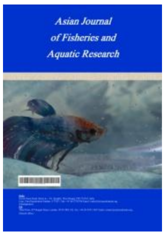

Asian Journal of Fisheries and Aquatic Research

18(4): 17-26, 2022; Article no.AJFAR.89321
ISSN: 2582-3760

Fortification of Red Tilapia Bone Flour as a Source of Calcium on Doughnut Preference Level

Yasyfa Ashila [a*], Rusky Intan Pratama [a], Yuniar Mulyani [a] and Iis Rostini [a]

[a] Department of Fisheries, Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Sumedang Regency, West Java, Indonesia.

Authors' contributions

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

Article Information

DOI: 10.9734/AJFAR/2022/v18i430448

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/89321

Original Research Article

Received 14 May 2022
Accepted 18 July 2022
Published 22 July 2022

ABSTRACT

This research aims to determine the percentage of addition of red tilapia bone flour as a source of calcium in the most preferred doughnut. The research was conducted on January until February 2022 at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran and the Test Services Laboratory, Faculty of Agricultural Industrial Technology, Universitas Padjadjaran. The research method used was experimental method, that made doughnuts with different levels of addition of red tilapia bone flour, which consists of 5 treatments (0%; 2.5%; 5%; 7.5%; and 10%) with 20 panelists semi-trained as a test to determine the preference level of the panelists to doughnuts. Observations were made on organoleptic tests and chemical tests. The most preferred fortification of red tilapia bone flour on doughnut was the 5% treatment with the value of the preference level on appearance, texture, and aroma being 7 (preferred) and taste was 9 (very preferred). The results of chemical test analysis on 5% treatment for moisture content is 18,91%, ash content is 2,97%, protein content is 6,29%, fat content is 27,95%, carbohydrate content is 43,88%, and calcium content is 0,1007% or 1006,60 mg/kg.

Keywords: Bonefish; calcium; donut; fortification; red tilapia.

**Corresponding author: Email: yasyfaashila@gmail.com, yasyfa18001@mail.unpad.ac.id;*

1. INTRODUCTION

Tilapia production in Indonesia increased by 3.05% during the period from 2015 to 2018. The largest number of tilapia production in 2018 was dominated by the regions of West Java, West Sumatra, South Sumatra, Central Java, North Sulawesi, North Sumatra, West Nusa Tenggara, East Java, South Kalimantan, Bengkulu, and DI Yogyakarta. Tilapia is an export commodity, especially to the United States in the form of filets with the highest demand in the global market in 2018 reaching 123,752,000 kg [1].

The demand for red tilapia in the form of frozen filets and product processing with red tilapia meat as raw material along with the amount of waste produced in the form of fish bones. Fish bone waste can be utilized optimally by processing the waste into flour so that the bone waste produced is not wasted, because it can cause environmental pollution if not handled properly [2].

Fish bones contain high calcium phosphate, which is 14% of the total bone composition [3] and can be well absorbed by the human body about 60-70% [4]. The high calcium content in fish bones can make fish bones as an alternative source of calcium that is cheaper, easy to obtain, and easily absorbed by processing into flour [5]. Calcium is a micronutrient (mineral) needed by the body in high amounts compared to other minerals [6]. Based on data from the Nutrition Research Center of the Ministry of Health of the Republic of Indonesia, osteoporosis sufferers in Indonesia have reached 19.7% and are in the sixth largest after China [7].

Red tilapia bone flour can be added to a product as an ingredient for making products, one of which is doughnut. Doughnut have been widely produced in Indonesia and marketed to the public. The main ingredient in making doughnut is wheat flour which contains macronutrients [8], there are carbohydrates, protein and fat, and contains micronutrients such as calcium, but in very small amounts.

A product with good nutritional content but is not liked by many people, then the function of adding nutrients to the product will not be useful [9]. The level of preference can be measured using an organoleptic test through the sensory evaluation. Based on this description, it is necessary to conduct research to determine the level of preference for doughnut with the addition of red tilapia bone flour as a source of calcium so that it can produce donut that have high calcium and delicious taste.

