Asian Journal of Food Research and Nutrition

Volume 3, Issue 3, Page 656-666, 2024; Article no.AJFRN.119841

The Effect of Adding Chayote Purée on the Preference Level of Mackerel Dumpling with Mocaf Flour

Firda Nuraisyah [a++*], Rusky Intan Pratama [a#], Fittrie Meyllianawaty Pratiwy [a#] and Evi Liviawaty [a#]

[a] *Faculty of Fisheries and Marine Science, Padjadjaran University Jatinangor Campus, Raya Bandung Sumedang km. 21 Street, Jatinangor, West Java 45363, Indonesia.*

Authors' contributions

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

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/119841

Original Research Article

Received: 13/05/2024
Accepted: 14/07/2024
Published: 16/07/2024

ABSTRACT

Mocaf flour has the characteristics of viscosity degree, gelation ability, rehydration power, and solubility better than tapioca flour but does not have gluten to form chewiness. Pectin content in chayote can function as a chewing agent in dumpling products. The purpose of this study was to determine the appropriate substitution level of chayote purée in mackerel dumpling using mocaf flour. The research was conducted experimentally with the treatment of using 25% mocaf flour and adding chayote purée to mackerel dumpling at 0%, 15%, 25%, and 35%. Organoleptic tests on appearance, aroma, texture, and taste were analyzed by Friedman test, Chi-square, and Bayes method. The control and most preferred treatments were then tested for chemical contents of

[++] *Student at Fisheries;*
[#] *Lecturer at Fisheries;*
**Corresponding author: E-mail: firda19003@mail.unpad.ac.id;*

Cite as: *Nuraisyah, Firda, Rusky Intan Pratama, Fittrie Meyllianawaty Pratiwy, and Evi Liviawaty. 2024. "The Effect of Adding Chayote Purée on the Preference Level of Mackerel Dumpling With Mocaf Flour". Asian Journal of Food Research and Nutrition 3 (3):656-66. https://www.journalajfrn.com/index.php/AJFRN/article/view/162.*

protein, fat, water, ash, crude fiber, and carbohydrates. The chemical test results were analyzed descriptively. The results showed that mackerel dumpling with 25% mocaf flour and 25% chayote purée addition was preferred by panelists with a median score of appearance 7 (liked), aroma 9 (very liked), texture 8 (liked), and taste 8 (liked). The results of proximate analysis showed protein levels of 13.93%, fat 3.87%, water 58.47%, ash 2.21%, crude fiber 1.48%, and carbohydrates 20.04%.

Keywords: Chayote; dumpling; mocaf; preference level.

1. INTRODUCTION

Mackerel is an economically important fish in Indonesia and even the world because it has a high protein content and is good for growth [1]. A few marine fish species such as mackerel contain high omega-3 fatty acids up to 10.9 g/100 g [2]. Mackerel is a fish with a high nutritional content compared to other fish [3]. The protein nutrition contained in mackerel is quite high at 21.4 g/100 g [4]. Mackerel is usually used in making dumpling because it has a sharp aroma, savory taste, tight texture, slightly chewy [5], and is sticky [6].

Dumpling is a typical food product from China which is one type of dim sum [7]. During its development, dumpling was in great demand by the Indonesian people and was easily found in hawker centers, and many people also made dumpling as an alternative side dish [8]. Dumpling is starting to be recognized by the Indonesian people who are mostly Muslim, so the contents of dumpling are replaced with mackerel, shrimp, crab, or chicken meat mixed with tapioca flour, then wrapped in wonton skin [9]. Tapioca flour functions as a filler so that it can keep dumpling sturdy [10].

Excessive consumption of tapioca starch can cause blood sugar disease or diabetes. In addition, many people avoid consuming high carbohydrate ingredients for dietary reasons [11]. The disadvantages of starch in tapioca are that it takes a long time to cook (higher energy), the paste that is formed tends to be hard and not clear, is too sticky, and is not resistant to acid treatment [12].

Mocaf is a cassava flour product that is processed using the principle of cassava cell modification by fermentation dominated by lactic acid bacteria (LAB) microbes [13]. Mocaf flour as a local food alternative acts as a filler that contains high starch, which is 85-87% [14]. Mocaf flour has better characteristics of viscosity degree (adhesion), gelation ability, rehydration power, and solubility compared to ordinary cassava flour or tapioca [15]. Mocaf is rich in fiber with a prebiotic effect that helps the growth of probiotics in the stomach making it suitable for diabetics. Mocaf is also free of gluten, which is good for people with autism and does not cause allergies due to consuming gluten [16]. The gluten substance that causes chewiness is not found in mocaf, so it cannot be used 100% in wet products so as not to reduce product quality [17]. Dumpling can be chewy by using the right type of flour and chayote [18].

