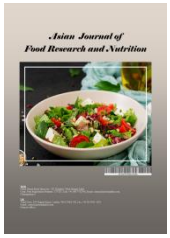

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Formula of Mustard (*Brassica juncea* L) Stick Fortified Mung Bean (*Vigna radiata*) Flour

Al Muthiah [a++], A. Ita Juwita [b], Muhammad Fitri [b] and Arham Rusli [a*]

[a] Food Security Applied Masters Study Program, Pangkep State Polytechnic of Agriculture, Indonesia.
[b] Agroindustry Study Program, Department of Agricultural Technology, Pangkep State Polytechnic of Agriculture, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The use of mung bean flour in making snacks has been shown to increase the nutritional content and functional properties of the product, especially protein, minerals and dietary fiber. This study aims to determine the best formulation for making mustard sticks fortified with mung bean flour. The study was carried out using the Completely Randomized Design (CRD) method with 3 (three) treatments. Each treatment was repeated 3 (three) times. The treatment applied was the proportion of the use of wheat flour and mung bean flour, i.e.: 3:1 (F1), 1:1 (F2). and 1:3 (F3). Each treatment was compared with the control (F0). Observations were made on the organoleptic properties and chemical composition including moisture content, protein content and ash content. The organoleptic properties were analysed statistically using SPSS software. The chemical composition were analysed descriptively to compare the chemical composition of the best formulation with the formulation without the addition of mung bean flour (control). The results showed that the

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[++] *Students;*
**Corresponding author: E-mail: arhamrusli@polipangkep.ac.id;*

fortification of mung bean flour in the manufacture of mustard sticks can be made with the proportion between wheat flour and mung bean which is 3:1. This indicates that the use of mung bean flour in the manufacture of sticks can reduce the use of wheat flour by 25%. In addition, fortification of mung bean flour in the manufacture of mustard sticks can increase the nutritional content of mustard sticks, especially protein and ash.

Keywords: Chemical composition; functional properties; fortification; organoleptic; snack.

1. INTRODUCTION

Mustard (*Brassica juncea* L) is a horticultural commodity that has a short shelf life because it has a high moisture content. Mustard greens are a source of vitamins and minerals needed by the body. Mustard greens contain vitamin C, the phytochemicals lutein and zeaxanthin, and are a source of flavonoids, especially quercetin. Besides being processed into vegetable dishes, mustard greens can be processed into various types of food including snacks, crackers and noodles [1,2,3].

Mustard stick is a snack that uses mustard greens as an additional ingredient to form a green color [4]. In addition to the formation of a green color, the use of mustard greens in making sticks can increase the mineral content, vitamins, antioxidants and anticancer. Mustard greens are a source of green pigment, minerals and vitamins. The green color of mustard greens is due to its high chlorophyll content. Chlorophyll can act as a natural cleanser (promoting detoxification), antioxidant and anticancer [5].

Increasing the nutritional value of mustard sticks can be done by enriching the ingredients used in their manufacture. One of the ingredients added to the manufacture of mustard sticks is mung bean flour. Mung bean flour has a high protein content, so the addition of mung bean flour in the formulation for making mustard sticks can improve the functional properties of mustard sticks. Mung bean flour has a protein content of 22.75% and fat 1.05% [6].

The use of mung bean flour in making snacks has been carried out on snack bars and cookies. The results of research using mung bean flour in the manufacture of snack bars and cookies have been shown to increase the nutritional content and functional properties of products, especially protein, minerals and dietary fiber [7,8]. This study aims to determine the best formulation for making mustard sticks fortified with mung bean flour.

2. MATERIALS AND METHODS

2.1 Materials

The tools used in making the sticks are knives, steamed pans, blenders, frying pans, scales, measuring cups, and pasta machines. The tools used in chemical testing are erlenmeyer, desicator, porcelain cup, Kjeldahl flask, distillation flask, oven, tanur, pipette, test tube, mortar and stamper. Materials used in making the mustard sticks are mustard paste. mung bean flour, wheat flour, tapioca flour, butter, eggs, seasoning and salt. The materials used in chemical analysis are K_2SO_4, H_2SO_4 98%, NaOH 40%, H_3BO_3 1%, HCl 0.1 M.

2.2 Research Methods

The method used in this study is an experimental method using a completely randomized design (CRD) with three treatments. Each treatment was repeated three times. The treatment applied was the ratio of the use of wheat flour and mung bean flour, namely: 3:1 (F1), 1:1 (F2), and 1:3 (F3). Each treatment was compared with the control (F0).

