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Evaluation Type of Fish on Nutritional and Sensory Properties of Fish-Flavoured-Spicy-Tamarind Cube

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Abstract: Spicy tamarind is a common dish for Malaysian and is suitable to cook with any type of fish. Besides, seasoning cubes become more popular in the community as the fastest way of cooking. However, marine fish and freshwater fish has characteristics that could influence the nutrition and sensory properties of spicy tamarind cube. The aim of this study is to formulate fish-flavoured-spicy-tamarind cubes with different types of fish powders. Moreover, it also analyses the nutritional contents by their ash content, protein content, total fat content and minerals content. Besides, a sensory evaluation was conducted to determine the influence of fish powders on the sensory properties of the cube by evaluating its taste, aroma, texture (thickness of gravy) and overall acceptance. The results showed the range of ash content for all samples between 12.5% to 12.6% with sample F_T and F_C having the highest ash contents (12.6%). Besides, the protein content of the cubes showed a range of 9.4% to 9.5% and sample F_T has the highest content of protein (9.5%). Moreover, the fat content of the cubes exhibited a significant difference with the sample F_T and sample F_C obtained the highest content of total fat (17.3%) and the lowest fat content was obtained by sample F_A. Mineral detection showed the cubes consisted of potassium (K), iron (Fe), manganese (Mn), magnesium (Mg), sodium (Na), zinc (Zn), copper (Cu), tin (Tn), chlorine (Cl), calcium (Ca), phosphorus (P) and arsenic (Ar). In addition, the sensory evaluation results showed that sample F_T was preferred in terms of its taste and texture (thickness of gravy) Meanwhile, sample F_T and F_C were also more accepted by panelists. In conclusion, freshwater fish managed to influence more the spicy-tamarind cube in terms of nutritional contents and sensory properties than marine fish as a previous study stated before.

Keywords: Fish Powder, Nutrition Content, Seasoning Cube, Sensory Evaluation, Spicy Tamarind

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1. Introduction

Spicy-tamarind or known as ‘Asam Pedas’ is one of the traditional Malay foods that has been a Malaysian favourite since a long time ago. Spicy tamarind involved many ingredients such as chili paste, tamarind and onion. This kind of dish has so many variations that are categorized by geographical areas which make it more unique dishes [1]. Nowadays, seasoning cubes or bouillon cubes have become more popular among people. The characteristics of seasoning cube are complete with basic ingredients such as onions, spices and others. It also can be dissolved by hot water in a short period which is easier to use in cooking. However, only soup and tomyam seasoning cube can be found in the local market nowadays, while spicy tamarind is only found commercially as a paste [2].

There is a variety of raw and fresh food that can be cooked with spicy tamarind such as fish and poultry. Besides, spicy tamarind is always related to any type of fish that becomes locals' favourite. As for this study, both types of fish are needed to be processed until becoming powder. The production of fish powder will ensure the homogenizing process of spicy-tamarind powder become easier. Generally, fish are known as the main source of protein, polyunsaturated fatty acid (PUFA) and vitamin components which are essential for healthy and balanced nutrition [3]. A study by Balami [4] shows that fish protein mainly helps to build and repair muscle tissues, to improve blood quality and immunity. Meanwhile, Khalili Tilami & Sampels [5] found studies about the effect of fish protein related to inflammation, metabolic syndrome and osteoporosis. Fish also contains omega-3 long-chain PUFA which mainly are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) that had shown a positive effect. Therefore, it is easier for the consumer to assess and consume the food product while balancing their nutrient requirement.

Furthermore, the development of fish-flavoured-spicy-tamarind cubes also may be keeping up with the fast-food trend since it can be an alternative way to consume spicy tamarind dishes in a short period [6]. It also could help a household to save their expenses from buying more fish and ingredients to cook with the related dish. Moreover, by the development of spicy tamarind cube with marine and freshwater fish, it will not be limited to only a flavour but, provide an option for the consumer to choose based on their preferences. It also promotes more variation among existing fish stock or fish powder. The development of this cube has shown grown interest in innovation and nutritive foods to fulfil consumers’ demands. Therefore, it is easier for the consumer to assess and consume the food product while balancing their nutrient requirement.