Chayote is known as a vegetable that is easy to obtain and has a lot of nutritional content [19]. Chayote has a good fiber content of 4.5% and a high water content of 83%. Consumption of fiber in sufficient quantities is very good for the digestive system [20]. Chayote is used as an additional ingredient in making dumpling because it contains pectin content, which is a high value functional food [8]. Chayote contains 6.57% pectin [21]. Pectin is useful as gel formation or chewiness of a product [22]. Chayote is added to dumpling to make it more tender and not hard even though it is cold [23], and remains chewy when bitten [18].

2. METHODOLOGY

2.1 Time and Place

This research conducted from February to April 2024 at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University for the making of mackerel dumpling and organoleptic test. Chemical test were conducted at the Food Technology Laboratory, Faculty of Engineering, Pasundan University.

2.2 Materials and Tools

The main ingredient used was mackerel (*Scomberomorus commersonii*) as much as 2 kg from Sehat Cileunyi Market. Other ingredients used were chayote (*Sechium edule*) from Sehat Cileunyi Market, Mocafine brand of mocaf flour from Rumah Mocaf Indonesia online store, Gunung Agung brand of tapioca flour, ice, egg white, salt, sugar, onion, garlic, pepper, wonton skin, vegetable oil, and water. The tools used in this research are knife, cutting board, digital scale, food processor, blender, spoon, steamer pan, stove, digital thermometer, timer, stainless tray, label sticker, and melamine plate.

2.3 Methods

The method used in this research is experimental. Mackerel dumpling was made with tapioca flour substituted with mocaf flour at 25%. Chayote purée was used to substitute mackerel fish at 0%, 15%, 25% and 35%. Mackerel dumpling was served to a taste panel consisting of 20 panelists.

2.4 Procedures

The procedure for making mackerel dumpling was based on the research of [8] with modifications. Mackerel was cleaned from the bone, tail, head and washed with water until clean. Mackerel was filleted lengthwise on the back using a knife. Mackerel meat, ice, salt, and sugar were put into a food processor to pulverized for 1 minute. Tapioca flour (75%), mocaf flour (25%), chayote purée (0%, 15%, 25%, 35%), as well as egg white and other spices were put into a food processor to be pulverized for 5 minutes or until the mixture was well mixed. The dough was weighed evenly (±15 g) and molded using a spoon to be placed into the wonton skin. Dumpling samples were steamed in a steamer pan at 90-100°C for 30 minutes or until cooked and has reached a chewy and dense texture. The pan was greased with vegetable oil beforehand to prevent the dumpling from sticking. Cooked dumpling were carefully removed, and arranged on a stainless tray. The dumplings were left on the tray for sometime to get cool.

2.5 Parameters

2.5.1 Hedonic test

Hedonic test is a sensory analysis test that determines the extent of quality differences between several similar products by assessing characteristics and determining the level of product preference [24]. The hedonic test includes several specifications such as appearance, aroma, texture, and taste. The hedonic test used scale consisted of 9 (very liked), 7 (liked), 5 (neutral/normal), 3 (disliked), and 1 (very disliked) [25].

2.5.2 Chemical test

Proximate analysis of the control sample and the most preferred sample by taste panelists was done. Protein content was analysed by Kjeldhal method, soxhlet apparatus was used to analyse for oil. Moisture, ash and crude fiber content were analysed using gravimetric method, while carbohydrate content was calculated by difference [26].

2.6 Data Analysis

Organoleptic test (hedonic test) data was analyzed using Friedman's non-parametric two-way analysis of variance, Chi-square and Bayes method for making best decision. Chemical test results (protein, fat, water, ash, crude fiber, and carbohydrates content) were analyzed descriptively.

3. RESULTS AND DISCUSSION

3.1 Hedonic Test

3.1.1 Appearance

The results of the appearance of mackerel dumpling with mocaf flour and the addition of chayote purée are presented in Table 1.

Table 1. The results of the appearance of mackerel dumpling

Treatments	Median	Average ± SD
A (0%)	7	$6,4 \pm 1,96^a$
B (15%)	7	$7,4 \pm 1,39^a$
C (25%)	7	$7,6 \pm 1,47^a$
D (35%)	7	$7,6 \pm 1,47^a$

Description: Mean values of appearance followed by the same letter indicate not significantly different according to multiple comparison test at 5% level

Fig. 1. Appearance of mackerel dumpling with mocaf flour and the addition of 0%, 15%, 25%, and 35% chayote purée

Table 2. The results of aroma of mackerel dumpling

Treatments	Median	Average ± SD
A (0%)	7	6,1 ± 2,10^{a}
B (15%)	7	6,8 ± 1,28^{a}
C (25%)	**9**	**7,9 ± 1,37^{b}**
D (35%)	7	6,8 ± 2,04^{a}

Description: Mean values of aroma followed by the same letter indicate not significantly different according to multiple comparison test at 5% level

The 0% treatment shows that mackerel dumpling has a yellowish color because there is no addition of chayote purée. The 15% treatment shows mackerel dumpling with a slightly yellowish color. The 25% and 35% treatments with the highest average value showed mackerel dumpling with a yellowish white color. According to [8], the addition of chayote purée to mackerel dumpling does not significantly affect the color because mackerel meat and chayote do not have a sharp color, which is white, and chayote does not have color pigments. The appearance of mackerel dumpling with mocaf flour and the addition of 0%, 15%, 25%, and 35% chayote purée are presented in Fig. 1.

