Global Scientific JOURNALS

GSJ: Volume 8, Issue 3, March 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

RED TILAPIA'S BONE FLOUR FORTIFICATION AS A SOURCE OF CALCIUM ON DRY CHOUX PASTRY PREFERENCE LEVEL

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KeyWords
Fortification, red tilapia, bone flour, preference level.

ABSTRACT

This research aimed to determine the percentage of the addition of red tilapia's bone flour on dry choux pastry preference level. This research was carried out from October - January 2020 in the Laboratory of Fishery Products Processing Technology, Faculty of Fisheries and Marine Science Unpad, Laboratory Testing Service, Faculty of Agricultural Industry Technology Unpad, and Laboratory Chemical Applications and Services - PPBS Chemistry Department Unpad. The method used is an experimental method with four treatments adding red tilapia bone flour based on the amount of flour, which is 0%; 7,5%; 10% and 12,5% with the parameters of the observation of the test of preference (appearance, aroma, texture, and taste). The results showed that the treatment of adding 10% red tilapia bone flour was most preferred compared to other treatments based on the test which *Bayes* had a higher alternative value of 7,64 with the calcium content of 0,486%, the water content of 2,46%, the protein content of 10,04%, ash content 5,01%, fat content 42,91% and hardness 1161,81 gf.

INTRODUCTION

Indonesia has various types of fish to meet the nutritional needs of the community both from freshwater and seawater. According to Afrianto and Liviawaty (1989), the protein content in fish meat is quite high, reaching 20% and is composed of several amino acids which have a pattern close to the pattern of amino acid requirements in the human body, and thus fish have a biological value of 90%. One type of freshwater fish that has been widely cultivated is red tilapia (*Oreochromis niloticus).* Red tilapia has a meaty aroma and a neutral taste and has meat that is thick enough so that it is suitable for filet use (Justicia et al. 2012).

The red tilapia fillet processing industry is very popular in the world market, this is marked by the demand for red tilapia that continues to increase every year. Demand for tilapia which tends to increase causing tilapia production in Indonesia has also increased. In 2015 tilapia fish production by 1,084,281 tons increased to 1,187,812 tons in 2016 (Directorate General of Aquaculture Fisheries 2016 KKP). Indonesia is an exporter of red tilapia to various countries. In the first quarter of 2015, it was noted that Indonesia's tilapia exports to the United States had reached 71,742 tons or worth 328 million USD (Sumandiarsa et al. 2017).

The process of processing and preserving fish is an important part of the fishing industry chain. Along with the development of the fishing industry and the level of consumption of fish in the household, the resulting waste will also increase. Fish processing business always produces waste in the form of solid waste (bones, heads, tails, scales) and liquid waste which will directly or indirectly hurt the environment because it causes pollution. According to Rohmah et al. (2015), fish processing waste in the form of fish bones is bulleyor takes up space, so it requires a large enough space for its storage. Therefore there is a need for efforts to utilize bone waste to reduce the negative impact caused if the waste is not utilized.

Bone is one form of waste produced from the fish processing industry which has the highest calcium content in the body of the fish. For food and nutrition, fish bones are very rich in calcium that humans need, because the main elements of fish bones are calcium, phosphorus, and carbonate. Fishbones can be processed into the flour so that its utilization can be efficient for the body. Processing of red tilapia bones into flour containing calcium can be applied to one form of food products that are easily accepted by the public, namely dry choux pastry.

Dry choux pastry is a type of product pastrymade from boiled dough that goes through the process of pengovenan twice.Dry choux pastry brownish yellow, crispy texture and has a savory taste. In the manufacture of dry choux pastry, all ingredients are boiled except eggs (Marom et al. 2014). Making dry choux pastry by adding red tilapia flour is an effort to utilize red tilapia waste which can improve the nutritional status of a population. Also, fortification of red tilapia flour can be an alternative in diversifying fishery products.

