e-ISSN 2581-0405
Asian Journal of Applied Research for Community Development and Empowerment
Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Nutritional and Sensory Characteristics of Catfish and Oyster Mushrooms Meatballs

Jamilatun Nuro[1], Dedin Finatsiyatull Rosida[1,2], Anugerah Dany Priyanto[1,2]*

[1]*Department of Food Technology, Faculty of Engineering and Science, Universitas Pembangunan Nasional Veteran Jawa Timur, Indonesia. 60294*
[2]*Innovation Center of Appropriate Food Technology for Lowland and Coastal Area, Universitas Pembangunan Nasional Veteran Jawa Timur, Indonesia.*

ARTICLE INFO

Article History:
Received: 12 April 2025
Final Revision: 29 May 2025
Accepted: 29 May 2025
Online Publication: 31 May 2025

KEYWORDS

Fish Meatballs, Catfish, Oyster Mushroom, Carrageenan

CORRESPONDING AUTHOR

*E-mail: dedin.tp@upnjatim.ac.id

A B S T R A C T

Catfish is a type of aquaculture product that can be used to make meatballs. Catfish meat is white and has a savory taste. It is also nutritious. Using oyster mushrooms to make meatballs can increase their hardness because they contain pectin, which forms a colloidal dispersion in hot water and a chewy gel when cooled. Carrageenan is a gelling agent that increases the tenderness of catfish meatballs. This study aims to determine the effect of the Proportion of catfish and oyster mushrooms on the nutritional value of catfish meatballs. The research employed a completely randomized design (CRD) factorial pattern, with factor I representing the proportion of catfish and oyster mushrooms (90:10, 80:20, and 70:30) and factor II representing the percentage of carrageenan added (1%, 2%, and 3%). The results of the study indicate that the optimal treatment involves a proportion of 80% catfish and 20% oyster mushrooms, along with the addition of 3% carrageenan, yielding a moisture content of 68.54%, ash content of 1.33%, protein content of 14.79%, fat content of 4.36%, carbohydrate content of 10.98%, and sensory value with appearance 8.08 (very like), aroma 7.96 (like), texture 7.79 (like), taste 8.04 (very like).

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 12: Responsible Consumption and Production
SDG 14: Life Below Water

1. INTRODUCTION

1.1. Research Background

Meatballs are a popular processed meat product with a good taste and chewy texture. They are usually made from beef or chicken. Beef contains saturated fatty acids. Saturated fat increases cholesterol. Beef meatballs contain 74 mg/100 g of cholesterol, while chicken meatballs contain 82 mg/100 g [1]. Consuming foods high in cholesterol can harm health; if cholesterol levels in the body are excessive, they can trigger diseases such as hypertension, heart disease, and stroke [2].

Fish meatballs are a fishery diversification product with high economic value and better nutritional content than beef and chicken meatballs. Catfish (Pangasius sp.) is one aquaculture product that can be used to make meatballs. Catfish contains nutrients that are beneficial to the body, including protein and omega-3 fatty acids. Catfish have a relatively high unsaturated fat content, at a ratio of 75:25 [3]. According to [4], the chemical composition of catfish is as follows: protein 16.08%, fat 5.75%, carbohydrates 1.5%, ash 0.97%, and water 75.7%.

Oyster mushrooms were chosen as raw materials fortifying in making meatballs because oyster mushrooms have many benefits, including oyster mushrooms also have properties as gelling, binders, and stabilizers. Substitution of oyster mushrooms in the production of meatballs can increase the hardness of meatball products because they contain pectin. mushroom glutamic acid content of 17.7g/100g protein gives a savory taste and enhances umami flavor. In addition, the high fiber content in oyster mushrooms of 11.5%/100g [5] can be used as a source of dietary fiber.

Chewing agents are usually added to improve the texture of meatballs. Carrageenan can be used to reduce chewy ingredients derived from synthetic materials [6]. Using carrageenan can improve the chewiness of meatballs by helping to form a gel and binding well with protein and water. This gives the meatballs the strength to withstand external pressure, resulting in a compact and chewy texture [8]. Further research is needed on the nutritional and sensory characteristics of oyster mushroom catfish meatballs containing carrageenan.