The yellowish color of mackerel dumpling is caused by the Maillard reaction between reducing sugar and protein in the heating process, resulting in a more yellowish dumpling [27]. The white color of mackerel dumpling can also be caused by the use of mocaf flour. According to [28], the bright white color of mocaf flour is caused by the absence of the Maillard reaction between protein and glucose during the cassava fermentation process so that brown melanoid substances are not formed intensively.

3.1.2 Aroma

The results of the aroma of mackerel dumpling with mocaf flour and the addition of chayote purée are presented in Table 2.

The 0% treatment produced dumpling with a mackerel aroma that was too strong because there was no addition of chayote purée so that the ingredients used were less balanced and less favored by panelists. The 25% treatment produced dumpling with a distinctive aroma of mackerel like dumpling in general so that it was liked by the panelists. The 35% treatment produced dumpling with a weak mackerel aroma due to the higher addition of chayote purée.

Panelists disliked dumpling with a strong mackerel aroma. According to [29], preferred foods are those that have a normal aroma or do not cause a dominant aroma between the ingredients used. According to [30], the aroma of an ingredient is acceptable if it has a certain distinctive aroma. The higher the addition of chayote purée, the distinctive aroma of mackerel in dumpling will decrease. According to [31], chayote has a fresh and mild herbaceous aroma in sweet and savory dishes.

The distinctive aroma of cassava that tends to be disliked by consumers can be eliminated in the fermentation process of making mocaf flour so that a distinctive aroma of starch hydrolysis results [32,33]. The aroma of mackerel dumpling is also influenced by the spices used. According to [34], garlic has essential oil content that creates a volatile aroma with a fragrant sensation and can also provide a savory taste to food.

3.1.3 Texture

The results of the texture of mackerel dumpling with mocaf flour and the addition of chayote purée are presented in Table 3.

Table 3. Average texture of mackerel dumpling

Treatments	Median	Average ± SD
A (0%)	5	4,5 ± 1,43[a]
B (15%)	7	6,4 ± 1,73[ab]
C (25%)	8	**7,8 ± 1,36[b]**
D (35%)	8	7,5 ± 1,82[b]

Description: Mean values of texture followed by the same letter indicate not significantly different according to multiple comparison test at 5% level

Table 4. The results of taste of mackerel dumpling

Treatments	Median	Average ± SD
A (0%)	5	5,0 ± 1,72[a]
B (15%)	7	6,2 ± 1,77[ab]
C (25%)	7	**7,7 ± 1,17[b]**
D (35%)	7	7,5 ± 1,57[b]

Description: Mean values of taste followed by the same letter indicate not significantly different according to multiple comparison test at 5% level

The 0% treatment produced mackerel dumpling with a slightly dry and lumpy texture because there was no addition of chayote purée so that the ingredients used were less balanced and less favored by panelists. The 25% treatment produced mackerel dumpling with a chewy texture like dumpling in general so that it was liked by the panelists. The 35% treatment produced mackerel dumpling with a slightly juicy or watery texture due to the higher addition of chayote purée.

Panelists dislike mackerel dumpling that have a dry texture. According to [35], foods with low water content will make the texture of the food hard, while foods with high water content will make the texture of the food soft and tend to be watery. According to [36], dumpling is a steamed processed product and is classified as a product that requires compact, non-soft, not juicy or hard gel formation criteria. The higher the addition of chayote purée, the more juicy or watery the texture of the mackerel dumpling will be. According to [37], chayote flesh has a texture like a cross between potato and cucumber. According to [38], chayote has a high water content of around 90%, a soft and tender texture. According to [8], chayote contains 6.7% pectin content. According to [39], pectin is a dietary fiber that is classified as water-soluble fiber and is able to bind large amounts of water so that it can form a gel or thick liquid.

The addition of tapioca flour and mocaf flour increases panelists preference for the texture characteristics of dumpling because mocaf flour stabilizes the chewiness of tapioca flour [40]. Food products with added mocaf flour form a chewier texture [41]. The principle of making mocaf flour causes changes in flour characteristics, namely increasing viscosity, gelation ability, rehydration power, and solubility so that mocaf flour has a better texture than tapioca flour and wheat flour [42].