However, the type of fish affects its nutritional value and sensory properties. For example, marine fish has a low content of fat and high content of omega-3 than freshwater [7]. Moreover, each individual has their preference on the type of fish. Therefore, in this study, two different types of fish which are marine and freshwater were used to formulate a fish-flavoured-spicy-tamarind cube such as anchovies, Indian mackerel, Nile tilapia and catfish. The effects on the sensory properties of the spicy tamarind cube also were evaluated. Then, the nutritional values of the cubes were analysed which are the total content of ash, protein, lipids and minerals. Besides, a sensory evaluation was carried out to evaluate overall acceptance by people. The quality attributes which are taste, aroma, texture (thickness of gravy) and overall acceptance was analysed to fulfil the requirement of consumer’s demand.

2. Materials and Methods

2.1 Production of fish-flavoured-spicy-tamarind cube

The marine fish and freshwater fish that are used for this study are anchovies (*Stolephorus indicus*), Indian mackerel (*Rastrelliger kanagurta*), Nile tilapia (*Oreochromis niloticus*) and catfish (*Clarias gariepinus*) and collected from the nearest places including Pagoh and Bandar Muar. Spicy tamarind paste was bought from Hawa Foods Enterprise. All the raw materials were dried by an electric food dehydrator (Hendi, Malaysia) for 48 hours at 60˚C. The dried raw materials were blended using an electric dry blender (Panasonic, MX-GM-1011, Malaysia) before filtering them using a mesh with the size of 1.0 cm. Then, both powders were mixed based on a formulation which is sample F_A for anchovies, F_M for Indian mackerel, F_T for Nile tilapia and F_C for catfish. Lastly, the fish-flavoured-spicy-tamarind powder was molded into a cube with dimensions of 3.0 cm × 2.3 cm × 1.0 cm.

2.2 Nutritional evaluation of fish-flavoured-spicy-tamarind cube

2.2.1 Chemical Analysis

Chowdhury *et. al.* [8]'s methods were referred to carry out this part. All types of fish-flavoured-spicy-tamarind cubes were analysed for ash, protein, fat and mineral content according to the AOAC method. The ash contents were determined by using a furnace and incinerated at 525˚C for 3-4 hours until uniformly white or gray ash formed. The percentage of ash contents was calculated based on Eq 1. After that, the protein contents were determined by using the Kjeldahl method (N x 6.25) and calculated the percentage of nitrogen based on Eq 2. To determine fat content, the Soxhlet method was analysed by using petroleum ether as solvent extraction and was calculated according to Eq 3. Meanwhile, X-Ray Diffraction (XRD) was analysed the mineral content of the cubes.

$$\%\text{Ash} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100 \qquad Eq. 1$$

$$\%\text{Nitrogen} = \frac{[(\text{T})_\text{s} - \text{T}_\text{b}] \times \text{Normality of HCl} \times \text{Atomic mass of N}_2}{\text{Weight of sample}} \times 100 \qquad Eq. 2$$

$$\%\text{Fat} = \frac{\text{Weight of the ether}-\text{soluble material}}{\text{Weight of sample}} \times 100 \qquad Eq. 3$$

2.3 Sensory evaluation of fish-flavoured-spicy-tamarind cube

Sensory evaluation was carried out with 40 untrained panelists that were chosen randomly to do the hedonic test [8]. Each panelist was given 5 different types of fish-flavoured-spicy-tamarind gravy to evaluate and answer the 9-points hedonic scale.

2.4 Statistical analysis of fish-flavoured-spicy-tamarind cube

Analysis of Variance (ANOVA) was used to determine the differences of average score from hedonic test and followed by Tukey honest significant difference (HSD) and least significant difference (LSD) with p-value ≤ 0.05 was considered as a significant difference.

3. Results and Discussion

3.1 Nutritional evaluation of fish-flavoured-spicy-tamarind cube

The nutritional properties of the cubes were determined with 4 samples of fish-flavoured-spicy-tamarind cubes which are F_A (anchovies), F_M (Indian mackerel), F_T (Nile tilapia) and F_C (Catfish) were analysed their ash, protein, total fat and a few minerals content. Table 1 indicates the results. The higher ash contents were determined for sample F_T and F_C with 12.6% respectively. Meanwhile, sample F_T shows a higher percentage for protein content (9.5%). Fish is known as one of the main sources of protein which is also described as 'complete protein' since contains all of the amino acids in the right proportion 10]. Based on Ariño *et al.* [11], marine fish has constant and only fewer significant differences between species. Moreover, both type of fish has a high content of amino acids such as glutamic acid and histidine. The influences of anchovies and Indian mackerel prove that the protein content of samples F_A and F_M does not show any significant differences and they are also constant.