2. MATERIALS AND METHODS

This research was conducted on January until February 2022 at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran for the manufacture of red tilapia bone flour, making doughnuts with the addition of red tilapia bone flour in accordance with the treatment specified was 0%, 2.5%, 5%, 7.5%, 10% and organoleptic tests on doughnuts and the Test Services Laboratory of the Faculty of Agricultural Industrial Technology, Universitas Padjadjaran for analysis of moisture content, ash, protein, fat, carbohydrates and calcium.

2.1 Tools and Materials

The tools used in this research are sieve (80 mesh), blender, doughnut mold, measuring cup, cloth, gas stove, electric oven, pan, plate, knife, pressure cooker, rolling pin, spoon, spatula, stopwatch, cutting board, scale digital, container, and frying pan. The materials used in this research is red tilapia bone which is processed into red tilapia bone flour and used as much as 0 gr in the 0% treatment, 15 gr in the 2.5%, 30 gr in the 5%, 45 gr in the 7,5%, and 60 gr in the 10%. The ingredients used in making doughnut for each treatment were red tilapia bone flour with the appropriate amount that has been determined, and several other ingredients that have been purchased and prepared from the supermarket which are 600 gr wheat flour, 75 gr margarine, 4 egg yolks, 11 gr yeast, 80 gr sugar, 10 gr salt, 250 ml water, and cooking oil for doughnut frying process.

2.2 Research Methods

The research method was experimental method, that made doughnuts with different levels of adding red tilapia bone flour. The level of preference for doughnuts was analyzed by Friedman's non-parametric statistical method consisting of 5 treatments and 20 semi-trained panelists as a test. The treatment of adding red tilapia bone flour to the doughnut is as follows:

Treatment A: 0% or without the addition of red tilapia bone flour.
Treatment B: 2.5% addition of red tilapia bone flour.

Treatment C: 5% addition of red tilapia bone flour.
Treatment D: 7.5% addition of red tilapia bone flour.
Treatment E: 10% addition of red tilapia bone flour.

2.3 Research Stages

The research was conducted through three stages. First stage was made of red tilapia bone flour which refers to Asni [10]. The second stage was made doughnuts with the addition of red tilapia bone flour which refers to Wardani et al. [9]. The formulation of ingredients for making doughnuts refers to Bakhtiar et al. [11]. The third stage was organoleptic test with parameters of appearance, aroma, texture, and taste, then chemical test with parameters of moisture content, ash, protein, fat, carbohydrate, and calcium.

2.4 Observed Parameters

The parameters observed in this research are the level of appearance, aroma, texture, and taste of doughnut with the addition of red tilapia bone flour using a hedonic scale with five levels ranging from 1 to 9, those are very dislike (1), dislike (3), neutral/ordinary (5), preferred (7), highly preferred (9), and also chemical parameters those are moisture content, ash, protein, fat, carbohydrate, and calcium [12]. Organoleptic characteristics were tested using a hedonic test with 20 semi-trained panelists consisting of students from the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia.

2.5 Data Analysis

The data from the calculation of the doughnut chemistry test will be analyzed descriptively and compared with the quality requirements of the doughnut based on the Indonesian National Standard (SNI), while the organoleptic observation data were analyzed using non-parametric statistics, that is the two-way analysis of variance Friedman test with *Chi-square* test [13]. Friedman test was used to determine the effect of adding red tilapia bone flour to the level of preference for the doughnut produced. The statistics used in the Friedman test are defined by the following formula:

$$Xr^2 = \frac{12}{\mathrm{nk}\,(k+1)} \sum_{j}^{k} = 1\ (R_j)^2 - 3\ n\ (k + 1)$$

Description:

Xr^2 = Friedman Test Statistics
n = Deuteronomy
k = Treatment
R_j = Total ranking of each treatment

The panelist's decision making on the criteria for the preferred doughnut product was carried out by multiple comparisons, then the Bayes method was used to determine the best treatment. The calculation results from the Bayes test will show that the element that has the highest priority value is the most preferred by the panelists [14]. The Bayes equation is as follows:

$$XG = \sqrt[n]{\Pi.Xi}$$

Description:

XG = Geometric mean
Π = Permutation
n = Number of panelists
X_i = Rating from the 1st panelist

3. RESULTS AND DISCUSSION

3.1 Hedonic Test

3.1.1 Appearance

Appearance is an organoleptic parameter that is quite important, because if the panelists give the impression of a good and preferred appearance, then the panelists will see the other organoleptic parameters, that are aroma, texture, and taste [15]. The results of the assessment of the average appearance of the doughnuts are presented in Fig. 1.