3.1.4 Taste

The results of the taste of mackerel dumpling with mocaf flour and the addition of chayote purée are presented in Table 4.

The 0% treatment produced dumpling with a mackerel taste that was too strong because there was no addition of chayote purée so that the ingredients used were less balanced and less preferred by panelists. The 25% treatment produced dumpling with a savory mackerel taste, tending to be salty and slightly sweet like dumpling in general so that it was liked by the panelists. The 35% treatment produced dumpling with a weak mackerel taste due to the higher addition of chayote purée.

Panelists disliked dumpling with a strong mackerel taste. According to [29], panelists tend to like a balanced taste, meaning that food products are not dominated by one ingredient with other ingredients. According to [43], a good processed fish product is a product that still has the taste of the fish used. The higher the addition of chayote purée, the less the distinctive taste of mackerel in dumpling. According to [44], chayote that is boiled, baked, or sautéed as a vegetable has a taste similar to cooked cucumber and zucchini, [45] and tends to be sweet if the chayote is cultivated.

Taste is influenced by several factors such as cooking methods, the addition of salt and seasonings, and starch sources that contain different chemical contents that create a distinctive taste [46]. Mixing tapioca flour and mocaf flour does not really affect the taste of dumpling [40]. Acidic contents in mocaf flour when processed will produce a distinctive aroma and taste that can cover the aroma and taste of cassava up to 70% [47]. The use of spices, especially garlic, can affect the taste produced because it contains bioactive components such as alicin [36].

3.2 Decision Making with Bayes Method

The results of the weight criteria in determining the preferred treatment by considering the criteria of appearance, aroma, texture, and taste of mackerel dumpling are presented in Table 5.

Based on the results of the calculation, the highest weight of the criteria is the taste parameter of 0.54, which means that the taste parameter is the most important assessment or as the main consideration according to the panelists in choosing mackerel dumpling products with mocaf flour and the addition of chayote.

Based on the results of calculations using the Bayes method, it was found that mackerel dumpling with the use of 25% mocaf flour and the addition of 25% chayote purée had the highest alternative value of 7.43, which means that it was most preferred by panelists compared to other treatments.

3.3 Chemical Test

The results of the chemical test observations of mackerel dumpling on protein, fat, water, ash, crude fiber, and carbohydrates content are presented in Table 6.

3.3.1 Protein content

Based on the chemical test results, the protein content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 13.81% which increases with the addition of 25% chayote purée to 13.93%. The protein content of mackerel dumpling increased because it was influenced by the addition of chayote purée which has protein content of 0.82% [48].

The high protein content is influenced by the ingredients used, especially the raw material, namely mackerel. According to [4], the protein content produced by mackerel fish is quite high at 21.4 g/100 g. [49] stated that the use of high protein raw materials will produce high protein processed products, and vice versa. The use of fillers also plays a role in the protein content of mackerel dumpling.

Table 5. Assessment decision matrix with bayes method

Treatments	**Criteria**				**Alternative Value**
	Appearance	**Aroma**	**Texture**	**Taste**	
A (0%)	7	7	5	5	5.69
B (15%)	7	7	7	7	7.00
C (25%)	7	**9**	8	7	**7.43**
D (35%)	7	7	8	7	7.12
Weight Criteria	0.19	0.16	0.12	**0.54**	

Table 6. Chemical test results of mackerel dumpling

Chemical Composition	**Chemical Test Results (%)**	
	A (0%)	**C (25%)**
Protein	13.81	13.93
Fat	3.77	3.87
Water	58.00	58.47
Ash	2.10	2.21
Crude fiber	1.42	1.48
Carbohydrates	20.90	20.04

3.3.2 Fat content

Based on the chemical test results, the fat content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 3.77% which increases with the addition of 25% chayote purée to 3.87%. The fat content of mackerel dumpling increased because it was influenced by the addition of chayote purée which has fat content. According to [48], the fat content of chayote is 0.13%.

Fat content is influenced by the ingredients and processing used in making mackerel dumpling. According to [33], the fat content of mackerel fish ranges from 0.2% to 5% [50]. Stated that the steaming process can also affect fat and protein levels in fish meat because steaming can reduce mineral, fat and protein levels. The observed increase in the fat content of mackerel dumpling is due to the fat content in moaf flour (0.3 grams) and tapioca flour (0.5 grams) [40].

3.3.3 Water content

Based on the chemical test results, the water content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 58.00% which increases with the addition of 25% chayote purée to 58.47%. The water content of mackerel dumpling increased because it was influenced by the addition of chayote purée which has a high water content. According to [20], the water content of chayote is 83%. According to [51], chayote contains high fiber which is a factor in water binding power, the higher the fiber content of a material, the higher the water binding power because fiber has water binding power. According to [52], high moisture content can lead to deterioration by microorganisms and cause chemical reactions.