However, the influences of Nile tilapia and catfish did show 0.1% differences for protein contents in between sample F_T and F_C. According to Malaysia Food Composition Database, Nile tilapia has higher protein content than catfish per 100g.

Next, fish are also rich with lipids that contain many types of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) and it also varies according to the species. The sample F_M and F_T show that the addition of Indian mackerel and Nile tilapia powders did affect the total fat content in the cube which is higher than anchovies and catfish. According to a previous study, freshwater fish has a higher content of fat and a lower concentration of omega-3 than marine fish [11]. Besides that, Indian mackerel is also categorized as fatty fish that contains longer chain omega-3 than leaner fish [10]. Meanwhile, the fat content of tilapia powder was high since it was farmed freshwater fish. Generally, farmed fish has a high amount of muscle fat rather than wild fish because their diet was controlled by the owner [11]. The same goes with sample F_C that has the second highest fat content because it was added with catfish powder known as farmed freshwater fish. Hence, it shows a significant difference of percentage than sample F_A which was added with anchovies' powder.

Table 2 shows the results of mineral contents that can be detected in the cubes. Based on the results, only a few minerals can be detected which are potassium (K), iron (Fe), manganese (Mn), magnesium (Mg), sodium (Na), zinc (Zn), copper (Cu), tin (Tn), chlorine (Cl), calcium (Ca), phosphorus (P) and arsenic (Ar). Some minerals such as K, Ca, P and Ar cannot be detected from certain samples. These minerals were detected by referring to Malaysia Food Regulation (1985) under Permitted Added Nutrient (Twelfth Schedule) and Maximum Permitted Proportion of Metal Contaminant in Specified Food (Fourteenth Schedule). Fortunately, all samples did not surpass the maximum permitted metal contamination. In addition, samples F_T and F_C show a high content of minerals than sample F_A and F_M. Based on Petricorena [10], the mineral intake of fish may affect by their surroundings such as gills and skin, not only from their diets but farmed fish has a high content of minerals than wild. A study from Pervin *et al.* [11] showed that farmed sea bass fish has higher mineral content than wild sea bass fish. Hence, both fish powders did affect the mineral content of cubes. However, the study of fish's minerals contents also varies based on the authors and it will be hard to compare each other since it depends on different conditions where the fish live. Therefore, the mineral contents of these samples generally were influenced by other ingredients from the spicy tamarind powder.

Table 1: Composition of fish-flavoured-spicy-tamarind cubes

Components	Samples Mean ± SD			
	F_A	F_M	F_T	F_C
Ash content (%)	12.50 ± 0.15^a	12.50 ± 0.1^a	12.60 ± 0.1^a	12.60 ± 0.2^a
Protein (%)	9.40 ± 0.01^a	9.40 ± 0.07^a	9.50 ± 0.04^a	9.40 ± 0.06^a
Total Fat (%)	13.4 ± 0.06^a	17.3 ± 0.13^c	17.3 ± 0.03^c	16.3 ± 0.04^b

[a,b,c] Values with different letters in the same row are significantly difference ($p < 0.05$)

Variations: F_A = Anchovies powder, F_M = Indian mackerel powder, F_T = Nile tilapia powder; F_C = Catfish powder; Control = Spicy tamarind cube

Table 2: Mineral contents of fish-flavoured-spicy-tamarind cubes

Minerals	Samples Mean ± SD			
	F_A	F_M	F_T	F_C
Potassium (K)	-	0.4 ± 0.1[a]	0.2 ± 0.1[a]	0.7 ± 0.1[b]
Iron (Fe)	1.1 ± 0.2[ab]	1.3 ± 0.1[b]	0.8 ± 0.1[a]	3.0 ± 0.2[c]
Manganese (Mn)	3.4 ± 0.2[b]	3.7 ± 0.1[b]	5.8 ± 0.1[c]	1.1 ± 0.1[a]
Magnesium (Mg)	0.8 ± 0.1[a]	1.0 ± 0.1[b]	1.5 ± 0.1[c]	1.1 ± 0.1[b]
Sodium (Na)	1.8 ± 0.3[b]	1.2 ± 0.3[b]	0.3 ± 0.1[a]	6.6 ± 0.5[c]
Zinc (Zn)	0.1 ± 0.1[a]	0.4 ± 0.1[b]	0.7 ± 0.1[c]	0.7 ± 0.1[c]
Copper (Cu)	0.7 ± 0.1[b]	4.8 ± 0.1[d]	0.3 ± 0.1[a]	1.1 ± 0.1[c]
Tin (Tn)	3.2 ± 0.2[c]	0.9 ± 0.4[a]	1.9 ± 0.1[b]	0.4 ± 0.1[a]
Chlorine (Cl)	5.3 ± 0.5[b]	2.3 ± 0.3[a]	4.8 ± 0.5[b]	11.3 ± 0.3[c]
Calcium (Ca)	-	10.2 ± 0.3[a]	17.3 ± 0.4[b]	-
Phosphorus (P)	6.9 ± 0.1[c]	4.1 ± 0.2[a]	6.2 ± 0.2[b]	-
Arsenic (Ar)	0.3 ± 0.2[a]	0.9 ± 0.2[b]	1.6 ± 0.1[c]	-

