

Innovation in the use of mung bean flour and wheat flour with the addition of Pak choy puree to chicken gyoza skin as a high-protein food

[Inovasi pemanfaatan tepung kacang hijau dan tepung terigu dengan penambahan bubur pakcoy pada kulit gyoza ayam sebagai pangan tinggi protein]

Yenny Febriana Ramadhan Abdi^{1*}, Angel Lestari Maynar¹, Alfi Nur Rochmah¹, Dininurilmi Putri Suleman¹, Dini Nadhilah¹

¹ Program Studi Teknologi Hasil Pertanian, Sekolah Vokasi, Universitas Sebelas Maret, Jalan Kolonel Sutarto Nomor 150K, Jebres, Kota Surakarta, Jawa Tengah.

* Email korespondensi : yennyabdi@staff.uns.ac.id.

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ABSTRACT

The utilization of mung bean flour as a nutritional enhancer in food processing can serve as a preference for increasing protein content. One type of food product that can incorporate mung bean flour is gyoza. Gyoza wrappers are typically made from wheat flour with low protein content. Mung bean flour can be added to improve its protein content. Additionally, mung bean flour in gyoza wrappers can be combined with fresh antioxidant-rich ingredients, such as Pak choy, to enhance antioxidant activity. This study aimed to determine the effect of using mung bean flour and wheat flour with the addition of Pak choy puree on chicken gyoza's sensory and chemical quality. The research employs a Completely Randomized Design (CRD) with a non-factorial approach, using four formulations: F0 (150 g wheat flour), F1 (100 g wheat flour and 50 g mung bean flour), F2 (75 g wheat flour and 75 g mung bean flour), and F3 (50 g wheat flour and 100 g mung bean flour). The obtained data were analyzed using ANOVA (analysis of variance) followed by the DMRT test at a 5% significance level. The results from the sensory evaluation indicate that the best formulation was the chicken gyoza sample with 50 g of mung bean flour and 100 g of wheat flour. The chemical analysis results for this formulation include moisture content (53.3%), protein content (11.23%), fat content (2.63%), and antioxidant activity (4.83%).

Keywords: gyoza, green bean flour, Pak choy, protein

ABSTRAK

Pemanfaatan tepung kacang hijau sebagai penambah nutrisi dalam pengolahan pangan dapat dijadikan sebagai salah satu preferensi dalam meningkatkan kandungan gizi protein. Jenis olahan pangan yang dapat memanfaatkan tepung kacang hijau adalah gyoza. Kulit Gyoza umumnya terbuat dari bahan tepung terigu dan mengandung rendah protein, sehingga untuk meningkatkan kandungan proteinya dapat ditambahkan tepung kacang hijau. Selain itu, tepung kacang hijau dalam kulit gyoza dapat dikombinasikan dengan bahan pangan segar tinggi antioksidan seperti pakcoy untuk meningkatkan aktivitas antioksidannya. Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan tepung kacang hijau dan tepung terigu dengan penambahan puree pakcoy terhadap mutu sensoris dan kimia gyoza ayam. Penelitian menggunakan rancangan acak lengkap (RAL) non faktorial dengan perlakuan empat formulasi yaitu F0 (150 g tepung terigu), F1 (100 g tepung terigu dan 50 g tepung kacang hijau), F2 (75 g tepung terigu dan 75 g tepung kacang hijau) dan F3 (50 g tepung terigu dan 100 g tepung kacang hijau). Data yang diperoleh dianalisis menggunakan ANOVA (analysis of variance) dan dilanjutkan uji DMRT dengan taraf signifikansi 5%. Hasil yang diperoleh berdasarkan pengujian sensoris menunjukkan bahwa formulasi terbaik terdapat pada sampel gyoza ayam dengan penambahan 50 g tepung kacang hijau dan 100 g tepung terigu dengan hasil uji kimia meliputi kadar air (53,3%), kadar protein (11,23%), kadar lemak (2,63%) dan aktivitas antioksidan (4,83%).

Kata kunci: gyoza, pakcoy, protein, tepung kacang hijau

Introduction

Mung beans are one type of legume that is easy to process in the community, one of which is in the form of mung bean flour (Baetillah et al., 2022). The processing of mung bean flour aims to reduce moisture content, extend shelf life, and expand its utilization. According to Lathifah et al. 2022, mung bean flour has a high protein content of 22.9%. In addition, the protein compounds in mung beans can counteract free radicals and prevent changes in the physical properties of food, making mung bean flour a promising ingredient for further development in food products (Zhu et al., 2022). One potential utilization of mung bean flour is through innovation in chicken gyoza products.