1.2. Research Objective

The objectives of this study were to determine the effect of the proportion of catfish and oyster mushrooms with the addition of carrageenan on the nutritional and sensory of meatballs and to determine the best combination of treatments from the Proportion of catfish and oyster mushrooms with the addition of carrageenan to produce fish meatballs with good characteristics and consumers like.

2. MATERIALS AND METHODS

2.1. Materials and Tools

The raw materials used in this study were catfish and oyster mushrooms obtained from the Sidoarjo Larangan Market. Additional ingredients include carrageenan brand "KRI-02", sago flour brand "Hunkwe Bakso Cap Kancil," egg white, garlic, shallots, salt, pepper, and ice cubes. Chemicals used in this study include distilled water, hexane solvent, K2SO4, HgO brand "Merck," H_2SO_4 brand "Merck," NaOH brand 'Merck', HCL, H_3BO_3 brand "Merck," phosphate buffer, and filter paper.

The tools used in the meatball-making process are basin, spoon, knife, chopper, and pot. Tools used in the analysis include cup, oven, desiccator, electric stove, furnace, digital scales, filter paper, soxhlet extraction apparatus, condenser, fat flask, measuring cup, distillation apparatus, kjeldahl flask, test tube, and Erlenmeyer.

2.2 Methodology

This research used a completely randomized design (CRD) factorial pattern with two factors and two replications. Factor I is the Proportion of catfish meat and oyster mushroom consisting of 90:10, 80:20, 70:30. Factor II is the concentration of carragenan 1%, 2%, 3%. If there is a significant difference, it will be continued with the DMRT 5% further test. The samples in this study from treating the proportion of catfish and oyster mushrooms with the addition of carrageenan obtained 9 samples from the combination of the two treatments.

Description:

A1B1 = Proportion of catfish meat 90: oyster mushroom 10 with the addition of carrageenan 1%
A1B2 = Proportion of catfish meat 90: oyster mushroom 10 with the addition of carrageenan 2%
A1B3 = Proportion of catfish meat 90: oyster mushroom 10 with the addition of carrageenan 3%
A2B1 = Proportion of catfish meat 80: oyster mushroom 20 with the addition of carrageenan 1%
A2B2 = Proportion of catfish meat 80: oyster mushroom 20 with the addition of carrageenan 2%
A2B3 = Proportion of catfish meat 80: oyster mushroom 20 with the addition of carrageenan 3%
A3B1 = Proportion of catfish meat 70: oyster mushroom 30 with the addition of carrageenan 1%
A3B2 = Proportion of catfish meat 70: oyster mushroom 30 with the addition of carrageenan 2%
A3B3 = Proportion of catfish meat 70: oyster mushroom 30 with the addition of carrageenan 3%

The data obtained were processed using Analysis of Variance (ANOVA) and continued with Duncan's Multiple Range Test (DMRT) to determine the differences between treatments. The results of all tests were analyzed using the De Garmo method to determine the product with the best treatment results.

2.2. Making of Oyster Mushroom Puree

White oyster mushrooms are sorted to remove unwanted parts, and then oyster mushrooms are washed thoroughly with running water; the mushrooms are then continued with the steam blanching process at a temperature of ± 80 C for 5 minutes. Blanching aims to activate enzymes, remove impurities, and reduce the number of microorganisms found in mushrooms. Oyster mushrooms are mashed with a food processor for 1 minute, producing oyster mushroom puree [9].

2.3. Making of Meatballs

Prepare 200 grams of fish meat and oyster mushrooms that have been weighed. Grind the meat chopper for 1 minute until evenly smooth; mix (add carrageenan, sago flour, garlic, shallots, egg whites, salt, pepper, and ice cubes). Then mash again until evenly distributed with a chopper for 1 minute. Mold the meatball dough into a round shape. Then, the finished meatball dough is boiled in 85-100˚C water for 15 minutes until the meatballs float. Meatballs that have been boiled are cooked and drained to cool.

2.4. Research Analysis

2.4.1. Nutritional Evaluation of Meatballs

The parameters analyzed include water, ash, protein, fat, and carbohydrate content.