METHOD OF RESEARCH

Place and Time of Research

Thestudy was conducted inOctober - January 2020 at the Laboratory of Fisheries Product Processing, Faculty of Fisheries and Marine Sciences, Padjadjaran University for the manufacture of red tilapia bone flour, making of dry choux pastryand hedonic testing (preference test). Laboratory of Agricultural Industrial Technology, Faculty Test Services Laboratory of Padjadjaran University for calcium testing hardness. Chemical Application and Service Laboratory - PPBS Chemistry Department, Padjadjaran University for the analysis of water content, protein, ash, and fat.

Tools and Materials

The tools used in this study include gas stoves, digital scales, pans, cutting boards, plates or containers, presto, blenders, sieves Tyler 100 mesh, electric ovens, pans, spoons, mixers, pipingbag, measuring cups, and questionnaire sheets. While the materials used in this study include red tilapia bone waste, red tilapia bone flour, wheat flour, chicken eggs, margarine, salt, water, and baking powder.

Method

The method used in this study is experimental. The level of preference for dry choux pastry was analyzed using the non-parametric statistical method two-way analysis Friedman with test Chi-Square consisting of four treatments and 20 semi-trained panelists as a test, while the fortification of red tilapia bone flour based on the amount of wheat flour namely: 0%; 7,5%; 10% and 12,5%.

The parameters observedincluded red tilapia yield, dry choux pastry yield, hedonic test (appearance, aroma, texture, and taste), the hardness ofdry choux pastry,and proximate test (calcium content, water content, protein content, ash content, and fat content) on dry choux pastry.

RESULTS AND DISCUSSION

Red Tilapia Bone Flour Yield

Yield is the most important parameter to determine the economic value and effectiveness of a product or material process (Putranto et al. 2015).Red Tilapia Bone Flour Yield is presented in Table 1.

Table 1. Red Tilapia Bone Flour Yield

Weight (g)		
Red Tilapia	**Wet Bone**	**Bone Flour**
8000	358	163
Yield (%)		**45,53**

Based on the above results, the yield of red tilapia bone flour produced is 45,53%. According to the research of Justicia et al. (2012), the yield of red tilapia bone flour was 38,75%. The yield is not much different because the types of fish used are the same, namely red tilapia and the process of making red tilapia bone flour using the same procedure. Factors affecting bone yield include the fineness of the material used. According to Saranaung et al. (2018), the finer the material, the higher the yield produced. The yield of red tilapia bone flour produced is used as an ingredient that is added to the dry choux pastry as an effort to fortify calcium.

Dry Choux Pastry Yield

Based on the observation results of rendered dry choux pastry, it was found that the more the fortification of red tilapia bone flour fortification treatment, the lower the yield obtained. The yield of dry choux pastry is presented in Table 2.

Table 2. Dry Choux Pastry Yield

Red Tilapia Bone Flour (%)	Weight (g)		Dry Choux Pastry Yield (%)
	Dough	Dry Choux Pastry	
0	497	187	37,62
7,5	506	190	37,55
10	516	193	37,40
12,5	528	197	37,31

Based on the results above, the yield of dry choux pastry decreases with the increasing fortification of red tilapia bone flour. This is because a bone meal is hygroscopic which absorbs water. Red tilapia bone flour can absorb the water content in a dry choux pastry batter so that it will result in a decrease in water content. According to Nurfitriani et. al (2018), a decrease in water content that is high enough to cause gluten elasticity to decrease, the binding capacity or structure of the dough built by gluten is less integrated or less compact, causing dry bread to be a little hard and produce residual crumbs, thus making the yield less and less.

Appearance

Appearance is an important organoleptic parameter because it is a sensory trait that is first seen by consumers (Herliany et al. 2013). The appearance results are shown in Table 3.

Table 3. The Dry Choux Pastry Appearance Mean in Each Treatment

Red Tilapia Bone Flour (%)	Median	Appearance Mean
0	7	7,8 b
7,5	8	8 b
10	7	6,7 ab
12,5	5	6 a

Explanation: The mean followed by the same letter showed that there are no significant differences according to the multiple comparison test at 95% confidence interval.