Gyoza is a traditional Japanese food consisting of two parts: the wrapper made from wheat flour and the filling made from meat (Wijaya & Dirpan, 2021). According to the USDA (2019), the protein content of gyoza per 100 g is 8.72 g, which comes from the filling. Based on the Regulation of the Minister of Health of the Republic of Indonesia No. 41 of 2014, adults require a protein intake of around 25–30 g per meal. In contrast, not all proteins in food can be fully absorbed by the body. Therefore, it is necessary to increase the protein content of gyoza products. The enhancement of gyoza's protein content should not be limited to the filling but also extend to the wrapper. Purwoko & Ekawatiningsih (2021) previously researched innovative gyoza wrappers using suweg tuber flour. However, the best formulation (168 g wheat flour and 24 g suweg tuber flour) yielded a very low protein content (only 1 g). Thus, using mung bean flour in gyoza wrappers can increase their protein content.

Gyoza is processed through a heating method, necessitating the addition of other antioxidant sources to help inhibit free radical oxidation reactions. One approach is to combine mung bean flour with ingredients rich in antioxidants, such as Pak choy. Pak choy has an antioxidant content of 38.98% (Andriani & Anggraini, 2023; USDA, 2019). Applying mung bean flour in gyoza wrappers is also expected to enhance antioxidant activity. Mung bean flour contains secondary metabolites such as saponins, flavonoids, triterpenoids, and tannins, which are antioxidants (Andriani & Anggraini, 2023).

Research on developing gyoza using mung bean flour and Pak choy puree in the wrapper has not yet been reported. Previous studies have attempted to increase the protein content of gyoza wrappers, such as by using 30% soybean flour (Folorunso & Ayodele, 2018) and cereals like barley (Tamura et al., 2021), which resulted in a gyoza wrapper protein content of 12.7%. Mung bean flour reported in previous studies has been applied in processed products such as mochi (Agustine et al., 2022), nuggets (Utami et al., 2023), and snack bars (Octaviany et al., 2024). Therefore, the study must innovate gyoza wrappers by incorporating mung bean flour and Pak choy puree. This research aims to determine the effect of combining mung bean flour and wheat flour with the addition of Pak choy puree as a high-protein food for chicken gyoza wrappers.

Materials and methods

Materials and equipment

The main ingredients used in this study were mung beans (Gunung Mas), wheat flour (Segitiga Biru), tapioca flour (Cap Pak Tani), Pak choy, chicken meat, and carrots, which were purchased from the Caruban market. Other ingredients included salt, granulated sugar, sesame oil (Saus 58), oyster sauce (Saus 58), water, and cooking oil (Fortune). The chemicals used for analysis included H_2SO_4 , NaOH, HCl, H_3BO_3 , petroleum benzene, DPPH, ethanol, and distilled water. The equipment used in this study included a food processor (chopper), blender (Miyako), 80-mesh sieve, 7.5 cm diameter round mold, form paper, laboratory glassware, analytical balance (Radwag), drying oven (Memmert), distillation set (Iwaki), Soxhlet apparatus (Iwaki), and a UV-VIS spectrophotometer (Memmert).

Research methodology

The research design used a Completely Randomized Design (CRD) method with four treatment formulations, including the wheat flour ratio to mung bean flour. The experiment was repeated 3 times. The formulations used in this study can be seen in Table 1.

Table 1. Formulation of the ratio of mung bean flour and wheat flour usage

Formulation of the sample wheat flour: mung bean flour (g)	Wheat flour (g)	Mung bean flour (g)
F0 (150:0 g)	150	0
F1 (100:50 g)	100	50
F2 (75:75 g)	75	75
F3 (50:100 g)	50	100

The data were analyzed using Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level using SPSS Statistics 26 software.

Research stages

a. Preparation of mung bean flour

The first stage of the research began with the preparation of mung bean flour. 500 g of dried mung beans were ground using a blender for 15 minutes or until smooth and then sifted using an 80-mesh sieve (Lathifah et al., 2022).

b. Preparation of pak choy puree

The second stage is the preparation of Pak choy puree, following the procedure from Arofah and Bahar (2017). The preparation of Pak choy puree begins with 50 g of Pak choy, which is then washed with running water and blanched for 2 minutes at a temperature of approximately 100°C. The blanched Pak choy is drained until its moisture content decreases and blended for 3-5 minutes or until the desired texture is achieved (Purwoko & Ekawatiningsih, 2021).

c. Preparation of gyoza wrappers

The third step is the preparation of gyoza wrappers using mung bean flour and wheat flour according to the predetermined proportions. Tapioca flour, 50 g, is also added to all treatments during the preparation of the gyoza wrappers. Making the gyoza wrapper begins by weighing the flour and all the ingredients used in each formulation, which include 50 g of Pak choy puree, 1 tsp of salt, and 1 tbsp of cooking oil. The ingredients are mixed, and 90 ml of boiling water is added, followed by stirring for 1 minute. The Pak choy puree is mixed until evenly distributed. Once expanded, the dough is molded using a round mold with a diameter of 9 cm (Purwoko & Ekawatiningsih, 2021).