[a,b,c,d] Values with different letters in the same row are significantly difference ($p < 0.05$)

Variations: F_A = Anchovies powder, F_M = Indian mackerel powder, F_T = Nile tilapia powder; F_C = Catfish powder; Control = Spicy tamarind cube

3.2 Sensory evaluation of fish-flavoured-spicy-tamarind cube

A hedonic test of the fish-flavoured-spicy-tamarind cube was carried out with 40 untrained panelists while taste, aroma, texture (thickness of broth) and overall acceptance were evaluated. Table 2 shows the result of the test in terms of mean scores. Meanwhile, Figure 1 shows a radar chart of mean scores of sensory attributes of fish-flavoured-spicy-tamarind cube compared to the spicy tamarind cube. For taste, there was a significant difference as sample F_T has the highest score (6.80) while sample F_M has the lowest score (5.86). Hence, most of the panelists preferred the spicy-tamarind cube with Nile tilapia powder. There was no significant difference in aroma among all samples. Therefore, each fish powder did not affect the aroma of the cube. Besides, sample F_T also achieved the highest score (6.90) for texture and the lowest score was achieved by sample F_A (5.68). The addition of Nile tilapia powder did affect the texture of the spicy tamarind broth that was presented to the panelists. In addition, sample F_T and F_C were preferred by panellists for overall acceptance since they scored 6.88. Sample F_T that was preferred by panelists was not meet the expectation of this study. Based on multiple previous studies, marine fish has a better taste due to the high concentration of glutamic acid than freshwater fish. However, Goes *et al.* [13] had recommended the low percentage of inclusion of tilapia carcass for the spinach cake. This recommendation had been applied during the production of fish-flavoured-spicy-tamarind cubes by decreasing the fish powder in its formulation and also affected the flavour of fish-flavoured-spicy-tamarind cube especially anchovies powder flavour and Indian mackerel powder flavour. Besides, the addition of other ingredients in the spicy tamarind also could improve the taste and flavour of the cubes such as spices and chilies [13]. Karimah *et al.* [14] who studied the addition of bony lip barb fish meat in a cream soup, had stated that the addition of the fish could increase the savory base cream soup because glutamate compound from glutamic acid was emancipated into the surrounding liquid. Hence, this may affect the taste of Nile tilapia flavoured-spicy-tamarind cube and let it achieve the highest score.

Nevertheless, the aroma attribute showed there is no significant difference between all types of fish and also did not meet the expectation. Generally, the fishy aroma is developed by volatile compounds such as fatty acid. However, this unpleasant aroma can be lessened by the combination of other ingredients or during processing [14]. During preparation for sensory evaluation, the cubes were heated and boiled to produce the gravy and the aroma was taken by other ingredients which were more aromatic than fish powders. A study from Goes *et al.* [13] also stated that different levels of inclusion of Nile tilapia did not influence the aroma of the spinach cake. Hence, the lower content of fish powders in the cubes has not affected the aroma of cubes that causing panelists could not differ the aroma for each flavour. These results did against Lekahena [15] where the addition of fortification of yellowtail tuna fish flour into fish sticks did show a significant difference in terms of aroma, same as Cropotova *et al.* [16] findings where mackerel was able to increase the intensity of haddock fish cake. In addition, in terms of texture attributes, the results showed that sample F_T is the most preferred by panellists. Based on previous studies, there is no significant difference in the texture between marine fish and freshwater fish. Chowdhury *et al.* [8] also stated that even though the percentage of fish powder was high, it did not show any significant difference in the fried fish ball. However, it may affect the preparation of fish-flavoured-spicy-tamarind gravy for sensory evaluation. The error occurred when the volume of water used for boiling was not suitable for a cube to disperse. Hence, the thickness of gravy may be different by each type of sample and it may affect panelists' choice. Moreover, the results of overall acceptance showed there is a significant difference between all samples. Most panelists accepted the sample F_T and F_C. Even though it did not meet the expectation, this study managed to ensure panelists accepted more freshwater fish since it was less favourable by people.