2.4.2. Sensory Evaluation of Meatballs

Sensory characteristics selected to evaluate the quality of catfish meatballs include appearance, aroma, texture, flavor. A total of 25 panelists were assigned to rate the acceptability of the product using a 9-point scale ranging from "very like" to "very dislike." Data analysis included the use of the Friedman test.

3. RESULT AND DISCUSSION

3.1. Nutritional Analysis of Meatballs

3.1.1. Water Content

Based on the analysis of variance, it can be seen that there is a significant interaction ($p \leq 0.05$) between the Proportion of catfish and oyster mushrooms with the addition of carrageenan on the water content of meatball products. The average water content of meatball products ranged from 67.65% - 70.28%. Not all treatments of catfish meatballs in this study have met the requirements of SNI 7266: 2017 concerning fish meatballs with a maximum value of 70% moisture content [10]. The treatment of

the Proportion of 90% catfish and 10% oyster mushrooms with the addition of 1% carrageenan produced the lowest water content value of 67.65%, while the treatment of the Proportion of 70% catfish and 30% oyster mushrooms with the addition of 3% carrageenan produced the highest water content value of 70.28%. Based on the research data, the lower the Proportion of catfish and the higher the Proportion of oyster mushrooms and the higher the addition of carrageenan causes the water content in meatball products to increase significantly, this is because the water content of oyster mushrooms is higher than the water content of catfish, oyster mushrooms have hydrophilic fibers that can bind water in large quantities and carrageenan can form bonds between proteins and carrageenan which will increase the area in the product to absorb water to the maximum.

Table 1. Nutritional Characteristics of Meatballs

Samples	Water (%)	Ash (%)	Protein (%)	Lipid (%)	Carbohydrate (%)
A1B1	67.65 ± 0.07[a]	1.15±0.028	15.19±0.01	5.82 ± 0.07[h]	10.19 ± 0.04[a]
A1B2	67.79 ± 0.04[b]	1.18±0.028	15.15±0.01	5.67 ± 0.03[g]	10.21 ± 0.03 [a]
A1B3	68.22 ± 0.04[c]	1.21±0.028	15.06±0.04	5.24 ± 0.03[f]	10.27 ± 0.03 [a]
A2B1	68.24 ± 0.03[c]	1.23±0.014	14.94±0.01	5.13 ± 0.03[e]	10.46 ± 0.03[b]
A2B2	68.32 ± 0.01[c]	1.27±0.014	14.89±0.03	4.85 ± 0.01[d]	10.67 ± 0.01[c]
A2B3	68.54 ± 0.03[d]	1.33±0.028	14.79±0.03	4.36 ± 0.01[c]	10.98 ± 0.01[d]
A3B1	69.72 ± 0.04[e]	1.36±0.014	14.58±0.04	3.14 ± 0.04[b]	11.20 ± 0.03[e]
A3B2	69.84 ± 0.03[f]	1.39±0.042	14.55±0.03	2.98 ± 0.04[a]	11.24 ± 0.03[e]
A3B3	70.28 ± 0.04[g]	1.42±0.014	14.51±0.04	2.15 ± 0.04[a]	11.64 ± 0.03[f]

The analysis results of the oyster mushroom starting material contain a % water content of 88.65%, while catfish contains 76.18%. According to Ref. [11], the more oyster mushrooms are used, the more the meatballs' water content increases. High-fiber oyster mushrooms have many polar free hydroxyl groups, and the matrix structure that multiplies provides an opportunity to bind more polar compounds, such as water [7]. The addition of carrageenan can increase water content due to the ability of carrageenan as a gelling agent, where there is cross-linking of polymer chains to form a three-dimensional network that will bind water and cause polar and non-polar compounds to form a gel [12]. Ref. [13] added that carrageenan functions as a reasonable water retainer to increase the water binding capacity of the resulting product.