The basic formulation for making mustard sticks refers to the procedure carried out by the Research Institute for Agricultural Technology [9] with modifications to the use of wheat flour and mung bean flour. namely; 46.3% wheat flour, 15.27% tapioca flour, 12.31% mustard paste, 12.31% butter, 12.31% eggs, 0.74% flavoring and 0.74% salt. Formulations for each treatment are presented in Table 1.

Observations were made on mustard sticks including organoleptic tests, moisture content, ash content, and protein content. Organoleptic testing was carried out on the parameters of texture, color, aroma and taste using a scoresheet by 25 untrained panelists [10]. The criteria for assessing organoleptic properties are presented in Table 2.

Table 1. Mustard stick formulation fortified with mung bean flour

Ingredients (%)	Treatment			
	F0	F1	F2	F3
Wheat flour	46.3	34.73	23.15	11.57
Mung bean flour	0	11.57	23.15	34.73
Tapioca flour	15.27	15.27	15.27	15.27
Mustard paste	12.31	12.31	12.31	12.31
Butter	12.31	12.31	12.31	12.31
Eggs	12.31	12.31	12.31	12.31
Flavoring	0.74	0.74	0.74	0.74
Salt	0,74	0,74	0,74	0,74

Table 2. Criteria for assessing the organoleptic properties of mustard sticks fortified with mung bean flour

Score	Assessment criteria			
	Texture	Color	Aroma	Flavour
5	Very crunchy	Greenish yellow	Typical mung beans are very strong	Very tasty
4	Crunchy	Yellow	Typical mung beans are strong	Tasty
3	Slightly crunchy	Slightly brown	Typical medium mung beans	Slightly tasty
2	Not crunchy	Chocolate	Typical mung beans less	Not tasty
1	Not very crunchy	Very chocolate	Typical mung beans are very lacking	Not very tasty

The chemical content tests included moisture content analysis using the AOAC gravimetric method, ash content analysis using the AOAC gravimetric method, and protein content analysis using the N-Total determination method using the Kjeldahl AOAC method [11].

2.3 Data Analysis

Organoleptic test results data were tested statistically using analysis of variance and continued with Duncan's multiple distance difference test for parameters that had a significant effect. Statistical data analysis using SPSS software. The results of the chemical composition test were tested descriptively to compare the chemical composition of the best formulation with the formulation without the addition of mung bean flour (control).

3. RESULTS AND DISCUSSION

3.1 Organoleptic Properties

Organoleptic properties are important parameters in determining whether or not a food product can be developed or produced commercially. This is because the level of consumer or market acceptance is highly dependent on the organoleptic properties of the product. true to color, aroma and taste. While the texture parameters are not significantly affected by the treatment applied. The average panelist assessment of the organoleptic properties of mustard sticks fortified with mung bean flour is presented in Table 3.

The results showed that the addition of mung bean flour in the manufacture of mustard sticks did not affect the texture of the mustard sticks, where the average panelist assessment was in the range of 3.80 – 4.00, which means that the mustard sticks texture was categorized as crunchy. Texture is an important property in food products [12]. The texture characteristic of mustard sticks desired by consumers is crunchy and not easily broken or crushed. The fracture strength of a stick can be influenced by the percentage of moisture content, binder material and the characteristics of the raw materials used [13]. The higher the moisture content, the lower the fracture strength produced because the stick texture will be softer or mushy. The texture of mustard sticks is also influenced by the amylose content of mung bean flour, where the higher the proportion of addition of mung bean flour, the less crunchy the mustard sticks are. The addition of mung bean flour into the formulation can increase the amylose content of the resulting snack bars. The amylose content of mung bean flour is 28.8%. The higher the amylose content,

the stronger the bonds between molecules, because amylose forms a hard texture [14].

The data in Table 3 showed that the higher the comparison of the use of mung bean flour, the panelist's assessment of color tends to decrease where the color assessment is the same as the control is a proportion of 3:1. The results of this study indicate that the more proportion of mung bean flour is used, the resulting mustard sticks will be dark in color and tend to be disliked by consumers, this is because the chlorophyll pigment in mustard greens and mung beans affects the color of the sticks.

The fortification of mung bean flour in the manufacture of mustard sticks affects the aroma of the mustard sticks produced, where the addition of mung bean flour to the formulation of mustard sticks will give the desired mung bean aroma. The results showed that the addition of mung bean flour formed a distinctive aroma of mung bean on mustard sticks with a medium category for all treatments. Aroma is one of the determining variables on the organoleptic properties of foodstuffs, because in general the level of consumer preference for food products is largely determined by aroma.