Water content is also influenced by the high water content in mackerel raw materials. According to [3], the water content in mackerel is 75.35%. According to [53], the water content of fish dumpling is influenced by protein and starch gelatinization due to the steaming process with hot temperatures causing the granules to break down so that the granule molecules expand and absorb water. According to [40], the type of starch that makes up mocaf flour and tapioca flour determines the moisture content of the dumpling sample. Mocaf flour has an amylose content of around 19% while tapioca is around 17% and mocaf flour has an amylopectin content of around 81% while tapioca flour is around 83%.

3.3.4 Ash content

Based on the chemical test results, the ash content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 2.10% which increases with the addition of 25% chayote purée to 2.21%. The ash content of mackerel dumpling increased because it was influenced by the addition of chayote purée which has ash content of 0.2% [54,55] stated that the higher the ash content, the higher the mineral content in a food ingredient. According to [56], macro minerals found in chayote are calcium, magnesium, phosphorus, potassium, and sodium. Micro minerals found in chayote are iron, zinc, manganese, and selenium.

Ash content is influenced by the ingredients used in making mackerel dumpling. According to [3], the ash content of mackerel is 0.95%. [57] stated that mackerel has a fairly high content of sodium, potassium, phosphorus, magnesium, and zinc, and lower amounts of other minerals. The use of fillers also plays a role in the ash content of mackerel dumpling. The ash content of mocaf flour in [58] is 1.5% and tapioca flour in [59] is 0.6%.

3.3.5 Crude fiber content

Based on the chemical test results, the crude fiber content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 1.42% which increases with the addition of 25% chayote purée to 1.48%. The crude fiber content of mackerel dumpling increased because it was influenced by the addition of chayote purée which has a high fiber content. According to [20], the fiber content of chayote is 1.7%. According to [60], chayote has a pectin content of 6.75% which is one of the fiber components in plant cell walls and functions as a stabilizing agent in jelly, jam, and juice products. According to [61], chayote contains 1.7 g/100 g of pectin, which is higher than carrots 0.9 g/100 g, broccoli 0.5 g/100 g, and tomatoes 1.2 g/100 g.

Crude fiber content is also influenced by the fillers used in making mackerel dumpling. According to [32], mocaf flour has a fiber content of 2.39 g/100 g higher than cassava flour and tapioca flour. The crude fiber content of tapioca in [59] is 0.4%.

3.3.6 Carbohydrate content

Based on the chemical test results, the carbohydrate content of mackerel dumpling with mocaf flour and the addition of 0% chayote purée is 20.90% which decreases with the addition of 25% chayote purée to 20.04%. Carbohydrate levels are influenced by the ingredients used in making mackerel dumpling. This is in accordance with [62] statement, that the decrease in carbohydrates is believed to be caused by the use of the proximate analysis method [63]. States that if the average nutritional content of protein, fat, water, and ash increases, the carbohydrate content decreases, on the contrary, if the content of protein, fat, water, and ash decreases, the carbohydrate content increases.

Carbohydrate content decreased due to the higher stabilizer used which is [64], which in this study were pectin in chayote purée. The carbohydrate content of chayote is 4.51% [48]. The carbohydrate content of mackerel is 0.61% [54]. The carbohydrate content of tapioca flour is 86.9% [65], and the carbohydrate content of mocaf flour is 82.13% [66].

4. CONCLUSION

Based on the results of the study, it can be concluded that all treatments of adding chayote purée to mackerel dumpling with the use of mocaf flour by 25% are still preferred by panelists, but the treatment of adding chayote purée by 25% is a treatment that is more preferred than other treatments with a median level of preference for the characteristics of appearance 7 (liked), aroma 9 (very liked), texture 8 (liked), and taste 8 (liked). The results of proximate analysis showed protein levels of 13.93%, fat 3.87%, water 58.47%, ash 2.21%, crude fiber 1.48%, and carbohydrates 20.04%.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENTS

The author expresses deep gratitude to Rusky Intan Pratama, STP., M.Si., Fittrie M. Pratiwy, S.Pi., M.Sc., MIL., Ph.D., and Ir. Evi Liviawaty, MP. who have helped and guided in this research so that it can provide benefits to all parties.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ananda SH, Taharuddin. Pelatihan pembuatan pempek. Karya Kesehatan Journal of Community Engagement. 2020;1(1):13-15.
2. Halifudin. Karakteristik proksimat dan kandungan senyawa kimia daging putih dan daging merah ikan tongkol (*Euthynnus affinis*). Jurnal Kelautan. 2011;1: 1-10.
3. Purwaningsih S. Kandungan gizi dan mutu ikan tenggiri (*Scomberomorus commersonii*) selama transportasi. Prosiding Seminar Nasional Perikanan Indonesia. 2010;387-393.
4. Departemen Kesehatan Republik Indonesia. Pedoman umum gizi seimbang (panduan untuk petugas). Jakarta: Direktorat Bina Gizi Masyarakat; 2008.
5. Muthohar, Setyanova I. Membuat aneka produk olahan ikan. Jakarta: Penebar Swadaya; 2004.
6. Latifah L. Cara membuat siomay yang kenyal dan empuk, beserta 3 resep siomay yang mudah dibuat. Tribun Lifestyle. 2020;25:9. Accessed 12 April 2023.
   Available:https://m.tribunnews.com/lifestyle/2020/09/25/cara-membuat-siomay-yang-kenyal-dan-empuk-beserta-3-resep-siomay-yang-mudah-dibuat?page=all.
7. Alamsyah Y. Bisnis siomay dan pangsit (membuat, mengemas, & memasarkan). Jakarta: Agro Media Pustaka; 2007.
8. Nessianti A. Pengaruh penambahan puree labu siam (*Sechium edule*) terhadap sifat organoleptik siomay ikan tenggiri (*Scomberomorus commersoni*). E-Journal Boga. 2015;4(3): 79-84.
9. Gardjito M, Harmayani E, Santoso U. Makanan tradisional Indonesia. Makanan tradisional yang populer: menu sepiring langkap dan makanan berbasis buah-buahan. Yogyakarta: Gadjah Mada University Press; 2019.
10. Ramadhani WP, Verawati B, Rizqi ER. Formulasi ikan patin dan tepung daun kelor tinggi protein dan zat besi pada siomay sebagai pangan jajanan untuk

anak sekolah dasar (6-12 tahun). SEHAT: Jurnal Kesehatan Terpadu. 2023;2(2): 39-58.
11. Wardhani ML, Indrawati V. Pengaruh proporsi tepung maizena dan puree rumput laut terhadap kualitas produk siomay ikan gabus (*Opiocephalus striatus*). E-Journal Boga. 2016;5(1):148-157.
12. Katz EE, Labuza TP. Effect of water activity on the sensory crispness and mechanical deformation of snack food products. Journal of Food Science. 1981;46(2): 403-409.
13. Diniyah N, Subagio A, Sari RN, Vindy PG, Rofiah AA. Pengaruh lama fermentasi dan jenis singkong terhadap kadar air dan rendemen pati dari modified cassava flour (mocaf). Indonesian Journal of Pharmaceutical Science and Technology. 2018;5(2): 71-75.
14. Ariyani N. Formulasi tepung campuran siap pakai berbahan dasar tapioka-mocal dengan penambahan maltodekstrin serta aplikasinya sebagai tepung pelapis keripik bayam. Thesis. Purwokerto: Jenderal Soedirman University; 2010.
15. Salim E. Megolah singkong menjadi tepung mocaf (bisnis produk alternatif pengganti terigu). Yogyakarta: Lily Publisher; 2011.
16. Normasari RY. Kajian penggunaan tepung mocaf (modified cassava flour) sebagai substitusi terigu yang difortifikasi dengan tepung kacang hijau dan prediksi umur simpan cookies. Thesis. Surakarta: Sebelas Maret Univeristy; 2010.
17. Sasongko H. Ekspor tepung olahan semanis madu. Warta Ekspor. 2016;1-20.
18. Mentari AE. Resep siomay ayam udang, lembut dan empuk pakai labu siam. Kompas.com. 2022;12:6. Accessed 22 November 2023.
Available:
https://www.kompas.com/food/read/2022/06/12/110700675/resep-siomay-ayam-udang-lembut-dan-empuk-pakai-labu-siam
19. Wiadnya IB, Zaetun S, Lina WL. Efektivitas pemberian filtrat labu siam (*Sechium edule*) terhadap penurunan kadar kolestrol total pada darah hewan coba tikus (*Rattus noruegius*) strain wistar. Jurnal Media Bina Ilmiah. 2014;8(1): 50-51.
20. United States Department of Agriculture. Nutrient values and weights are for edible portion of chayote. United States: National Database for Standard Reference Declease; 2013.
21. Daryono ED. Ekstraksi pektin dari labu siam. Jurnal Teknik Kimia. 2012;7(1).
22. Hanum T. Ekstraksi dan stabilitas zat pewarna dari katul beras ketan hitam (*Oryza sativa glutinosa*). Buletin Teknologi dan Industri Pangan. 2000;11(1).
23. Indriani E. Siomay ala si abang. Just Try & Taste. 2012. Accessed 20 February 2023;8:10. Available: http://www.justtryandtaste.com/2012/10/siomay-ala-si-abang.html.
24. Tarwendah IP. Studi komparasi atribut sensoris dan kesadaran merek produk pangan. Jurnal Pangan dan Agroindustri. 2017;5(2): 66-73.
25. Soekarto ST. Penilaian organoleptik untuk industri pangan dan hasil pertanian. Jakarta: Bharata Karya Aksara; 1985.
26. AOAC. Official methods of analysis of the association of official analytical chemists. Virginia: Association of Official Analytical Chemists; 2005.
27. Candra, Puspitasari F, Rahmawati H. Proksimat dan organoleptik siomay ikan lele (*Clarias batrachus*) dengan perbandingan tepung dan daging. Prosiding Seminar Nasional Lingkungan Lahan Basah. 2020;5(2): 63-66.
28. Yani AV, Akbar M. Pembuatan tepung mocaf (modified cassava flour) dengan berbagai varietas ubi kayu dan lama fermentasi. Edible: Jurnal Penelitian Ilmu-Ilmu Teknologi Pangan. 2018;7(1): 40-48. Indonesian.
29. Azizah A. Tingkat kerapuhan dan daya terima biskuit yang disubstitusi tepung daun kelor (*Moringa oleifera*). Thesis. Surakarta: Muhammadiyah University of Surakarta; 2015.
30. Koswara S. Teknologi modifikasi pati. E book pangan. Semarang: University of Muhammadiyah Semarang; 2006.
31. Weber S. Chayote brings a fresh, lightly herbaceous aroma to both sweet and savory dishes. Feast Magazine. 2021;20:9. Accessed 23 April 2024
Available:https://www.feastmagazine.com/recipes/chayote-brings-a-fresh-lightly-herbaceous-aroma-to-both-sweet-and-savory-dishes/article_ab788fd8-1745-11e8-aedd-bf64f548fddd.html#:~:text=Chayote%20brings%20a%20fresh%2C%20lightly,both%20sweet%20and%20savory%20dishes
32. Dasir, Suyatno, Agustin S, Robi A. Karakteristik fisik, kimia dan organoleptik pempek dengan subtitusi tepung mocaf