3.1.2. Ash Content

Based on the results of the analysis of variance, it can be seen that there is no significant interaction ($p \geq 0.05$) between the treatment of the Proportion of catfish and oyster mushrooms with the treatment of adding of carrageenan to the ash content of meatballs. Table 1**.** shows that the average value of ash content ranged from 1.15-1.42%. The treatment of the Proportion of 90% catfish and 10% oyster mushrooms with the addition of 1% carrageenan produced the lowest ash content value of 1,15%, while the treatment of the Proportion of 70% catfish and 30% oyster mushrooms with the addition of 3% carrageenan produced the highest ash value of 1,42%. The ash content values obtained for all treatments of the proportion of catfish and oyster mushrooms are in accordance with SNI 7266: 2017 concerning fish meatballs with a maximum value of 2.5% [10].

The results showed that the lower the proportion of catfish and the higher the proportion of oyster mushrooms, the more significantly the ash content of meatballs increased. The increase in ash content was due to the ash content of oyster mushrooms in this study, which was 1.47% and the catfish used in this study had an ash content of 0.86%, so the largest contributor to ash content was oyster mushrooms. The more oyster mushrooms added, the higher the ash content. [11] stated that adding oyster mushrooms will increase the ash content of the resulting product. This is related to the mineral content in oyster mushrooms, which can increase ash content when the mushrooms are added to a material or process. According to Ref. [14], oyster mushrooms are rich in minerals, such as iron 4mg, sodium 837mg, calcium 3.14 mg, potassium 3.793 mg, and phosphorus 7.17 mg.

The results showed that ash content increased as the concentration of carrageenan increased. this can be caused by carrageenan derived from seaweed, which contains many salts and minerals such as K, Mg, Ca, Na, and ammonium galactose. This is following Ref. [15] which states that carrageenan itself has a high mineral salt content of 18.60% Added by Ref. [16] that the increase in ash content in products with the addition of carrageenan is due to carrageenan containing mineral salts, thus increasing the ash content of the product.

3.1.3. Protein Content

Based on the results of the analysis of variance, it can be concluded that there is no significant interaction ($p \geq 0.05$) between the treatment of the Proportion of catfish and oyster mushroom and the treatment of the addition of the carrageenan on the protein content of the meatball. The average protein content of the meatballs was between 14.51% and 15.19%. The protein content obtained for all treatments is consistent with SNI 7266:2017 for fish balls, which requires a minimum value of 7% [10] The treatment of the Proportion of 90% catfish and 10% oyster mushrooms with the addition of 1% carrageenan produced the highest protein content value of 15,19%, while the treatment of the Proportion of 70% catfish and 30% oyster mushrooms with the addition of 3% carrageenan produced the lowest protein value of 14,51%.

https://doi.org/10.29165/ajarcde.v9i2.665

The results of the study show that the lower the proportion of catfish and the higher the proportion of oyster mushrooms, the lower the meatballs protein content. This is because a lower proportion of catfish can cause a decrease in the protein content of the fish balls. The decrease in protein content is because the catfish is the primary source of protein in catfish balls. According to the research data on the raw materials, the protein content of the catfish meat is 16.26%, and the protein content of the oyster mushroom is 4.78%. Therefore, the catfish meat is the primary source of protein. This is consistent with the statement of [17]. They state that a product's protein content is influenced by the quantity and type of meat used as the main ingredient and the protein content of the additional ingredients used.

The treatment of the addition of carrageenan concentration did not give a significant effect on the protein content produced, this is thought to be because the protein content in carrageenan is low. This is supported by the statement [15], which states that carrageenan does not affect the protein content of meatballs because the protein content in carrageenan is low at 2.80% so that its addition does not affect increasing the protein content of meatballs. Based on the research data, it shows that the higher the addition of carrageenan causes the protein content to decrease, this can occur because the water content value of meatball products can influence the protein content in meatballs. This is following [16] which states that carrageenan can bind to proteins so as to increase the surface area that can absorb or bind water, the higher the water content value results in decreased protein levels.

3.1.4. Fat Content

Based on the analysis of variance, there is a significant interaction ($p \leq 0.05$) between the proportion of catfish and oyster mushrooms with the addition of the percentage of carrageenan to the fat content of the meatballs. According to Table 1**.** the average fat content of the meatballs is between 2.15% and 5.82%. The treatment of 70% catfish and 30% oyster mushrooms, along with the addition of 3% carrageenan, produced the lowest fat content, at 2.15%. In contrast, treating 90% catfish and 10% oyster mushrooms and adding 1% carrageenan produced the highest fat content, at 5.82%.