d. Preparation of gyoza filling

The fourth step is the preparation of the gyoza filling using fresh chicken as the main ingredient. The ingredients used in the preparation of the gyoza can be seen in Table 2. Then, all the ingredients are mixed and stirred until evenly combined.

e. Preparation of chicken gyoza

The final stage is the preparation of chicken gyoza by combining the gyoza filling with the wrappers made in stage 3, following the procedure from Purwoko & Ekawatiningsih (2021). The first step is to prepare the gyoza wrappers that have been made and fill them with one teaspoon of chicken filling. The filled gyoza wrapper is then shaped into the typical gyoza form. This process is repeated until all the wrappers and

filling are used. After steaming for 30 minutes, the gyoza can be packaged and stored at a temperature of 10°C-18°C. The chicken gyoza with the wrapper combination according to the treatment is ready for product analysis, which includes sensory testing and chemical analysis, such as moisture content, protein, fat, and antioxidant activity test.

Table 2. Formulation of chicken gyoza with the addition of mung bean flour

Ingredients	Formulation of the sample wheat flour: mung bean flour (g)			
	F0 (150:0 g)	F1 (100:50 g)	F2 (75:75 g)	F3 (50:100 g)
a. Gyoza Wrapper				
Mung bean flour (g)	0	50	75	100
Wheat flour (g)	150	100	75	50
Tapioca flour (g)	50	50	50	50
Pak choy puree	50	50	50	50
Salt (tsp)	1	1	1	1
Seasoning (tsp)	½	½	½	½
Cooking oil (tbsp)	1	1	1	1
Boiling water (ml)	90	90	90	90
b. Gyoza Filling				
Chicken meat (g)	150	150	150	150
Tapioca flour (g)	20	20	20	20
Oyster sauce (tbsp)	1	1	1	1
Sesame oil (tsp)	1	1	1	1
Salt (tsp)	½	½	½	½
Seasoning (tsp)	½	½	½	½
Sugar (l)	1	1	1	1
Carrot (g)	20	20	20	20
Spring onion (g)	5	5	5	5

Research parameters

a. Sensory analysis

The sensory evaluation of the chicken gyoza with the combined wrapper according to the treatment was carried out using the Hedonic Scale Scoring method with 30 panelists. The sensory testing focused on color, aroma, taste, and texture, using a rating sheet with five preference scores: 1 = strongly dislike, 2 = dislike, 3 = neutral, 4 = like, and 5 = strongly like (Hamundu & Herdhiansyah, 2023).

b. Chemical analysis

Chemical analysis consisted of the moisture, protein, and fat content. The moisture content analysis in this study was carried out using the Thermogravimetric method (Utami et al., 2023). The protein content of the chicken gyoza with the wrapper according to the formulation was tested using the Kjeldahl method (Purnama and Pakerti, 2022). Distillation was performed using a micro Kjeldahl distillation set. The fat content analysis in this study was carried out using the Soxhlet method, with petroleum benzene as the fat solvent (Jeacklin et al., 2023). The final result is obtained by weighing until a constant weight is achieved.

c. Antioxidant activity

The determination of antioxidant activity in the chicken gyoza with the wrapper and the addition of mung bean flour can be performed using the DPPH (1,1-diphenyl-2-picrylhydrazyl) method with a UV-Vis spectrophotometer. The principle of the DPPH method is based on an oxidation-reduction reaction (Ayanti et al., 2021). Antioxidant activity can be calculated by determining the inhibition percentage using the following formula :

$$\% \text{ Inhibition} = \frac{A \text{ blank} - A \text{ sample}}{A \text{ blank}} \times 100\%$$

Results and discussion

Sensory test results

The sensory testing conducted on the chicken gyoza with various formulations of the wheat flour and mung bean flour ratio aimed to determine the panelists' preference levels for the parameters: aroma, color, taste, and texture. The sensory test results on the chicken gyoza with the addition of mung bean flour and Pak choy puree can be seen in Table 3 and Figure 1.

Table 3. Sensory test results of chicken gyoza with different ratios of added mung bean flour and wheat flour

Sample formulation wheat flour: mung bean flour (g)	Average			
	Aroma	Color	Taste	Texture
F0 (150:0 g)	2.83±0.913 ^a	2.83±0.648 ^a	3.10±0.662 ^a	3.03±0.765 ^a
F1 (100:50 g)	4.03±0.718 ^c	3.50±0.777 ^b	4.00±0.743 ^b	3.70±0.794 ^b
F2 (75:75 g)	3.50±0.861 ^b	3.50±0.682 ^b	3.40±1.248 ^a	3.33±0.758 ^{ab}
F3 (50:100 g)	3.50±0.861 ^b	3.63±0.809 ^b	3.57±0.971 ^{ab}	3.33±0.994 ^{ab}

Note: Numbers followed by the same lowercase letters in the same column are not significantly different at the 5% level according to the DMRT test, with five preference scores: 1 = strongly dislike, 2 = dislike, 3 = neutral, 4 = like, and 5 = strongly like.