Table 2: Sensory evaluation of fish-flavoured-spicy-tamarind cube

Sample	Sensory Attributes Mean ± SD			
	Taste	Aroma	Texture	Overall acceptance
F_A	6.10 ± 1.39^{ab}	6.28 ± 1.55^{a}	5.68 ± 1.42^{a}	6.23 ± 1.35^{ab}
F_M	5.86 ± 1.44^{a}	6.65 ± 1.27^{a}	5.73 ± 1.22^{a}	5.93 ± 1.25^{a}
F_T	6.80 ± 1.42^{b}	6.93 ± 1.29^{a}	6.90 ± 1.19^{b}	6.88 ± 1.42^{b}
F_C	6.75 ± 1.32^{ab}	6.60 ± 1.32^{a}	6.78 ± 1.31^{b}	6.88 ± 0.99^{b}
Control	$6.16 \pm 1.^{62ab}$	6.20 ± 1.59^{a}	6.58 ± 1.63^{b}	6.50 ± 1.54^{ab}

^{a,b} Values with different letters in the same row are significantly difference ($p < 0.05$)

Variations: F_A = Anchovies powder, F_M = Indian mackerel powder, F_T = Nile tilapia powder; F_C = Catfish powder; Control = Spicy tamarind cube

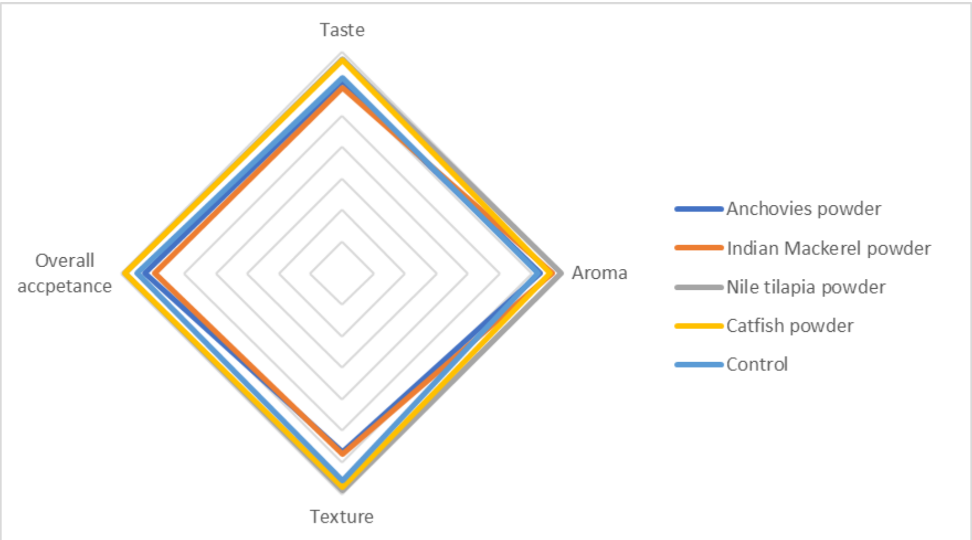

Figure 4.2: Radar chart of the sensory attributes of fish-flavoured-spicy-tamarind cubes compared to spicy tamarind cubes.

4. Conclusion

From this study, in the nutritional aspect, sample F_T has the highest protein content and total fat content. Meanwhile, sample F_T and F_C are the samples that have the higher minerals content. Besides, the sensory evaluation showed that samples with the addition of freshwater fish (sample F_T and F_C) are more preferred by panelists. To be concluded, freshwater fish managed to influence the spicy-tamarind cube in terms of nutritional contents and sensory properties as the previous study stated before.

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References

[1] Jais, A. S. (2016). Deconstructing Malay Delicacies “Asam Pedas”: Critical Ingredients and Flavour. Proceedings of 2016 Festival Agro Makanan Dan Bioteknologi, September, 28–29. https://doi.org/10.13140/RG.2.1.1642.7764

[2] Adzaly, N. Z., Kasim, N., Watt Moey, S., Anvarali, M. N., Manshor, M. R., Abd Halim, K. H., Akbar, A., & Mohamad, H. (2018). Shelf life study and sensory evaluation of culinary product (‘Asam pedas’ cube) using Chitosan film. Malaysian Applied Biology, 47(4), 79–87.