The proportion of catfish decreases, the proportion of oyster mushrooms increases, and the amount of carrageenan increases. This causes the fat content of the meatballs to decrease significantly. This is because the fat content of catfish is higher than that of oyster mushrooms and carrageenan. The initial analysis of the fish fillets showed that they contained 5.20% fat, while the mushrooms contained 0.42% fat. Adding carrageenan can reduce the fat content of the meatballs because protein binds more to carrageenan and water than to fat. [18] state that the fat content is closely related to the water content; the higher the water content, the lower the fat content. [7] state that oyster mushrooms are high in fiber, have many free hydroxyl groups that are polar, and have a multilayered matrix structure that allows them to bind polar substances such as water, but not non-polar substances such as fat. According to [19], the decrease in fat content in meatballs is also influenced by oyster mushrooms, which have an unsaturated fatty acid profile. Unsaturated fatty acids are unstable and react easily. The double bonds in unsaturated fatty acids easily react with oxygen. According to [20], The addition of carrageenan can reduce the fat content of bakso. This is because protein binds more to carrageenan and water, reducing the amount of fat. The higher the concentration of carrageenan added, the more fat that is released. This is because carrageenan functions more as a water binder than a fat binder.

3.1.5. Carbohydrate Content

Based on the results of the analysis of variance, there is a significant interaction ($p \leq 0.05$) between the Proportion of catfish and shiitake mushrooms with the addition of carrageenan on the carbohydrate content of the meatball product. Table 1. shows that the average carbohydrate content of the meatballs ranges from 10.19% to 11.64%. The treatment of 90% catfish and 10% oyster mushroom with 1% carrageenan produced the lowest carbohydrate content, 10.19%, while the treatment of 70% catfish and 30% oyster mushroom with 3% carrageenan produced the highest carbohydrate content, 11.64%.

3.2. Sensory Analysis of Meatballs

Table 2. Sensory test result of Meatballs

Samples	Appearance	Aroma	Texture	Taste
S1T1	7.28±0.61	8.08±0.64	7.76±0.66	7.60±0.82
S1T2	7.32±0.56	7.68±0.69	7.72±0.68	7.44±0.58
S1T3	7.24±0.60	7.52±0.59	7.88±0.67	7.40±0.58
S2T1	7.56±0.65	7.52±0.65	7.56±0.65	7.52±0.65
S2T2	7.80±0.82	7.60±0.71	7.76±0.83	7.80±0.82
S2T3	8.08±0.64	7.96±0.54	7.96±0.68	8.04±0.61
S3T1	7.84±0.80	7.36±0.86	7.08±00.95	7.28±0.94
S3T2	7.80±0.58	7.28±0.68	7.24±0.66	7.28±0.68
S3T3	7.72±0.54	7.24±0.66	7.28±0.74	7.32±0.69

3.2.1. Appearance

Based on the results of the research in Table 2. shows the level of panelists' preference for the appearance of meatballs, the results of the number of rankings range from 97-165. The treatment of meatballs with a proportion of 80% catfish and 20% oyster mushrooms with the addition of 3% carrageenan has the highest level of liking with a total score of 8.08 (very like). This is because panelists prefer the whiter color of meatballs, typically fish meatballs, with a smooth surface and a round shape. The increasing addition of oyster mushrooms will increase the color of the meatballs. Following [23], that the level of brightness is influenced by oyster mushrooms which have a white color so as to produce meatballs with a white color. The higher the oyster mushrooms added, the brighter the appearance of the meatballs. [21] added that the white color in oyster mushrooms comes from natural pigments, namely anthoxanthins. This pigment will change color to white when the cooking process occurs. Although oyster mushrooms can form color changes in meatballs, overall, the meatballs produced are almost the same color, namely white [22].