Based on the panelists' assessment of the appearance of the doughnuts, it was found that all treatments had a median value of 7 (preferred). The highest average appearance value of 7.20 was found in doughnut with 5% treatment, while the lowest average value of 6.40 was found in doughnut with 10% treatment. Friedman's statistical test results showed that all treatments were not significantly different. This can be because the red tilapia bone flour used is white or almost the same color as wheat flour, so the red tilapia bone flour does not affect the appearance of the doughnuts. Baskoro [16] stated that red tilapia bone flour had a pure white color.

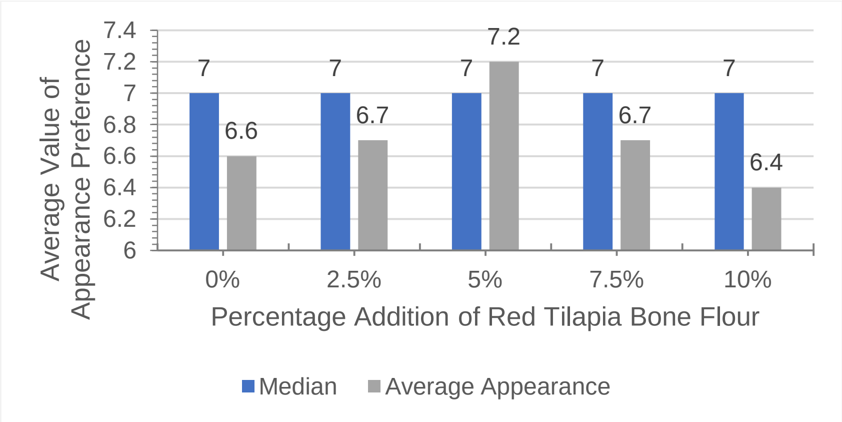

Fig. 1. The average appearance of doughnut

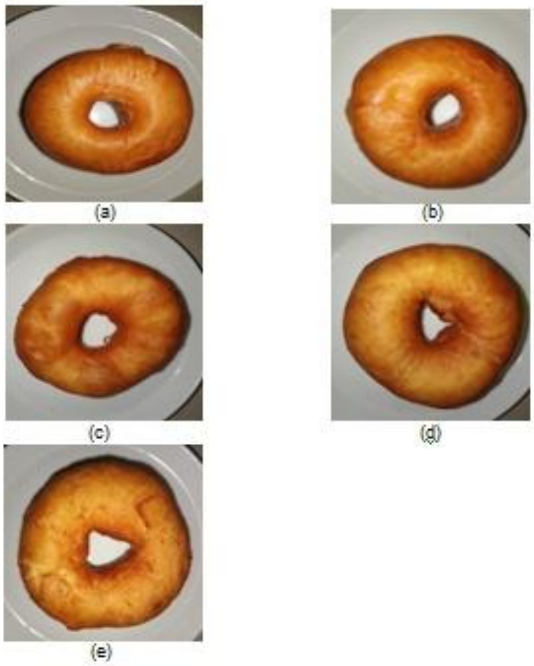

Fig. 2. Doughnut with the treatment of adding red tilapia bone flour percentage
(a) 0% or without the addition of red tilapia bone flour, (b) 2.5% addition of red tilapia bone flour, (c) 5% addition of red tilapia bone flour, (d) 7.5% addition of red tilapia bone flour, (e) 10% addition of red tilapia bone flour

The surface of the doughnut is brownish yellow due to the *Maillard* reaction during the frying process. Winarno [17] said that protein (primary amine group) meets reducing sugar derived from carbohydrates if it meets at high temperatures during the frying process it will produce a brown material which is called a *Maillard* reaction or non-enzymatic browning (browning process). The inside of the doughnut in each treatment is yellowish white, because the red tilapia bone flour used is white so it doesn't affect the color of the inside of the doughnut as well.

3.1.2 Aroma

Aroma is one of the factors that will determine consumers to choose a product because the aroma can attract consumers attention to the food product [11]. The aroma in food products is produced from the main ingredients and complementary ingredients added to the dough [18]. The results of the average doughnuts aroma assessment are presented in Fig. 3.