Based on statistical tests, the fortification of red tilapia bone flour in dry choux pastry did not give a real difference in appearance at 0%, 7,5%, and 10% treatments, while 12,5% treatment was significantly different from the 0% and 7,5% treatments. where the color is slightly brown compared to other treatments. The brownish color of dry sus cakes is caused by a reaction non-enzymatic browning (Maillard). Reaction Maillard is a reaction between carbohydrates and proteins that are affected by temperature, resulting in a color change to brown called melanoidin. Melanoidin is formed when glucose and lysine amino acids react at high temperatures. The lysine amino acid comes from the breakdown of the helical structure and the collagen peptide bond due to gradual heating. A collagen is mostly a form of protein in a bone meal (Rachmansyah et al. 2018).

Aroma

The aroma is one of the factors that will determine consumers to choose products because the aroma can attract consumers' attention to these food products (Bakhtiar et al. 2019). The aroma results are shown in Table 4.

Table 4. The Dry Choux Pastry Aroma Mean in Each Treatment

Red Tilapia Bone Flour (%)	Median	Aroma Mean
0	7	6,7 a
7,5	7	7,1 a
10	8	7,6 a
12,5	7	6,6 a

Explanation: The mean followed by the same letter showed that there are no significant differences according to the multiple comparison test at 95% confidence interval.

Based on statistical tests, fortification of red tilapia bone flour did not significantly affect the aroma of dry choux pastry. The dry choux pastry has a distinctive aroma of dry choux pastry and the aroma of red tilapia bone which is not detected by the panelist senses because red tilapia bone flour has a fishy aroma that is not too fragrant, so there is no difference in aroma from the addition of red tilapia flour. According to Nurfitriani et. al. (2018), red tilapia bone flour has a neutral and fishy aroma that is not too fragrant.

The aroma of dry choux pastry is influenced by the components of the ingredients used in making dry choux pastry including salt, margarine, and eggs. The use of salt, margarine, and eggs in cake processing will be able to increase the distinctive aroma of

the product. According to Oktariani et al. (2017), salt and margarine can increase the aroma in the processing during combustion. While materials such as eggs will produce aroma compounds such as aldehydes that can produce aromas such as fruit and butter, as well as pyrazine compounds that can produce distinctive aromas on a sponge (Imami and Sutrisno 2018).

Texture

The texture is one of the parameters that play an important role in the acceptability of a food product (Agustina et al. 2016). The texture results are shown in Table 5.

Table 5. The Dry Choux Pastry Texture Mean in Each Treatment

Red Tilapia Bone Flour (%)	Median	Texture Mean
0	5	5,9 a
7,5	7	6,2 ab
10	7	6,9 ab
12,5	9	7,6 b

Explanation: The mean followed by the same letter showed that there are no significant differences according to the multiple comparison test at 95% confidence interval.

Based on statistical tests, the fortification of red tilapia bone flour in dry choux pastry did not give a significant texture difference in the treatment of 7,5%, 10%, and 12,5% while the 0% treatment was significantly different from the 12,5% treatment where the texture was less crisp compared to other treatments. The highest average texture value is in the treatment of adding 12,5% red tilapia bone flour which is 7,6 (likes) with the texture of a crisp dry choux pastry when bitten in the mouth. This is due to the addition of a greater amount of red tilapia bone flour so that it will add crispness to the dry choux pastry when bitten in the mouth. By the statement Darmawangsyah et al. (2016), that the greater addition of fishbone meal will add crispness to the resulting cookies. The crispness of dry choux pastry is caused by the hydrophilic groups in the protein contained in the fishbone meal much more than starch, thus making the texture more savory and crispy.

Taste

Taste is the most important factor in determining whether or not a food product is preferred compared to other factors because the taste is a determining factor for a product to be accepted or not (Rachmansyah et al. 2018).The taste results are shown in Table 6.