3.2.2. Aroma

Based on the research results, Table 2 shows the panelists' preference for the aroma of meatballs; the results of the rankings range from 95-166. The treatment of meatballs with a proportion of 90% catfish and 10% oyster mushrooms with the addition of carrageenan by 1% has the highest level of favorability with an

average score of 8.08 (very like). This is thought to be due to panelists who like the characteristic aroma of fish and a little mushroom aroma. According to the opinion of [23], the more oyster mushrooms are used, the less fish aroma is produced and the more pungent the mushroom aroma will be. According to [24], oyster mushrooms have a strong aroma, so if there are more oyster mushrooms, the strong aroma will be stronger. The smell comes from the volatile compound 1-octen-3-ol, getting sharper as the oyster mushroom added increases [25]. [16] added, the more carrageenan added to the product does not affect the aroma of the product, because hydrocolloids including carrageenan generally do not contain volatile ingredients that cause aroma in food ingredients.

3.2.3. Texture

Based on the research data Table 2. shows the level of panelists preference for meatball texture, the results of the number of rankings range from 90-155. The treatment of meatballs with a proportion of 80% catfish and 20% oyster mushrooms with the addition of 3% carrageenan has the highest level of liking with an average score of 7.96 (like). This is thought to be because panelists like meatballs with a chewy texture. The higher the Proportion of oyster mushrooms added, the more tender the meatballs will be. Following the statement of [24], that the greater the amount of oyster mushrooms added to the meatballs, the lower the texture score (less chewy meatball texture). This happens because oyster mushrooms have a high water content of 88.56%. According to Ref. [22] High water content affects the high water content in the meatball dough so that the ability to bind water is also low and the resulting meatballs tend to be tender. Chewiness can also be influenced by myosin (protein) content in catfish meat. Myosin in fish meat plays an important role in clumping and gel formation, if the fish meat is cooked it will produce a chewy structure [11]. The research data shows that the higher the addition of carrageenan, the more favorable the texture of the meatballs. This is because carrageenan is able to form a gel that increases the chewiness of meatball products. [26] It states that carrageenan can form a gel that causes a chewier texture along with the addition of carrageenan, which causes the average liking for texture to increase at concentrations of 1%, 2%, and 3%.

3.2.4. Taste

Based on the research data Table 2. shows the level of panelists preference for the taste of meatballs obtained the results of the number of ranks ranging from 107-168. The treatment of meatballs with a proportion of 80% catfish and 20% oyster mushrooms with the addition of 3% carrageenan has the highest level of taste preference with an average score of 7.96 (like). This is thought to be due to panelists who like the characteristic taste of fish and the taste of oyster mushrooms, the taste of food is influenced by the components contained in food such as protein, fat and carbohydrates that compose it. Added by [27], that the savory taste comes from fish that contains high protein, protein contains glutamic acid which causes a savory taste. Oyster mushrooms have umami flavor because oyster mushrooms contain high glutamic acid. This is following the literature of [28], which stated that adding white oyster mushrooms improves the taste score because it contains glutamic acid. Glutamic acid content is 17.7g/100g protein, giving a savory taste and increasing the umami taste. Taste is also influenced by spices such as salt, sugar, shallots, garlic and pepper [23].

4. CONCLUSION

Fish meatballs are a fishery diversification product with high economic value and better nutritional content than beef and chicken meatballs The proportion of catfish is 80%, and oyster mushroom 10% with the addition of 3% carrageenan is the best treatment with a water content of 68.54%, ash content 1.33%, protein content 14.79%, fat content 4.36%, carbohydrate content 10.98%, and sensory values with appearance 8.08 (very like), aroma 7.96 (like), texture 7.79 (like), taste 8.04 (very like).

ACKNOWLEDGEMENT

We would like to thank on the Innovation Center of Appropriate Food Technology for Lowland and Coastal Area, Universitas Pembangunan Nasional Veteran Jawa Timur for providing facilities and contributions in this research.

REFERENCE

[1] Sitepu, M. A. K., H. W. Mewengkang, D. M. Makapedua, L. Damongilala, E. Mongi, F. Mentang, & V. Dotulong. 2020. Kajian Mutu Bakso Ikan Tuna yang Disubstitusi Tepung Karagenan. Media Teknologi Hasil Perikanan, 8(1): 31-38.

[2] Mumpuni, Yekti, Wulandari, Ari. 2011. Cara Jitu Mengatasi Kolesterol. Yogyakarta: C.V. Andi Offset.