Based on the panelists' assessment of the doughnut aroma, it was found that the median value ranged from 5 to 7 (ordinary to preferred). The highest average value of aroma is 7.1 found in doughnut with 5% treatment, while the lowest average value of aroma is 5.70 found in doghnut with 7.5% treatment. Friedman statistical test results showed that all treatments were not significantly different, meaning that the addition of red tilapia bone flour had no significant effect on the doughnuts. The aroma produced has a distinctive aroma of doughnut and the aroma of fish bones that were not smelled by the panelists, because the red tilapia bone flour used had been through a repeated washing process so that there was no fishy smell. Baskoro [16] said that red tilapia bone flour has a tasteless and fishy aroma that is not smelt.

The aroma of the doughnut is also affected by the Maillard reaction which produces a different aroma according to the combination of free amino acids and sugars in certain foods. Each amino acid produces a characteristic aroma when heated with a given sugar, due to the production of certain aldehydes [19]. The frying process can also affect the aroma of the doughnuts, which during the frying process will cause changes in aroma, color, texture, and taste, and volatile compounds are formed which generally come from aromatic compounds. The aroma obtained is a natural flavor content in the oil and the result of a reaction with fried food ingredients. Heating oil during the frying process can produce volatile compounds. The composition of volatile compounds consists of alcohols, esters, lactones, aldehydes, ketones and aromatic compounds [20]. The use of margarine in doughnut dough can also strengthen the aroma of the doughnuts. Fat is an important component because it functions as an aroma enhancer [21].

3.1.3 Texture

The texture of an ingredient will affect the taste produced by the food ingredient. Changes in the texture of a material will change the aroma and taste, because the texture can affect the speed of stimulation of the olfactory cells and salivary glands [17]. The results of the average doughnut texture assessment are presented in Fig. 4.

Based on the panelists' assessment of the texture of the doughnuts, it was found that the median value was 7 (preferred). The highest average texture value of 7.10 was found in doughnut with 5% treatment, while the lowest average texture value of 6.60 was found in doughnut with 10% treatment. Friedman's statistical test results showed that all treatments were not significantly different, but seen from the value of the average level of preference for doughnut textures, it decreased with increasing addition red tilapia bone flour. The 5% treatment can increase the doughnut preference level, but with further additions such as 7.5% and 10% treatment will reduce the doughnut preference level. This is caused by the addition of red tilapia bone flour which is getting higher, it will result in lower gluten content.