The aroma sensation produced by the olfactory system is one of the test parameters that can determine the accepted aroma if the produced material has a specific aroma (Elyzha et al., 2024). Based on Table 3, the sensory results for the aroma of the four formulations showed different results, which is suspected to be due to the addition of mung bean flour. The content of lauric acid and carboxylic acids in mung beans can be converted into ethyl laurate ester, thus producing the distinctive aroma of mung bean flour (Salsabila et al., 2022). According to the panelists, the sample with 100 g of wheat flour and 50 g of mung bean flour had a more favorable aroma. This result suggests that the less mung bean flour added, the more preferred it was by the panelists. Mung bean flour has a rancid aroma caused by the activity of the lipoxygenase enzyme. The lipoxygenase enzyme hydrolyzes fats into compounds that cause the rancid aroma, which belongs to the group of hexanal seven and hexanol (Yudiono, 2023). Additionally, the rancid aroma is also produced by the presence of antinutritional compounds such as saponins and alkaloids in mung bean flour, which impart a bitter taste and characteristic aroma. Food materials containing these compounds, if not correctly degraded during heating, will still retain their pungent aroma. Saponins are secondary metabolites and belong to the group of triterpenoid or steroid glycosides, consisting of one or more sugar groups attached to an aglycone or sapogenin, capable of forming yellow crystalline and amorphous substances with a pungent smell (Putri et al., 2023).

Color can attract attention because it is visible and gives the first impression, which the panelists evaluate (Lamusu, 2018). Based on Table 3, the sensory results for the color parameter in F0 (150:0) showed a lower preference score compared to F1 (100:50), F2 (75:75), and F3 (50:100). This is because F0 (150:0) is the control sample without the addition of mung bean flour. Samples with mung bean flour tend to produce a yellowish-green color. The control treatment generally produced a yellowish-white color, distinguishing it from the other formulations. In samples F1 (100:50), F2 (75:75), and F3 (50:100), the color of the chicken gyoza was similar. This suggests that adding mung bean flour influenced the product's color, resulting in a yellowish-green hue. According to Krisnawati and Saidi (2022), panelists are more attracted to products with striking colors. In this gyoza product, the more striking color was the yellowish-green produced by mung bean flour. The yellow color comes from carotenoid pigments in the mung bean flour (Ramadhan et al., 2024). The pak choy puree also contributes to the green color. According to Hidayat et al. (2024), green mustard contains chlorophyll, which can produce a green color.

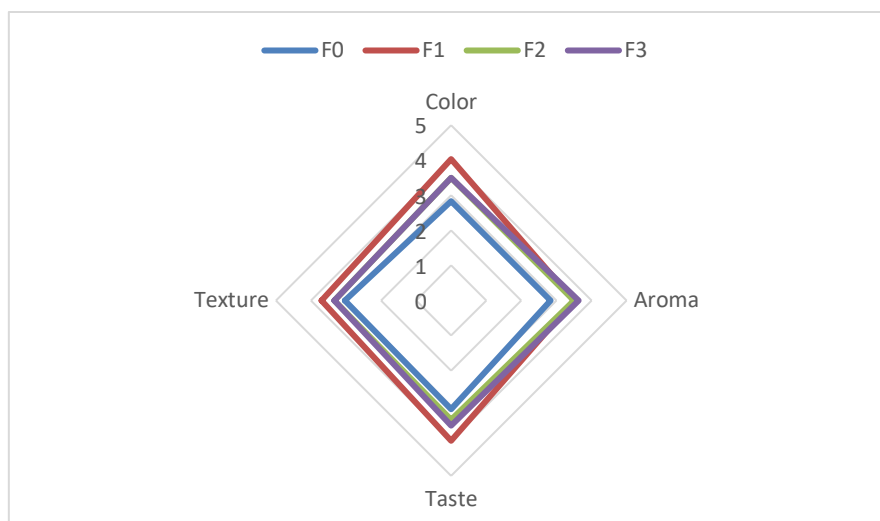


Figure 1. Sensory acceptance graph of chicken gyoza with different ratios of mung bean flour and wheat flour added.