The results showed that the fortification of mung bean flour in the manufacture of mustard sticks had a significant effect on the flavour of the mustard sticks produced. The data in Table 3 showed that the higher the ratio of the addition of mung bean flour to the formulation for making mustard sticks, the higher the tasty flavour of the mustard sticks produced, this is because the addition of mung bean flour will increase the specific amino acid and fatty acids content of the mustard sticks have an impact on tasty flavour formation. Bristhi et al. [15] have reported that mung bean protein isolate has a high content of Glutamic and Aspartic amino acids, namely 203.28 mg/mg of protein and 97.99 mg/mg of protein, respectively. Where the two amino acids are forming umami taste in food products. The magnitude of umami taste is synergistically enhanced when umami amino acids such as acidic L-amino acids (e.g., Glu, aspartate) and umami nucleotides such as 5′-purinemononucleotides (e.g., 5′-inosinate, 5′-guanylate) are mixed [16].

Based on the organoleptic properties of mustard sticks fortified with mung bean flour as a whole, the best formulation is the ratio of wheat flour and mung bean flour 3:1 (F1). This is supported by the results of organoleptic testing, where the F1 treatment has the same texture and color as the control treatment (F0), and has a better aroma and taste value than the control. The mustard sticks with the best formulation were then tested for their chemical composition and compared with the mustard sticks without the addition of mung bean flour.

3.2 Chemical Composition

The chemical composition of food ingredients is one of the considerations of consumers in choosing food ingredients to meet nutritional needs and benefits for body health. The results of testing the chemical composition of mustard sticks fortified with mung bean flour are presented in Table 4.

Table 3. The results of the assessment of the organoleptic properties of mustard sticks fortified with mung bean flour

Treatment	Texture	Color	Aroma	Flavour
F_0	4.00^a	4.60^b	2.10^a	2.20^a
F_1	3.97^a	4.60^b	3.23^c	3.51^b
F_2	3.93^a	2.77^a	3.10^b	4.10^c
F_3	3.80^a	2.43^a	3.27^c	4.50^d

The same superscript letters in the same column indicate that the treatment is not significantly different at the 95% confidence level

Table 4. Chemical composition of mustard sticks fortified with mung bean flour

Chemical Parameter	No mung bean flour (Control)	Fortified with mung bean flour (1:3)
Moisture (%)	3.47	3.82
Protein (%)	6.65	7.11
Ash(%)	2.11	3.51

The results showed that the addition of mung bean flour tended to increase the moisture, protein, and ash content. The protein, carbohydrate, fat, fibre and ash contents of mungbean are 22.9%, 61.8%, 1.2%, 4.4% and 3.5%, respectively [17]. Unlike most other legumes, consumption of mungbean results in little flatulence because of the easy digestibility of the protein and carbohydrate [18]. The water content of mustard sticks with the best formulation still meets the standard criteria for the moisture content of snacks, where based on SNI 01-2886-2015 it is stated that the good water content in snacks is a maximum of 4% [19].

Fortification of mung bean flour in the manufacture of mustard sticks is proven to increase the protein content of the mustard sticks. This is because mung bean flour has a protein content of 23.25% [20] which is higher than 8% wheat flour [21]. Protein content (specific of amino acids) is the most important nutrient that attracts consume mustard sticks. Due to their high protein content and digestibility, consumption of mung bean seeds in combination with cereals has been recommended to significantly increase the quality of protein intake as part of a vegetarian diet [22].

Likewise, the ash content of mustard sticks fortified with mung bean flour tends to increase. This shows that the addition of mung bean flour can increase the mineral content (macro minerals) and dietary fiber in mustard sticks which are beneficial for the health of the body. A high level of dietary fiber in food can be beneficial in providing large amounts of food to relieve constipation and maintain the health of the digestive tract [23].