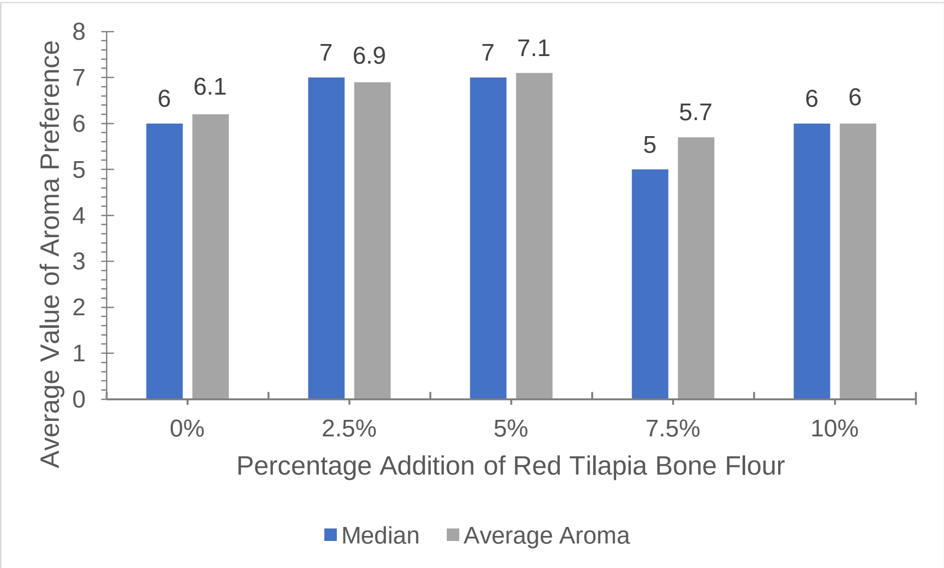

Fig. 3. The average aroma of doughnut

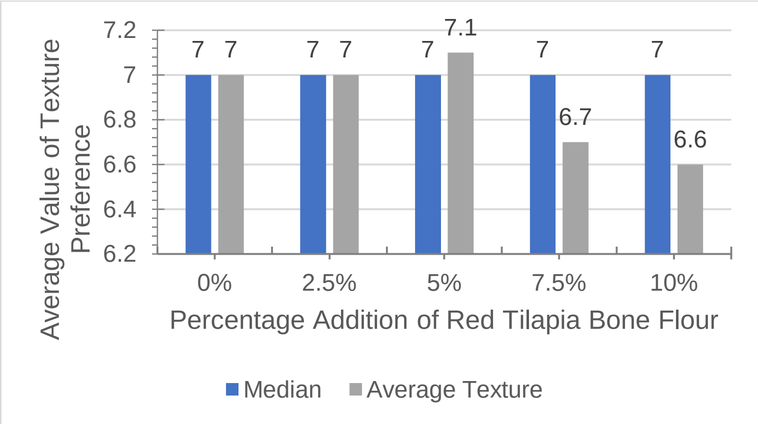

Fig. 4. The average texture of doughnut

The lower gluten content can result in a decrease in the elastic properties of the dough, so that the texture of the doughnut becomes harder. The protein in wheat flour can form gluten when added to water and produce a dough that is elastic and able to hold gas, but if the amount of gluten in the dough is only small, then the dough is less able to hold gas so that the pores formed in the dough are also small and the dough does not expand properly [22]. Rochima et al. [15] said that the presence of high calcium and phosphorus content will cause the bonding power or structure of the dough made by gluten to become less united or less compact so that the texture becomes harder.

3.1.4 Taste

Taste is a parameter that is assessed using the sense of taste and is an important factor in determining whether a product is accepted or rejected by consumers. The taste of a product can affect the level of consumer acceptance, although other parameters are good, but if the taste is not liked then the product will be rejected [18]. The results of the average doughnut taste assessment are presented in Fig. 5.

Based on the panelists' assessment of the doughnut taste, it was found that the median value ranged from 6 to 9 (preferred to highly preferred). The highest average taste value of 7.60 was found in doughnut with 5% treatment, while the lowest average value of 5.70 was found in doughnut with 7.5% treatment. Friedman's statistical test results showed that the fortification of red tilapia bone flour on doughnuts did not give a significant difference in taste in the 0%, 2.5%, and 10% treatments, while the 7.5% treatment was significantly different from the 5%. The 5% treatment was the most preferred treatment by the panelists because the doughnut still had a sweet, slightly savory, slightly calcareous doughnut taste, while doughnut with the addition of 7.5% red tilapia bone flour have a slightly sweet and savory taste, and a calcareous taste that is increasingly felt. The difference in taste in each formula is influenced by the amount of calcium added to the doughnut, resulting in an after taste that is slightly chalky [23].

3.2 Bayes Test

Decision making on the relative weight value and the appearance, aroma, texture, and taste criteria of red tilapia bone flour doughnuts was carried out by pairwise comparison of the 20 panelists. The results of the calculation of the weight of the appearance, aroma, texture, and taste criteria of doughnut are in Table 1.

Based on the results of the Bayes test calculation, the highest number of criteria weights is the taste parameter of 0.61, which means that the taste parameter is the most important assessment or as the main consideration in the selection of doughnut. The second most important parameter is aroma with a criterion weight of 0.17, then followed by appearance and texture parameters with a criterion weight of 0.12 and 0.10 respectively. The results of calculations in determining the best treatment using the Bayes method by considering the appearance, aroma, texture, and taste criteria of red tilapia bone flour doughnuts are listed in Table 2.

Score value is obtained based on the best treatment results for each parameter. The highest alternative value as a result of multiplying the weight value with the score value indicates the best doughnut [14]. Based on the calculation of the Bayes method, it was found that all the red tilapia bone flour fortification treatments on the doughnut were still accepted or favored by the panelists, but the doughnut with 5% red tilapia bone flour fortification treatment were the most preferred treatment with alternative values and the highest priority values were 8.23 and 19.17. The 2.5% treatment is in second place with alternative values and priority values 7.00 and 16.31, then followed by 0% and 10% treatment with alternative values and the same priority value, namely 6.83 and 15.92, then 7.5% treatment with alternative values and priority values of 6.05 and 14.10.