One factor that can determine whether consumers accept a product or not is its taste. Based on Table 3, the sensory results for the taste parameter in sample F0 (150:0) compared to samples F1 (100:50), F2 (75:75), and F3 (50:100) showed a lower preference score. This is suspected because sample F0 did not contain the addition of mung bean flour. Adding mung bean flour is believed to enhance the distinctive flavor of the chicken gyoza, thus affecting the panelists' preference. This result is because mung bean flour can give a savory and slightly off-flavor taste. Mung beans contain amino acids like glutamate, enhancing the savory (umami) flavor and making the product taste more decadent and delicious. In addition, the fat content in mung beans may enhance the product's flavor. Although mung beans are not a significant source of fat, they contain a certain amount of vegetable fats that can provide a softer texture and a richer taste.

Texture is a sensory attribute closely related to touch or tactile perception. It is generally considered as important as taste and aroma because it can affect the image of a food product. Additionally, texture can influence consumer perceptions of the food's quality (Arsyad et al., 2024). Based on the results in Table 3, the sensory evaluation for the texture parameter shows that adding 50 g of mung bean flour improved the texture preference. In contrast, adding a more significant amount (75:100) resulted in a texture preference similar to that of the control (without mung bean flour). Combining mung bean flour and wheat flour in the proper formulation results in a balanced texture. Typically, gyoza skin has a chewy texture, which is influenced by wheat flour as one of the main ingredients. The gluten content in wheat flour helps create elasticity and chewiness in the product. The more wheat flour used, the greater the chewiness of the product (Fadilah et al., 2020). In this study, adding mung bean flour also contributed to the chewy texture of the gyoza skin. This is because mung bean flour contains 33% amylose and 67% amylopectin. A lower amylose content compared to amylopectin can decrease the chewiness of the product (Lathifah et al., 2022).

Chemical test results

The moisture content in the gyoza skin samples ranged from 47.80% to 53.30% (Table 4). According to the moisture content standards of Dimsum (SNI 7756-2020), the moisture content complies with the requirement of a maximum of 60%. Based on the SPSS One-Way ANOVA test using Duncan's Multiple Range Test, the results indicate that the differences influenced the moisture content in the samples in the composition of the two types of flour used. Specifically, sample F1 (100:50), with a higher proportion of wheat flour, had a higher moisture content compared to F2 (75:75) and F3 (50:100), which had higher proportions of mung bean flour. The moisture content is influenced by the gluten content in wheat flour and the fiber content in mung bean flour. Wheat flour contains a significant amount of gluten, which helps

retain moisture, while mung bean flour contains high fiber but little gluten, making it less effective at binding water in the food product. These findings are consistent with Widianlara's (2018) and Damayanti's (2020) studies, where a higher addition of wheat flour increased the moisture content due to its gluten properties. Conversely, the higher the proportion of mung bean flour and the lower the proportion of wheat flour, the lower the moisture content, as Damayanti et al. (2020) demonstrated in their cookies study. Additionally, the interaction between starch and protein also affects water-binding capacity, decreasing moisture content. This reduction in moisture could be further influenced by protein denaturation during the steaming process, which affects the water-binding and emulsifying properties of the proteins, leading to protein coagulation (Lalopua & Onsu, 2021).

Table 4. Results of chemical testing on gyoza skins with different ratios of mung bean flour and wheat flour

The formulation of the sample: wheat flour: green bean flour (g)	Sample	Water Content (%)	Total Protein (%)	Fat Content (%)	Antioxidant Activity (%)
F0 (150:0 g)	F0	50.53±3.44 ^{ab}	10.41±0.11 ^a	1.91±0.71 ^a	3.50±1.99 ^a
F1 (100:50 g)	F1	53.30±0.36 ^b	11.33±0.20 ^b	2.62±0.02 ^{ab}	4.82±1.94 ^{ab}
F2 (75:75 g)	F2	49.23±0.81 ^a	10.25±0.07 ^a	2.98±0.24 ^b	7.20±1.90 ^b
F3 (50:100 g)	F3	47.80±1.27 ^a	11.19±0.24 ^b	3.26±0.60 ^b	13.27±1.54 ^c

Note: Numbers followed by the same lowercase letters in the same column are not significantly different at the 5% level according to the DMRT test.

The protein content in the chicken gyoza skin sample ranges from 10.25% to 11.33% (Table 4). According to the quality standard for dimsum (SNI 7756-2020), the protein content requirement, which is a minimum of 5%, has been met. Based on the One-Way ANOVA results using the Duncan test, the protein content in sample F0 (150:0) compared to samples F1 (100:50) and F3 (75:75) showed a lower protein content. This is because, in sample F0 (150:0), no green bean flour was added, which could have increased the protein content in the product. However, sample F1 (100:50) showed a higher protein content. This result is likely due to the protein content in the ingredients used, such as wheat and green bean flour. According to Ponelo et al. (2022), using green bean flour in French Baguette bread products resulted in a protein content ranging from 9.59% to 14.39%. Therefore, this suggests that the protein content in sample F1 (100:50) is higher compared to F0 (150:0) (without green bean flour addition).