[3] Ayu, D. F., Sormin, D. S., & Rahmayuni. 2020. Karakteristik Mutu dan Sensori Nugget (Pangasius Ikan Patin hypopthalmus) dan Nangka (Artocarpus heterophyllus) Muda. Jurnal Teknologi dan Industri Pertanian Indonesia, 12(2): 4-48.

[4] Panagan, A.T., H.Yohandini dan J.U. Dultom. 2011. Analisis kualitatif dan kuantitatif asam lemak tak jenuh omega-3 dari minyak ikan patin (Pangasius pangasius) dengan metoda kromatografi gas. Jurnal Penelitian Sains. 14 (4): 38-42.

[5] Alexs, M. 2011. Untung Besar Budi Daya Aneka Jamur. Pustaka Baru Press, Yogyakarta.

[6] Karim, Mutemainna dan D.N.F Asapari. 2015. Pengaruh Penambahan Tepung Karagenan Terhadap Mutu Kekenyalan Bakso Ikan Gabus. Jurnal Balik Diwa. 6(2): 41-49.

[7] Praseptiangga, D., T.P. Aviany dan N.H.R. Parnanto. 2012. Pengaruh Penambahan Gum Arab Terhadap Karakteristik Fisikokimia Dan Sensoris Fruit Leather Nangka (Aartocarpus Heterophyllus). Jurnal Teknologi Hasil Pertanian. IX (1): 71-83.

[8] Marzelly, A. D., S. Yuwanti, dan T. Lindriati. 2017. Karakteristik Fisik, Kimia, dan Sensoris Fruit Leather Pisang Ambon (Musa paradisiaca S.) dengan Penambahan Gula dan Karagenan. J. Agroteknologi. 11(2): 172-185.

[9] Putri, P. L. A., Yusa, N. M., & Suter, I. K. (2018). Pengaruh Perbandingan Talas Kimpul (Xanthosoma sagittifolium) dengan Jamur Tiram Putih (Pleurotus ostreatus) Terhadap Karakteristik Sate Lilit Keladi. Jurnal Ilmu Dan Teknologi Pangan (ITEPA), 7(4), 204–212.

[10] Badan Standarisasi Nasional. 2017 Bakso ikan. SNI 7266:2017. Standar Nasional Indonesia. Jakarta.

[11] Nuraisah. 2014. Kombinasi Jamur Tiram Putih (Pleurotus Ostreatus) Dengan Ikan Patin Dalam Pembuatan Bakso Ikan. Skripsi. Fakultas Perikanan dan Ilmu Kelautan. Universitas Riau, Pekan Baru.

[12] Sidi, N. C., E. Widowati Dan A. Nursiwi. 2014. Pengaruh Penambahan Karagenan Pada Karakteristik Fisikokimia dan Sensoris Fruit Leather Nanas (Ananas Comosus L. Merr.) dan Wortel (Daucus Carote). Jurnal Aplikasi Teknologi Pangan. 3(4): 122- 127.

[13] Ardianti, Y., S. Widyastuti., Rosmilawati., W. Sapiono., dan D. Handito. 2014. Pengaruh Penambahan Karagenan Terhadap Sifat Fisik Dan Organoleptik Bakso Ikan Tongkol (Euthynnus Affinis). 2014. Jurnal Agroteksos. 24(3):159 165.

[14] Kurniawan, A. 2011. Pengaruh Penambahan Jamur Tiram (Pleurotus ostreatus sp) terhadap Kualitas Kimia dan Organoleptik Bakso Ayam.Skripsi. Fakultas Pertanian Universitas Sebelas Maret, Surakarta. (tidak dipublikasikan)

[15] Ega, L., C. G. C. Lopulan Dan F. Meiyasa. 2016. Kajian Mutu Karagenan Rumput Laut Eucheuma Cottoni Berdasarkan Sifat Fisiko Kimia Pada Tingkat Konsentrasi Kalium Hidroksida (KOH) Yang Berberbeda. Jurnal Aplikasi Teknologi Pangan. 5 (2): 38-44.

[16] Handoko, Danny. 2018. Pengaruh Penambahan Karagenan Terhadap Mutu Otak Otak Ikan Patin (Pangasius Hypopthalmus). JOM. Universitas Riau. Pekanbaru.