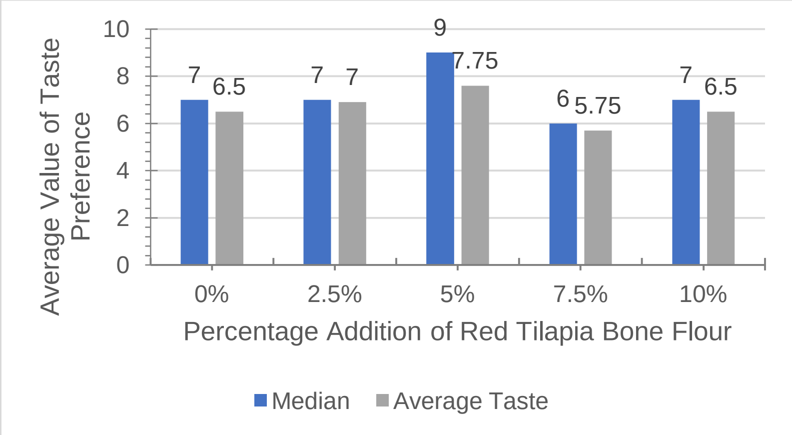

Fig. 5. The average taste of doughnut

Table 1. Doughnut criteria weight value

Criteria	Criterion weight
Appearance	0.12
Aroma	0.17
Texture	0.10
Taste	**0.61**

Table 2. Doughnut scoring decision matrix by Bayes test

Treatment (%)	Criteria				Alternative Value	Priority Value
	Appearance	Aroma	Texture	Taste		
0	7	6	7	7	6.83	15.92
2.5	7	7	7	7	7.00	16.31
5	7	7	7	9	8.23	19.17
7.5	7	5	7	6	6.05	14.10
10	7	6	7	7	6.83	15.92
Criterion Value	0.12	0.17	0.10	0.61	0.43	1.00

Table 3. Doughnut chemistry test results

No.	Analysis Parameters	Chemical Analysis Results (%)	
		Doughnut 0%	Doughnut 5%
1	Moisture content	17.78	18.91
2	Ash content	1.41	2.97
3	Protein content	5.59	6.29
4	Fat content	32.01	27.95
5	Carbohydrate content	43.21	43.88
6	Calcium content	0.0090	0.1007

3.3 Chemical Test

Chemical tests include moisture content, ash, protein, fat, carbohydrate, and calcium in the doughnuts. Chemical tests were carried out on doughnut with 0% treatment and the most preferred doughnut by the panelists were donut with 5% treatment. The results of the doughnut chemistry test can be seen in Table 3.

The moisture content of 0% donut is 17.78%, while the water content of 5% donut is 18.91%. Doughnuts with both treatments still have water content that meets the quality requirements of doughnut based on SNI 01-2000 (Indonesia National Standard) which states that the maximum water content in doughnut is 40%. Moisture content in 5% doughnut have a higher water content than 0% doughnut. This is because the moisture content contained in red tilapia bone flour also accumulates [24]. The increase in moisture content in red tilapia bone flour doughnuts can also be affected by the initial moisture content in the raw material [25]. The moisture content of tilapia bone flour is known to reach 14.2% [26].

The ash content of 0% doughnut is 1.41%, while the 5% doughnut ash content is 2.97%. The 5% doughnut have a higher ash content than 0% doughnut. The ash content in doughnut tends to increase along with the addition of red tilapia bone flour. This is because the main component in fish bones is minerals [11], so the ash content in the doughnut will increase with the increase in the percentage of red tilapia bone flour used.

The protein content of 0% doughnut is 5.59%, while the 5% doughnut protein content is 6.29%. The 5% doughnut have a higher protein content than 0% doughnut. The protein content in doughnut tends to increase along with the addition of red tilapia bone flour. This is due to the protein content contained in the added red tilapia bone flour. Fish bone flour is known to have a high protein content [27]. The protein content contained in tilapia bones is known to have a value of up to 40.8% [28].