[3] Doğan, G., & Ertan, Ö. O. (2017). Determination of amino acid and fatty acid composition of goldband goatfish [Upeneus moluccensis (Bleeker, 1855)] fishing from the Gulf of Antalya (Turkey). International Aquatic Research, 9(4), 313–327. https://doi.org/10.1007/s40071-017-0179-9

[4] Balami, S., Sharma, A., & Karn, R. (2019). Significance Of Nutritional Value Of Fish For Human Health. Malaysian Journal of Halal Research, 2(2), 32–34. https://doi.org/10.2478/mjhr-2019-0012

[5] Khalili Tilami, S., & Sampels, S. (2018). Nutritional Value of Fish: Lipids, Proteins, Vitamins, and Minerals. Reviews in Fisheries Science and Aquaculture, 26(2), 243–253. https://doi.org/10.1080/23308249.2017.1399104

[6] Rahman, M. A., Saifullah, M., & Islam, M. N. (2012). Fish powder in instant fish soup mix. Journal of the Bangladesh Agricultural University, 10(1), 145–148. https://doi.org/10.3329/jbau.v10i1.12106

[7] Moraes, G., & De Almeida, L. C. (2019). Nutrition and functional aspects of digestion in fish. In Biology and Physiology of Freshwater Neotropical Fish. Elsevier Inc. https://doi.org/10.1016/B978-0-12-815872-2.00011-7

[8] Chowdhury, M., Islam, M., & Alim, M. (2017). Development and evaluation of fish ball from fish powder supplemented with potato flour. Journal of the Bangladesh Agricultural University, 15(1), 95–102. https://doi.org/10.3329/jbau.v15i1.33534

[9] Huda, N., Masseri, M., Muhammad, N., Fazira, N., & Rahim, A. (2021). Effect of drying times and temperatures on the quality of traditional spicy sauce cube (Kesan Masa dan Suhu Pengeringan Terhadap Kualiti Kiub Sambal Tradisional). Malaysian Journal of Analytical Sciences, 25(4), 695–705.

[10] Petricorena, Z. C. (2015). Handbook of Food Chemistry. Handbook of Food Chemistry, 1–28. https://doi.org/10.1007/978-3-642-41609-5Ariño, A., Beltrán, J. A., Herrera, A., & Roncalés, P. (2012). Fish and seafood: Nutritional Value. Encyclopedia of Human Nutrition, 2–4, 254–261. https://doi.org/10.1016/B978-0-12-375083-9.00110-0

[11] Ariño, A., Beltrán, J. A., Herrera, A., & Roncalés, P. (2012). Fish and seafood: Nutritional Value. Encyclopedia of Human Nutrition, 2–4, 254–261. https://doi.org/10.1016/B978-0-12-375083-9.00110-0

[12] Pervin, T., Yeasmin, S., Islam, R., Kamruzzaman, -, Rahman, A., & Sattar, A. (2013). Studies on nutritional composition and characterization of lipids of Lates calcarifer (Bhetki). Bangladesh Journal of Scientific and Industrial Research, 47(4), 393–400. https://doi.org/10.3329/bjsir.v47i4.14068

[13] Goes, E. S. dos R., Souza, M. L. R. de, Kimura, K. S., Coradini, M. F., Verdi, R., & Mikcha, J. M. G. (2016). <b>Inclusion of dehydrated mixture made of salmon and tilapia carcass in spinach cakes. Acta Scientiarum. Technology, 38(2), 241. https://doi.org/10.4025/actascitechnol.v38i2.28852

[14] Karimah, Q. A., Junianto, Liviawaty, E., & Pratama, R. I. (2019). Sensory Evaluation of Bonylip Barb Fish Meat Cream Soup. World News of Natural Sciences, 26(July), 146–156.

[15] Lekahena, V. N. J. (2019). Characteristic of chemical and sensory of stick product which fortified with yellowfin tuna flour. Agrikan: Jurnal Agribisnis Perikanan, 12(2), 284. https://doi.org/10.29239/j.agrikan.12.2.284-290

[16] Cropotova, J., Mozuraityte, R., Standal, I. B., Szulecka, O., Kulikowski, T., Mytlewski, A., & Rustad, T. (2021). Sensory and Physicochemical Quality Characteristics of Haddock Fish Cake Enriched with Atlantic Mackerel. Food Technology and Biotechnology, 59(1). https://doi.org/10.17113/ftb.59.01.21.6695