(modified cassava flour). Jurnal Dinamika Penelitian Industri. 2022;33(1): 37-49.
33. Zulfahmi AN, Swastawati F, Romadhon. Pemanfaatan daging ikan tenggiri (*Scomberomorus commersoni*) dengan konsentrasi yang berbeda pada pembuatan kerupuk ikan. Jurnal Pengolahan dan Bioteknologi Hasil Perikanan. 2014;3(4): 133-139.
34. Srihari E, Lingganingrum FS, Damaiyanti D, Fanggih N. Ekstrak bawang putih bubuk dengan menggunakan proses spray drying. Jurnal Teknik Kimia. 2017;9(2):62-68.
35. Sudarmadji. Penentuan dasar-dasar kimia. Jakarta: Lepdikbud; 2005.
36. Astutik DM, Sulmartiwi L, Saputra E, Pujiastuti DY. The effect addition of kappa carrageenan flour to the level of gel strength and acceptability of dumpling from threadfin bream fish (*Nemipterus nematophorus*) surimi. IOP. Conf. Series: Earth and Environmental Science. 2020;441(1):1-9.
37. Baquiran PB. Chayote production guide. Cagayan: Department of Agriculture, Regional Field Office No. 02; 2012.
38. Rahman A. Pengaruh suhu penggorengan hampa (vacuum frying) terhadap karakteristik keripik labu siam (*Sechium edule*). Thesis. Padang: Andalas University; 2018.
39. Rauf R. Kimia pangan. Yogyakarta: Penerbit ANDI; 2015.
40. Mushthofa Z, Sunardi SA. Perbandingan tepung mocaf dan tepung tapioka dalam pembuatan siomai dengan penambahan tepung jamur tiram (*Pleurotus ostreatus*) sebagai sumber protein. Agrotechnology, Agribusiness, Forestry, and Technology: Jurnal Mahasiswa Instiper. 2023;1(2): 1147-1168.
41. Bayhaqi A, Bahar A. Pengaruh substitusi tepung mocaf (modified cassava flour) dan penambahan puree wortel (*Daucus carota* L.) terhadap hasil jadi pizza. Jurnal Tata Boga. 2016;5(1): 1-7.
42. Rahman MH, Ariani RP, Masdarini L. Substitusi penggunaan tepung mocaf (modified cassva flour) pada butter cookies kelapa. Jurnal Kuliner. 2021;1(2): 89-97.
43. Aswandi S. Fortifikasi tepung wortel terhadap tingkat kesukaan otak-otak ikan gabus. Thesis (In press). Jatinangor: Padjadjaran University; 2020.
44. Britannica. Chayote. Encyclopedia Britannica. 2024;22:5. Accessed 24 April 2024.
Available: https://www.britannica.com/plant/chayote
45. Wijaya SL. Analisis efisiensi distribusi labu siam di Kabupaten Semarang. Thesis. Semarang: Diponegoro University; 2019.
46. Naruki S. Kimia dan teknologi pengolahan daging. Yogyakarta: Universitas Gadjah Mada; 1991.
47. Subagio A, Windrati WS, Wintono Y, Fahmi F. Produksi operasi standar (POS): produksi mocal berbasis klaster. Jember: Jember Univeresity; 2008.
48. United States Department of Agriculture. National nutrient database for standard reference legacy release, basic report: 11149, chayote, fruit, raw. United States: Nutrient Data Laboratory; 2018.
49. Hasniar, Rais M, Fadilah R. Analisis kandungan gizi dan uji organoleptik pada bakso tempe dengan penambahan daun kelor (*Moringa oleifera*). Jurnal Pendidikan Teknologi Pertanian. 2019;5: 189-200.
50. Ana WI, Rastina, Iskandar CD, Isa M, Daud R, Hanifah M. Kadar lemak ikan kakap putih (*Lates calcarifer*) segar dan kukus. Jurnal Ilmiah Mahasiswa Veteriner (JIMVET). 2022;6(3):83-88.
51. Nugraheni D, Ambarsari I, Setiani C. Kajian mutu dodol wortel. Prosiding Semiloka Nasional Dukungan Agro-Inovasi untuk Pemberdayaan Petani. 2011;908-914.
52. Bell, LN. Moisture effects on food’s chemical stability. Water activity in foods: Fundamentals and applications. Oxford, UK: Blackwell Publishing; 2007.
53. Duha AA. Pengaruh perbandingan ikan kembung (*Rastrelliger kanagurta*) dan puree wortel (*Daucus carota* L.) terhadap karakteristik sensori siomay ikan kembung. Thesis. Bandar Lampung: University of Lampung; 2023.
54. Balai Bimbingan dan Pengujian Mutu Hasil Perikanan. Teknologi pengolahan surimi dan produk fish jelly. Jakarta: Balai Pengujian dan Pengawasan Mutu Hasil Perikanan (BPPMHP); 2005.
55. Puspitasari F, Adawyah R. Pengaruh substitusi labu kuning (*Curcubita moshcata*) terhadap kualitas bakso ikan nila (*Oreochromis niloticus*). Fish Scientiae. 2017;7(2):151-158.