4. CONCLUSION

Fortification of mung bean flour in the manufacture of mustard sticks can be done with a ratio between wheat flour and mung bean which is 3:1. This shows that the use of mung bean flour in making sticks can reduce the use of wheat flour by 25%. In addition, fortification of mung bean flour in the manufacture of mustard sticks can increase the nutritional content of mustard sticks, especially protein and ash.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Rathod MS, Hathan BS. Utilization of mustard leaves (*Brassica juncea*) powder for the development of cereal based extruded snacks. Int J Medical and Health Sci. 2015;9(8):880-884.
2. Irawan Y, Wulandari YW, Karyantina M. Vegetable chips with varying concentration of mustard green (*Brassica rapa*) porridge and wheat-tapioca flour ratio. J Food Tech and Indust. 2017;2(1):1-7. Indonesia.
3. Alifah S, Nurfida A, Hermawan A. Processing of mustard greens into green noodles which have high economic value in Sukamanis Village, Kadudampit District, Sukabumi Regency. J Empow Comm. 2019;1(2):52-58. Indonesia.
4. Susanto S. Pigment and Vitamin Stability in Green Mustard Ice Cream (*Brassica rapa chinensis*) for 4 Weeks of Storage. Essay. Food Technology Study Program. Faculty of Agricultural Technology. University of Katolik Soegijapranata. Semarang; 2014. Indonesia.
5. Kurniawan M, Izzati M, Nurchayati Y. Content of chlorophyll, carotenoids and vitamin C in some aquatic plant species. Bull Ana and Phy. 2010;18(1):28-40. Indonesia.
6. Lestari E, Kiptiah M, Apifah. Characterization of mung bean flour and optimization of the addition of mung bean flour as a substitute for wheat flour in making cakes. J Agro-Indust Tech. 2017: 4(1):20-34. Indonesia.
7. Yusufu MI, Obiegbuna JE, Obiegbuna JE. Studies on the utilization of green bean as raw material in cookies produced from wheat flour. Agri Sci Res J. 2015;5(6):92-97.
8. Gustiani DI, Fauziyah RN, Rosmana D, Nurjanah NF. Snack bar redmung mung bean and red bean flour as snack with isoflavon and fiber sources. Health Res J of Health Polytechnic Bandung. 2020; 12(1):180-189. Indonesia.
9. Research Institute for Agricultural Technology. Recipe Book. Research Institute for Agricultural Technology, Malang; 2020. Indonesia.
10. Nurainy, Nawansih O. Sensory Test. Textbooks. Bandar Lampung: Lampung University; 2006. Indonesia.
11. AOAC. Official Methods of Analysis. 18th Edition, Association of Official Analytical Chemists, Gaithersburg; 2007.

12. Okfrianti Y, Kamsiah, Hartati Y. Effect of addition of wheat cartilage of broiler levels of calcium and organoleptic properties cheese stick. J Indonesia Anim Sci. 2011: 6(1):11-18. Indonesia
13. Jauhariah D, Ayustaningwarno F. Low phosphore and protein snack bar based on rice processed products. J Nutri Coll. 2013; 2(2):250-261. Indonesia.
14. Sunyoto M, Andoyo R, Masitoh E. Characteristics of high protein snack bar made of modified sweet potato flour. Int J on Adv Sci Eng and Infor Tech. 2019;9(2): 422-427.
Available:https://doi.org/10.18517/ijaseit.9.2.7296.
15. Brishti FH, Zarei M, Muhammad SKS, Ismail-Fitry MR, Shukri R, Saari N. Evaluation of the functional properties of mung bean protein isolate fordevelopment of textured vegetable protein. Int Food Res J. 2017;24(4):1595-1605.
16. Kawai M, Sekine-Hayakawa Y, Okiyama A, Ninomiya Y. Gustatory sensation of l- and d-aminmo acids in humans. Amino Acids. 2012;43:2349–2358.
17. Offia OBI, Madubuike UB. The dehulling efficiency and physicochemical properties of pre-conditioned mung bean (*Vigna radiata* [L]. Wilczek) seeds and flour. African J Food Sci and Tech. 2014;6:1–11.
Available:https://doi.org/10.14303/ajfst.2014.104.
18. Nair RM, Yang R, Easdown WJ, Thavarajah D, Thavarajah P, d'A Hughes J, Keatinge JDH. Biofortification of mung bean (*Vigna radiata*) as a whole food to enhance human health. J Sci Food and Agric. 2013;93:1805-1813.
Available:https://doi.org/10.1002/jsfa.611.
19. National Standardization Agency. Extrudate Snacks (SNI 01-2886-2015). Jakarta: National Standardization Agency; 2015. Indonesia.
20. Ekafitri R, Isworo R. Utilization of Nuts as Raw Material for Protein Sources for Emergency Food. Faculty of Agriculture. Surakarta: Sebelas Maret University; 2014. Indonesia.
21. Sunarsi S, Sugeng MA, Wahyuni S, Ratnaningsih W. Using cassava into mocaf flour for empowerment of Sumberejo. Proceedings of the Seminar on Research Results and Community Service, Sukoharjo: University of Veteran Bangun Nusantara. 2011;306-310. Indonesia.
22. Tang D, Dong Y, Ren H, Li L, He C, et al. A review of phytochemistry, metabolite changes, and medicinal uses of the common food mung bean and its sprouts (*Vigna radiata*). Chem Central J. 2014;8: 4.
Available:https://doi.org/10.1186/1752-153x-8-4.
23. Ratnawati L, Desnilasari D, Surahman DN, Kumalasari R. Evaluation of physicochemical, functional and pasting properties of soybean, mung bean and red kidney bean flour as ingredient in biscuit. IOP Conf. Series: Earth and Environmental Science. IOP Publishing, 2019; 251(012026):1-9.
Available:https://doi.org/10.1088/1755-1315/251/1/012026

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