Table 6. The Dry Choux Pastry Taste Mean in Each Treatment

Red Tilapia Bone Flour (%)	Median	Taste Mean
0	7	6,8 a
7,5	7	7,1 a
10	8	7,8 a
12,5	7	6,7 a

Explanation: The mean followed by the same letter showed that there are no significant differences according to the multiple comparison test at 95% confidence interval.

Based on statistical tests, all treatments had no significant effect on the taste of dry choux pastry. That is because red tilapia bone flour has a tasteless taste. By the statement Nurfitrianiet. al. (2018), that red tilapia bone flour has a tasteless or tasteless taste. The lowest average value of the taste of dry choux pastry was found in the treatment of adding 12,5% red tilapia bone flour which was 6,7 (liked). This is due to the large amount of red tilapia bone flour that is added to the treatment of adding 12,5% red tilapia bone flour which results in a stronger fish bone flour flavor so that the distinctive taste of dry choux pastry will be reduced, as well as more chalky. According to Bunta et al. (2013), the main mineral component of fishbone flour is calcium which can give a chalky taste, so the more concentration of fishbone flour is added, the taste in fishbone flour is increasingly felt so that the level of panelists' preference for bagea cake decreases.

Decision Making by bayes method

The calculation results in determining the best treatment using the Bayes method by considering the appearance, aroma, texture and taste criteria of red tilapia bone flour dry choux pastry are shown in Table 7.

Table 7. Decision Matrix of Red Tilapia Bone Flour Dry Choux Pastry Assessment with Bayes Method

Treatment (%)	Criteria				Alternative Value
	Appearance	Aroma	Texture	Taste	
0	7	7	5	7	6,64
7,5	8	7	7	7	7,18
10	7	8	7	8	**7,64**
12,5	5	7	9	7	6,99
Criteria Value	0,18	0,14	0,18	**0,50**	

Based on the calculation of the weight criteria for appearance, aroma, texture, and taste of dry choux pastry obtained the highest number of criteria weight is the flavor parameter of 0,50 followed by the appearance, aroma, and texture. This shows that the taste criteria are the panelists' main consideration in choosing the product of dry choux pastry. Based on all parameters observed, the addition of 10% red tilapia bone flour was the panelist's most preferred treatment compared to other treatments.

Hardness Level

Hardness testing was carried out on the treatment without the addition of red tilapia bone flour and the most favored dry choux pastry treatment by the panelists based on the level of preference (10%).The results of the test for hardness of dry choux pastry are presented in Table 8.

Table 8. The hardness of Dry Choux Pastry

Red Tilapia Bone Flour (%)	Hardness of Dry Choux Pastry (g Force)
0	921,91
10	1161,81

Based on the above results, the greater the amount of addition of red tilapia bone flour to dry sus cakes, the hardness level of dry choux pastry increases.The hardness of the dry choux pastry is caused by the addition of red tilapia bone flour containing calcium and phosphorus which causes the water content of the dry choux pastry to be lower to cause the higher hardness value. By the statement Syadeto et al. (2017), the more addition of fish bone meal, the harder the product is related to the high calcium and phosphorus content in fishbone meal so that the hardness of the product will also change according to the amount of fishbone meal concentration.

Proximate

The proximate test is carried out to determine the nutritional content contained in dry choux pastry the most susceptible matter by panelists was based on the results of the assessment of the level of preference of the dry choux pastry, namely the treatment of adding 10% red tilapia bone flour and also testing the treatment without adding red tilapia bone flour. The results of the proximate analysis of the sample of dry choux pastry are presented in Table 9.

Table 9. Proximate Analysis Results of Dry Choux Pastry Samples(%)

Parameters (%)	Treatment(%)	
	0	10
Calcium Content	0,028	0,486
Water Content	3,45	2,46
Protein Content	9,16	10, 04
AshContent	2,52	5,01
Fat Content	44,69	42,91

In general, the addition of red tilapia bone flour can increase calcium content, protein content, and ash, while water and fat content tend to decrease. Changes in the increase and decrease will be explained in the next section.