56. Kurniawan Y, Johan VS, Hamzah F. Pemanfaatan labu siam dan kelopak rosella dalam pembuatan selai. Jurnal Online Mahasiswa Universitas Riau. 2018;5(2):1-5.
57. Musaiger AO, D'Souza R. The effects of different methods of cooking on proximate, mineral and heavy metal composition of fish and shrimps consumed in the arabian gulf. Arch Latinoam Nutr. 2008;58(1):103-9.
58. Badan Standardisasi Nasional. Standar Nasional Indonesia (SNI). Tepung mokaf (SNI 7622: 2011). Jakarta: Badan Standardisasi Nasional; 2011.
59. Badan Standardisasi Nasional. Standar Nasional Indonesia (SNI). Tapioka (SNI 3451: 2011). Jakarta: Badan Standardisasi Nasional; 2011.
60. Ningsih IT. Analisis fisikokimia dan sensoris selai labu siam (*Sechium edule* Sw) dengan substitusi pemanis stevia (*Stevia rebaudiana* Bertoni) dan berbagai jenis stabilizer. Thesis. Purwokerto: Muhammadiyah University of Purwokerto; 2021.
61. Elisabeth DA. Labu siam, jadi cantik karena kaya manfaat kesehatan. Buletin Teknologi dan Informasi Pertanian. 2008;19.
62. Hilman N. Studi kadar air hasil pengeringan terhadap mutu ikan teri kering yang dihasilkan. Thesis (In press). Padang: Andalas University; 2008.
63. Jayanti AE. Pemanfaatan flavor kepala udang windu (*Penaeus monodon*) berkalsium dari cangkang rajungan (*Portunus* Sp.). Thesis. Bogor: IPB University; 2009.
64. Sugito S, Hayati A. Penambahan daging ikan gabus (*Ophicepallus strianus* BLKR) dan aplikasi pembekuan pada pembuatan pempek gluten. Jurnal Ilmu-Ilmu Pertanian Indonesia. 2006;5(2):147-151.
65. Gumilar J, Rachmawan O, Nurdyanti W. Kualitas fisikokimia naget ayam yang menggunakan filer tepung suweg (*Amorphophallus campanulatus* B1). Jurnal Ilmu Ternak Universitas Padjadjaran. 2011;11(1): 1-5.
66. Aprilia NP, Yusa NM, Pratiwi ID. Perbandingan modified cassava flour (mocaf) dengan tepung kacang hijau (*Vigna radiata* L) terhadap karakteristik sponge cake. Jurnal Ilmu dan Teknologi Pangan. 2019;8(2): 171-180.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/119841