technology Journal*, 9(2), 39-45. https://doi.org/10.23969/pftj.v9i2.5596.
Wani, I. A., Andrabi, S. N., Sogi, D. S., & Hassan, I. (2019). Comparative Study of Physicochemical and Functional Properties of Flours from Kidney Bean (*Phaseolus vulgaris* L.) and Green Gram (*Vigna radiata* L.) Cultivars Grown in Indian Temperate Climate. *Legume Science*, 2(1), 1-12. https://doi.org/10.1002/leg3.11.
Wiranata, I. G. A. G., Puspaningrum, D. H. D., & Kusumawati, I. G. A. W. (2017). Formulations and Characteristics of Nutrimat Bar based on Soybean Flour (*Glycine max* L.) and Kidney Bean Flour (*Phaseolus vulgaris* L.) as Food for Chemotherapy Patients. *Indonesian Nutrition Journal*, 5(2), 133-139. https://doi.org/10.14710/jgi.5.2.133-139.
Yuniarsih, E., Adawiyah, D. R., & Syamsir, E. (2019). Character of Composite Flour of Beneng Taro and *Moringa oleifera* Leaves to Cookies. *Jurnal Mutu Pangan*, 6(1), 46-53. https://journal.ipb.ac.id/index.php/jmpi/article/view/26446