The fat content of 0% doughnut is 32.01%, while the 5% doughnut fat content is 27.95%. Doughnuts with both treatments still had fat content that met the quality requirements of doughnut based on SNI 01-2000 which stated that the maximum fat content in doughnut with the frying process was 33%. The 5% doughnut have lower fat content than 0% donut. The fat content in doughnut tends to decrease with the addition of red tilapia bone flour. This is because during the fermentation process, the fat is broken down by yeast into simpler compounds, because yeast is lipolytic which can hydrolyze fat and the yeast uses fat as a source of energy [29].

The carbohydrate content of 0% doughnut is 43.21%, while the carbohydrate content of 5% doughnut is 43.88%. Carbohydrate content in 5% doughnut has a value that is not much different from 0% doughnut. Carbohydrate content is highly dependent on the reduction factor. The lower the nutritional content such as moisture, ash, protein, and fat content, the carbohydrate content will increase, conversely the higher the nutrient content of moisture, ash, protein, and fat, the lower carbohydrate content [30]. The carbohydrate content in 100 grams of fish bones is 0.1 mg [31].

The 5% doughnut have higher calcium content than 0% doughnut. This can be seen from the total calcium content in 0% doughnut is 0.0090% or 90.23 mg/kg, while the calcium levels in 5% doughnut is 0.1007% or 1006.60 mg/kg. The more addition of red tilapia bone flour, the calcium levels in the doughnut will increase. The main constituents of fish bones are calcium, phosphorus, and carbonate, while those present in small amounts are sodium, chloride, hydroxide, and sulfate [32].

4. CONCLUSION

Based on the results of the research, it can be concluded that the fortification of red tilapia bone flour on doughnuts in all treatments was still accepted by the panelists with the most preferred treatment being 5% treatment which had a preference level of appearance, texture, and aroma are 7 (preferred) and taste are 9 (highly preferred). The results of the chemical test analysis on the treatment without the addition of red tilapia bone flour were moisture content of 17.78%, ash of 1.41%, protein 5.59%, fat 32.01%, carbohydrate 43.21%, and calcium 0.0090% or 90.23 mg/kg, while in the 5% treatment, the moisture content was 18.91%, ash 2.97%, protein 6.29%, fat 27.95%, carbohydrate 43.88%, and calcium 0.1007% or 1006.60 mg/kg.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Directorate of Business and Investment. Business opportunities and tilapia investment. Ministry of Maritime Affairs and Fisheries: Indonesia; 2019.
2. Ahmil H, Muliyati O, Mananta. Analysis of nutritional content of eel bone flour (*Anguila* sp). Ghidza: Journal of Nutrition and Health. 2021;5(1): 36-44.
3. Justicia A, Liviawaty E, dan Hamdani H. Fortification of red tilapia bone flour as a source of calcium on white bread preference level. Journal of Fisheries and Marine. 2012;3(4):17-27.
4. Edam M. Fortification of fish bone flour on physico-chemical characteristics of fish meatballs. Industrial Technology Research Journal. 2016;8(2): 83-90.
5. Trilaksani WE, Salamah, and Nabil M. Utilization of tuna fish bone waste (Thunus sp.) as a source of calcium with protein hydrolysis method. Fishery Technology Bulletin. 2006;9(2): 34-45.
6. Ferazuma H, Marliyati SA, and Amalia L. Substitution of dumbo catfish head flour (Clarias gariepinus sp) to increase the calcium content of crackers. Nutrition and Food Journal. 2012;6(1): 18-27.
7. Parinduri FK, Rahfiludin MZ, dan Fatimah S. Relation of calcium intake, vitamin D, phosphorus, caffeine, physical activity with bone density in young adult women. Journal of Public Health. 2017;5(4): 664-674.
8. Silaban A. Test the acceptability and nutritional content of doughnut with the addition of orange sweet potato, tempeh, and carrot. Faculty of Public Health. Universitas Sumatera Utara; 2019.
9. Wardani DP, Liviawaty E, dan Junianto. Fortification of tuna bone flour as a source of calcium on donut preference level. Journal of Fisheries and Marine. 2012;3(4): 41-50.
10. Asni Y. Study of making biscuits with addition of catfish bone flour (*Pangasius hipopthalmus*). Faculty of Fisheries and Marine Science. Bogor Agricultural Institute: Bogor; 2004
11. Bakhtiar S, Rohaya, dan Ayunda HM. Addition of milkfish bone flour (*Chanos chanos*) as a source of calcium and phosphorus in making baked donuts. Journal of Indonesian Agricultural Technology and Industry. 2019;11(1): 38-45.
12. AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists. Association of Official Analytical Chemist: Marlyand; 2005
13. Sudradjat M. Non-parametric statistics. Faculty of Agriculture. Padjadjaran University: Jatinangor; 1999.
14. Marimin M. Multiple criteria decision making techniques and applications. Grasindo: Jakarta; 2004.
15. Rochima E, Pratama RI, dan Suhara O. Chemical and organoleptic characterization of pempek with addition of carp bone flour from Cirata reservoir. Journal of Aquatics. 2015;6(1):79-86.
16. Baskoro P. Fortification of red tilapia bone flour on biscuit characteristics. Faculty of Fisheries and Marine Science. Padjajaran University: Jatinangor; 2008.
17. Winarno FG. Food chemistry and nutrition. PT. Gramedia Pustaka Utama: Jakarta; 2004
18. Soekarto ST. Organoleptic assessment for the food and agricultural products industry. Bharata Karya Aksara: Jakarta; 1985.
19. Fellows PJ. Food Processing Technology Principles and Practice, Second Edition. Woodhead Publishing Limited: England; 2000.
20. Ketaren S. Food oils and fats. Universitas Indonesia Press: Jakarta; 2005.
21. Oktaviana AS, Hersoelistyorini W, dan Nurhidajah. Protein content, flowering power, and organoleptic cookies with substitution of mocaf flour and kepok banana flour. Journal of Food and Nutrition. 2017;7(2): 72-81.
22. Subandoro RH, Basito, dan Atmaka W. Utilization of yellow millet flour and yellow sweet potato flour as substitution of wheat flour in making cookies on organoleptic and physicochemical characteristics. Journal of Food Technology. 2013;2(4): 68-74.
23. Kaya AOW. Utilization of catfish bone flour (Pangasius sp.) as a source of calcium and phosphorus in making biscuits. Faculty of Fisheries and Marine Science. Padjajaran University: Jatinangor; 2008.
24. Sumbodo J, Amalia U, dan Purnamayati L. Improved nutrition and characteristics of dumpling crackers with the addition of tilapia bone flour (*Oreochromis niloticus*). Journal of Fisheries Science and Technology. 2019;1(1): 30-36.
25. Pratama RI. Flavor characteristics of some smoked fish products in Indonesia. Faculty