The fat content in the chicken gyoza skin sample ranges from 1.91% to 3.26% (Table 4). According to the quality standard for dimsum (SNI 7756-2020), the fat content requirement has been met, which is a maximum of 12%. Based on the One-Way ANOVA results using the Duncan test, the fat content in sample F0 was found to be lower compared to samples F1 (100:50), F2 (75:75), and F3 (50:100). Sample F0 (150:0), which only used wheat flour and did not contain green bean flour, had the lowest fat content. This is consistent with Cicilia et al. (2021), who reported that wheat flour contains 1.21% fat, indicating that wheat flour has a lower fat content than green bean flour. According to Bait and Ahmad (2022), green bean flour contains 14.3% fat. Samples F2 (75:75) and F3 (50:100) exhibited higher fat content, likely due to the increased proportion of green bean flour, which contributes to the higher fat content. The fat content found in this study is still relatively low, ranging from 1.9% to 3.2%, but it meets the SNI quality standard, which allows a maximum of 12%. According to Kusumawati and Kom (2020), the low-fat content in gyoza can benefit consumers by fulfilling nutritional needs. Foods with low-fat content are suitable for consumption as nutritious and low-calorie meals.

Antioxidant activity

The antioxidant activity in the chicken gyoza skin sample ranges from 3.50% to 13.27% (Table 4). Based on the One-Way ANOVA results using the Duncan test, the antioxidant activity in sample F0 (150:0) was found to be lower compared to samples F1 (100:50), F2 (75:75), and F3 (50:100). Sample F0 (150:0) only

used wheat flour and did not contain green bean flour. Sample F3 (50:100) exhibited higher antioxidant activity, which is likely due to the increased addition of green bean flour, leading to a higher antioxidant value. According to Agustin et al. (2022), adding 30% green bean flour to mochi products resulted in an antioxidant activity of 11.645%. Green bean flour contains secondary metabolites such as saponins, flavonoids, triterpenoids, and tannins, which act as antioxidants (Andriani & Anggraini, 2023). The antioxidant activity in the gyoza skin samples is also supported by the protein content of green beans, which also plays a role as an antioxidant. Protein can inhibit oxidation through several pathways, including reactive oxygen species' inactivation and scavenging free radicals (Zhu et al., 2022). This argument is evident in Table 2, where the protein content in gyoza with green bean flour is higher than that in green bean flour without green bean flour. Additionally, antioxidant activity is also influenced by other ingredients in the gyoza, such as pakcoy. Pakcoy contains an antioxidant level of 29.73% at a concentration of 100 ppm. Therefore, adding pakcoy can affect the product's antioxidant content (Dwikartika et al., 2021).

Conclusion

Based on the research findings on the innovation of utilizing green bean flour (*Vigna radiata*) with the addition of pak choy puree in chicken gyoza skins as a high-protein food, it can be concluded that the addition of green bean flour and pak choy puree affects both the sensory and chemical quality of the gyoza. This research could be a discovery in the diversification of gyoza product processing by utilizing green bean flour to increase its protein nutritional content. The results obtained from the sensory test show that the best formulation is found in the chicken gyoza sample with the addition of 50 grams of green bean flour and 100 grams of wheat flour, with chemical test results indicating moisture content 53.3%; protein content 11.34%; and fat content 2.63%. Furthermore, green bean flour has the potential to be an antioxidant in the chicken gyoza skin, with an antioxidant activity value of 4.83%.

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References

- Kementerian Kesehatan Republik Indonesia. (2014). Peraturan Menteri Kesehatan Republik Indonesia Nomor 41 Tahun 2014 Tentang Pedoman Gizi Seimbang. http://hukor.kemkes.go.id/uploads/produk_hukum/PMK%20No.%2041%20ttg%20Pedoman%20Gizi%20Seimbang.pdf [Diakses Februari 2025].
- [USDA] U.S. Department Of Agriculture. (2019). Cabbage, chinese (pak-choi), raw. Fooddata Central. <https://fdc.nal.usda.gov/>
- Agustin, A. R., Widanti, Y. A., & Karyantina, M. (2022). Physicochemical and sensory characteristics of mochi beet (*Beta vulgaris* L.) with variations in the ratio of mung bean flour (*Vigna radiata* L.) glutinous wheat flour. *JITIPARI (Scientific Journal of Food Technology and Industry UNISRI)*, 7(1), 40-48. <http://ejurnal.unisri.ac.id/index.php/jtpr/index>
- Andriani, S., & Anggraini, D. I. (2023). Anticholesterol activity test of variation of pakcoy mustard mustard ethanol extract (*Brassica chinensis*) in vitro. *Journal of Pharmacy Science and Application*, 10(1), 44-50. DOI: 10.33508/jfst.v10i1.4574
- Arsyad, M., Inayah, A. N., & Lasande, A. (2024). Organoleptic test of cracker product quality on the effect of adding tofu pulp flour. *JASATHP: Journal of Agricultural Product Science and Technology*, 35-46. <https://doi.org/10.55678/jasathp.v4i1.1478>.
- Aryanti, R., Perdana, F., & Syamsudin, R. A. M. R. (2021). Telaah metode pengujian aktivitas antioksidan pada teh hijau (*Camellia sinensis* (L.) Kuntze): study of antioxidant activity testing methods of green tea