Calcium Content

The value of the calcium level of the treatment is 10% greater than the treatment of 0%. This shows that the addition of red tilapia flour to dry choux pastry can increase the calcium content in dry choux pastry. This is because red tilapia flour is the highest mineral source in the raw material for making dry choux pastry. The main minerals found in fish bones include calcium, phosphorus, and carbonate (Susanti et al. 2011). Fishbones contain a lot of calcium in the form of calcium phosphate as much as 14% of the total

bone structure. This form of calcium phosphate complex is found in bones and can be absorbed by the body well around 60-70% (Edam 2016).

Water Content

The value of water content shows a decrease in yield along with the increase of red tilapia bone flour. This is because the water contained in dry choux pastry will be bound by Ca^{++} found in fishbone flour, so the water content decreases. According to Darmawangsyah et al. (2016), that with the addition of fishbone meal also means the addition of Ca^{++} which will find particles ^{-}OH which are part of the water elements or H_2O so that the water content decreases with the addition of fishbone meal. Also, during the roasting process, a lot of water is evaporated from the dry choux pastry mixture, causing the water content to decrease. According to Haryani et al. (2017), that in the roasting process the water content will decrease due to the process of moving the mass of water from the middle of the product to the surface. While on the surface, the water content is very quickly evaporated so that by the time of roasting, the water content of the material has been lost a lot. Water content in pastries has fulfilled SNI 01-2973-1992 which is a maximum of 5%.

Protein Content

The value of the protein content of the resulting dry choux pastry rises together with the increasing amount of red tilapia flour. This is influenced by the high protein content in the red tilapia bone flour that is added, so the protein content of the dry choux pastry is increasing. Tilapia bone meal contains 40,8% protein (Petenuciet al*.* 2008). The use of raw materials that contain high protein will produce processed products that have high protein content, and vice versa (Hasniar et al. 2019). In addition to the use of added ingredients, the high and low values of protein are largely influenced by water content. According to Pratama et al. (2014), that the high or low measured protein value can be influenced by the amount of water content lost (dehydration) from the material. The measured protein value will be even greater if the amount of water lost is greater. The protein content of dry sus cake has fulfilled SNI 01-2973-1992 which is a minimum of 9%.

Ash Content

The value of ash content increases with an increasing amount of red tilapia bone flour. This is because red tilapia bone flour contains a lot of minerals, so the higher the amount of addition of red tilapia bone flour, the higher the ash content produced. By the statement Darmawangyah et al. (2016), the value of high ash content in pastries with the addition of fishbone flour treatment was caused by the main constituent components of fish bones containing living cells in the form of mineral salts. Mineral salts consisting of several elements include 80% calcium phosphate and the rest consists of calcium carbonate and magnesium phosphate. The ash content of dry choux pastry does not meet SNI 01-2973-1992 which is a maximum of 1.5%.

Fat content

The value of fat content shows a decrease with an increasing percentage of red tilapia bone flour. This can occur because the addition of a fishbone meal causes ash to increase resulting in decreased fat content. Ash content comes from mineral salt components consisting of calcium carbonate and magnesium phosphate. Decreased fat levels are caused by fat reacting with calcium and magnesium then forming deposits and eventually becoming crust, so that the fat read will decrease. According to Cholil et al. (2016), calcium and magnesium compounds react with a mixture of fat and base to form a precipitate. Because calcium and magnesium compounds are relatively difficult to dissolve in water, they tend to separate from the solution in the form of a precipitate or precipitate which eventually becomes a crust. The fat content value of dry choux pastry has fulfilled SNI 01-2973-1992 which is a minimum of 9.5%.

Conclusion

Based on the results of the study, fortification of red tilapia bone flourup to 12,5% is still preferred by panelists based on hedonic tests. The treatment of adding 10% red tilapia bone flour is most preferred compared to other treatments based on the test *Bayes* having a higher alternative value of 7,64 with the calcium content of 0,486%, water content of 2,46%, the protein content of 10,04%, the ash content of 5,01%, fat content 42,91% and hardness 1161,81 gf.

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