of Fisheries and Marine Science. Bogor Agricultural Institute: Bogor; 2011.
26. Petenuci ME, Stevanato FB, de Morais DR, Santos LP, Souza N, and Visentainer JV. Composition and lipid stability of tilapia fishbone flour. Ciênc Agrotec. 2010;34(5): 1279-1284.
27. Pratama RI, Rostini I, dan Liviawaty E. Characteristics of biscuits with the addition of jangilus fish flour (*Istiophorus* sp.). Journal of Aquatics. 2014;5(1): 30-39.
28. Petenuci ME, Stevanato FB, Visentainer JEL, Matsushita M, Garcia EE, de Souza NE, dan Visentainer JV. Fatty Acid Concentration, Proximate Composition, and Mineral Composition in Fishbone Flour of Nile Tilapia. Archivoes Latino Americanos de Nutricion. 2008;58(1): 87-90.
29. Saidin M. Isolation of amylase enzyme producing fungus from sweet potato (*Ipomea batatas*). Ahmad Dahlan University: Yogyakarta; 2008.
30. Mahfuz H, Herpandi, dan Baehaki A. Chemical and sensory analysis of fish crackers dried with a greenhouse effect dryer. Journal of Fishery Products Technology. 2017;6(1): 39-46.
31. Marsaoly M dan Mahmud. Making sago plates with tuna fish bone flour substitution (*Thunnus albacores*). Global Health Science. 2020;5(1): 28-33.
32. Ngudiharjo A. Fortification of red tilapia bone flour on calcium content and preference level of dry noodles. Faculty of Fisheries and Marine Science. Padjadjaran University: Jatinangor; 2011.

© 2022 Ashila et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/89321