- (*Camellia sinensis* (L.) Kuntze). *Jurnal Surya Medika (JSM)*, 7(1), 15-24. <https://doi.org/10.33084/jsm.v7i1.2024>.
- Baetillah, D. N., Fitria, M., Fauziyah, R. N., Dewi, M., & Gumilar, M. (2022). Dimsum ikan bandeng dan tepung kacang hijau sebagai makanan selingan tinggi protein dan zat besi bagi remaja putri. *Jurnal Gizi Dan Dietetik*, 1(2), 94-102. <https://doi.org/10.34011/jgd.v1i2.1244>
- Bait, Y., & Ahmad, L. (2022). Effect of annealling modified green bean flour addition on the physical, chemical and organoleptic characteristics of french baquette bread. *Jambura Journal of Food Technology*, 4(2), 185-197. <https://doi.org/10.37905/jjft.v4i2.15663>.
- Cicilia, S., Basuki, E., Alamsyah, A., Yasa, I. W. S., Dwikasari, L. G., & Suari, R. (2021). The characteristics of cookies from wheat flour and jackfruit seed flour are modified enzymatically. *Journal of Agritechology and Food Processing*, 1(1), 1-15. <https://doi.org/10.31764/jafp.v1i1.5960>.
- Damayanti, S., V. P. Bintoro & Setiani. B.E. (2020). Pengaruh penambahan tepung komposit terigu, bekatul dan kacang merah terhadap sifat fisik cookies. *Journal of Nutrition College*, 9(3), 181-186. <https://doi.org/10.14710/jnc.v9i3.27046>.
- Dwikartika, I., Aji, N. P., & Elly, M. (2021). Phytochemical screening of pakcoy leaf ethanol extract (*Brassica rapa* subsp. *chinensis*) and antioxidant test using the DPPH (Doctoral dissertation, Stikes Al-Fatah Bengkulu) method. <http://eprints.stikesalfatah.ac.id/id/eprint/99>
- Fadilah, R., Sari, R., & Sukainah, A. (2020). Effect of substitution of lindur mangrove fruit flour (*Bruguiera gymnorrhiza*) on the quality of wet noodles. *Journal of Agricultural Technology Education*, 6 (1), 75-88.
- Folorunso, A., & Ayodele, M. (2018). Nutritional and sensory evaluation of dumpling (Amala) produced from plantain-soy flour blends. *Annals: Food Science & Technology*, 19(3).
- Hamundu, A., & Herdhiansyah, D. (2023). Community preferences for sago cracker agroindustry through an organoleptic test approach. *Journal of Halal Agroindustry*, 9(2), 196-205. <https://doi.org/10.30997/jah.v9i2.6065>
- Hidayat, M. R., Romadhoni, I. F., Purwidiani, N., & Widagdo, A. K. (2024). Kremes noodle innovation with the use of mustard greens and kersen leaves. *Badge: Journal of Educational Science Innovation*, 2(4), 210-224. <https://doi.org/10.55606/lencana.v2i4.4058>
- Kusumawati, S., & Kom, S. (2020). *Nutrition for brain intelligence*. Alprin.
- Lalopua, V. M., & Onsu, A. (2021). Chemical and organoleptic characteristics of kamaboko surimi tuna swallow. *AGRITEKNO: Journal of Agricultural Technology*, 10(2), 74-82. <https://doi.org/10.30598/jagritekno.2021.10.2.74>.
- Lathifah, I. P. C., Sutiadiningsih, A., Suwardiah, D. K., & Pangesthi, L. T. (2022). Effect of mung bean flour substitution on the organoleptic properties of pudak cake. *Journal of Culinary Arts*, 11(2), 99-109. <https://ejournal.unesa.ac.id/index.php/jurnal-tata-boga/article/view/47972>.
- Octaviany, V. Melia, L. Sulandari, I. F. Romadhoni & Nugrahani Astuti. Inovasi snack bar dengan proporsi tepung ubi kayu (*manihot esculenta*) dan tepung kacang hijau (*Vigna Radiata*). *Lencana: Jurnal Inovasi Ilmu Pendidikan*, 2(4), 327-354. <https://doi.org/10.55606/lencana.v2i4.4084>
- Pakerti, A.L. & Purnama, R.C. 2022. Analisis kadar protein pada tepung jagung (*Zea mays* L.) yang dibeli dengan merek I di daerah Pasar Semuli Jaya Lampung Utara dengan menggunakan metode Kjeldahl. *Jurnal Analis Farmasi*, 7(2), 119-129. <https://ejournalmalahayati.ac.id/index.php/analisfarmasi/article/view/8186/pdf>.
- Ponelo, S.S., Bait, Y., & Ahmad, L. (2022). Pengaruh penambahan tepung kacang hijau termodifikasi annealling terhadap karakteristik fisik, kimia dan organoleptik roti french baquette. *Jambura Journal of Food Technology (JJFT)*, 4(2), 185-197. DOI: <https://doi.org/10.37905/jjft.v4i2.15663>
- Purwoko, R. A. & Ekawatiningsih, P. (2021). Inovasi produk gyoza tepung umbi suweg sebagai pemanfaatan sumber pangan lokal. *Prosiding Pendidikan Teknik Boga Busana*, 16(1), 1–10. <https://ojs.um-palembang.ac.id/index.php/JGSA/article/download/461/180/3048>.