[17] Nugroho, S. A., E.N. Dewi Dan Romadhon. 2014. Pengaruh Perbedaan Konsentrasi Karagenan Terhadap Mutu Bakso Udang (Litopanaeus Vanname). Jurnal Pengolahan dan Bioteknologi Hasil Perikanan. 3(4): 59 64.

[18] Nasution, P.S.N., D. Buchari dan Desmelati. 2018. The Effect of Addition of Straw Mushroom (Volvariella Volvaceae) on The Consumer Acceptance to the Catfish (Clarias Gariepinus) Grilled Cake. FAPERIKA. 5 (15): 95-105.

[19] Utomo, A.H., D. Rosyidi dan A.S. Widati. 2014. Studi Tentang Penmabahan Jamur Tiram (Pleurotus Ostreatus) Terhadap Kualitas Kimia Nugget Ayam. Fakultas Peternakan Universitas Brawijaya.

[20] Sinaga, Defyanti, D., & Nopianti, R. 2017. Karakteristik Bakso Ikan Patin (Pangasius Pangasius) Dengan Penambahan Karagenan, Isolat Protein Kedelai Dan Sodium Tripolyphospat. Jurnal Teknologi Hasil Perikanan, 6(1): 1-13.

[21] Novita, R.S dan L.T. Pangesthi. 2014. Pengaruh Proporsi Gluten Dan Jamur Tiram Putih Terhadap Mutu Organoleptik Bakso Nabati. Ejournal Boga. 3 (1): 111-119.

[22] Saadah, A.M., 2015. Pengaruh Substitusi Jamur Tiram (Pleurotus Ostreatus) Terhadap Kekerasan Dan Daya Terima Bakso Ikan. Skripsi. Progam Studi Ilmu Gizi Fakultas Ilmu Kesehatan Universitas Muhammadiyah Surakarta.

[23] Safitri, E., Sudarno Dan R. Kusdarwati. 2017. Pengaruh Penambahan Karagenan Terhadap Serat Kasar dan Peningktan Nilai Gel Strength Pada Produk Kamaboko Dari Komposit Ikan Belanak (Mugil Cephalus) dan Ikan Mujair (Oroechromis Mossambicus). Journal Of Marine And Coastal Science. 6(2): 101-114.

[24] Nefitri, A., N.I. Sari dan Sumarto. 2016. Kajian Mutu Bakso Ikan Tongkol (Euthynnus Affinis) Dengan Penambahan Tepung Jamur Tiram (Pleurotus spp). Fakultas Perikanan dan Ilmu Kelautan Universitas Riau.

[25] Ruri, D., T.K. Karo dan E. Yisraini. 2014. Pengaruh Perbandingan Jamur Tiram dan Tapioka dengan Penambahan Putih Telur Terhadap Mutu Bakso Jamur Tiram. J.Rekayasa Pangan dan Pert. 2 (1): 85-94.

[26] Aviana, T dan S. Heryani. 2016. Pengaruh perlakuan blansing dan variasi penggunaan gula terhadap

karakteristik organoleptik dan daya terima dendeng jamur tiram. Warta IHP. 33 (2): 90-96.

[27] Sitanggang, D., H. Rusmarilin dan L. M Lubis. 2015. Pengaruh Perbandingan Bubur Buah Papaya dan Belimbing Dengan Konsentrasi Karagenan Terhadap 77 Mutu Selai Lembaran. Jurnal Rekayasa Pangan dan Pertanian. 3(4): 482 488.

[28] Hardoko., E. Suprayitno., T. D. Sulistiyati., dan A. A. Arifin. 2017. Karakterisasi Nugget Pindang Ikan-Ampas Tahu Yang Ditambah Tepung Tulang Ikan Sebagai Sumber Kalsium. Jurnal Sains dan Teknologi

[29] Widyastuti, Netty; Tjokrokusumo, Donowati; dan Giarni, Reni. 2015. Potensi Beberapa Jamur Basidiomycota Sebagai Bumbu Penyedap Alternatif Masa Depan. Prosiding Seminar Agroindustri dan Lokakarya Nasional FKPT-TPI.

 https://doi.org/10.29165/ajarcde.v9i2.665