- Putri, P.A., M. Chatri¹, Advinda & Violita, L. (2023). Karakteristik saponin senyawa metabolit sekunder pada tumbuhan. *Serambi Biologi*, 8(2), 251-258. <https://doi.org/10.24036/srmb.v8i2.207>.
- Qamahadlina, A., Zuhrotun, N. A. Utami. (2023). Proximate, dietary fibre and organoleptic analysis of mung beans yoghurt. *The International Journal Of Science & Technoledge*, 11(10), 35-29. <https://doi.org/10.24940/theijst/2023/v11/i10/ST2310-013>.
- Ramadhan, T.W., Sulandari, N.L., Astuti & Huda.I (2024). Proporsi gluten dan tepung kacang hijau (vigna radiata l) pada pembuatan daging tiruan (meat analog) ditinjau dari sifat organoleptik. *Student Research Journal*, 2(4), 249-261. DOI: <https://doi.org/10.55606/srjyappi.v2i4.1392>
- Salsabila, N., Prayitno, S.A., & Novri.D. (2022). Penentuan mutu produk tortila substitusi tepung kacang hijau menggunakan uji Kruskal Wallis. *JUSTI (Jurnal Sistem Dan Teknik Industri)*, 3(4), 546-553. DOI: [10.30587/justicb.v3i4.6189](https://doi.org/10.30587/justicb.v3i4.6189).
- Septiani, A., Wening, D. K., & Ratnasari, D. (2024). The level of preference and nutritional value of black potato flour biscuits (*Coleus tuberosus*). *Scientific Journal of Health Nutrition (JIGK)*, 6(1), 49-55. <https://doi.org/10.46772/jigk.v6i01.1610>.
- Tamura, M., Osawa, H., Saito, T., & Kou, S. (2021). Binders for barley dumplings— effect on physicochemical properties and palatability. *Engineering in Agriculture, Environment and Food*, 14(1), 21-29. https://doi.org/10.37221/eaef.14.1_21
- Utami, S., Astuti, S., Herdiana, N., & Sartika, D. (2023). Formulation of mung bean flour and tapioca flour on the sensory properties of swanggi fish nuggets (*Priacanthus tayenus*). *Journal of Sustainable Agroindustry*, 2 (2), 284-297. <http://dx.doi.org/10.23960/jab.v2i2.8030>.
- Widiantara, T., Hervelly & Afiah, D.N. (2018). Pengaruh perbandingan gula merah dengan sukrosa dan perbandingan tepung jagung, ubi jalar dengan kacang hijau terhadap karakteristik jenang. *Pasundan Food Technology Journal*, 5(1), 1-9. DOI: <https://doi.org/10.23969/pftj.v5i1.803>.
- Wijaya, H., & Dirpan.A. (2021). Organoleptic product study of gyoza products with natural dyes extracted from purple sweet potatoes. In *Iop Conference Series: Earth And Environmental Science*, 870(1).
- Yudiono, K. 2023. Aktivitas antioksidan, total polifenol, total flavonoid, dan sifat sensoris inovasi tempe kedelai dengan substitusi tepung daun kelor. *Agrointek*, 17(4), 746- 754. <https://journal.trunojoyo.ac.id/agrointek/article/view/17146/pdf>
- Zhu, Y., Lao, F., Pan, X. & Wu, J. (2022). Food protein-derived antioxidant peptides: molecular mechanism, stability and bioavailability. *Biomolecules*, 12, 1-27. <https://doi.org/10.3390/biom12111622>