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RED TILAPIA'S BONE FLOUR FORTIFICATION AS A SOURCE OF CALCIUM ON DRIED BREAD'S ACCEPTANCE LEVEL

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KeyWords

Fortification, calcium, red tilapia, red tilapia's bone flour, dried bread, chemical test, physics test, acceptance level.

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ABSTRACT

Processing of red tilapia's bone into flour with high calcium content can be applied into one type of food product that is easly accepted by people is dried bread. This aim of this research was to determine the level of addition red tilapia's bone flour on dried bread's acceptance level. This research was carried out from January – August 2018 i the Laboratory of Fishery Products Processing Technology, Faculty of Fisheries and Marine Science and Laboratory Testing Service, Faculty of Agricultural Industry Technology. The method of that research was descriptive method for the yield of bone flour and dried bread and chemical tests (calcium content and water content) and physics test (hardness test and volume expanding), experimental method with 6 treatments were 0%, 5%, 7,5%, 10%, 12,5%, 15% of red tilapia's bone flour addition level based on the amount of wheat flour added in the dried bread formulation and 20 panelist as replication was used in this research. Based on the result of the panelist acceptance level test for appearance, aroma, texture, and taste of dried bread in the treatment of fortification up to 15% is still accepted. The treatment of adding red tilapia's bone flour 12,5% is preferable compare to other treatments based on Bayes test has a higher alternative value of 7,52 with calcium content 1,614%, water content 3,1%, volume expanding 39,8%, and hardnes 6043,26 gf.

INTRODUCTION

Calcium is the most abundant mineral found in the body, which is 1.5%-2% of body weight. Ninety-nine percent of calcium in the body is found in the bones and teeth, while the remaining 1% is in the nerves, muscles, and blood (Muchtadi and Palupi 1993). The common source of calcium consumed by people is milk. Based on Sulistia's (2007) research in Mulyani (2009), various types of food sources of calcium besides milk must be introduced to the community so that calcium needs are met. One source of calcium that has not been explored is the calcium source of aquatic animals, especially fish bones. Fish bones can be obtained from the remaining byproducts of filetic processing such as red tilapia.

Red tilapia bones that have been processed into flour have mineral content and the highest is calcium. This can be an alternative source of fisheries waste utilization, especially fish bones. Processing red tilapia bones into flour with high calcium content can be applied to one form of food product that is easily accepted by the community, namely dry bread.

Bread is a source of carbohydrates besides rice and noodles. The advantage of bread compared to rice and noodles is that the presentation is more practical because it can be directly eaten so that it is suitable for people who are busy (Justicia 2012). Bread has a relatively short shelf life because the water content in bread is still quite high. The development of bread products into dry bread can be an alternative to extend the bread shelf life.

The consumers' level of acceptance of a product that is going to be produced must be considered. The fortification of red tilapia bone flour containing calcium in dry bread can have an effect on the characteristics of bread which includes chemical, physical, and organoleptic. In chemical factors, it can be seen from the changes in water content and calcium content. The physical factors can be seen from the level of hardness and the level of volume expansion, and for organoleptics can be seen from the differences in appearance, aroma, texture, and taste (Baskoro 2008). This study aims to determine the level of addition of red tilapia bone flour on dry bread to the level of preference.

RESEARCH METHOD

Time and Location of Research

The research was conducted in January-July 2018 at the Fisheries Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran for the manufacture of red tilapia bone flour, dry bread making, hedonic testing (favorite test), development testing, and water content analysis and in the Test Services Laboratory, Faculty of Agricultural Industry, Universitas Padjadjaran for the analysis of calcium level and hardness level.

Tools and Materials

The tools used in this study include gas stove, digital scale, pan, cutting board, plates or containers, presto, blender, 80 mesh Tyler sieve, electric oven, spoon, knive, mixer, baking pan, measuring cup, and styrofoam plate.

The materials used in this research include red tilapia bone waste, water, red tilapia bone flour, milk, wheat flour, sugar, salt, yeast, eggs, shortening, and bread improver.

Research Method

The method used in this study is descriptive and experimental methods. Descriptive method is carried out for the yield of bone flour and dry bread as well as chemical tests (calcium level and moisture level) and physical tests (hardness test and volume expnsion test). Six treatments for adding red tilapia bone flour based on the amount of flour, namely:

A. The addition of 0% red tilapia bone flour
B. The addition of 5% red tilapia bone flour
C. The addition of 7.5% red tilapia bone flour
D. The addition of 10% red tilapia bone flour
E. The addition of 12.5% red tilapia bone flour
F. The addition of 15% red tilapia bone flour

The hedonic test uses 20 semi-trained panelists as replicates (Soekarto, 1985) to determine the level of acceptance of panelists against dry bread. The panelists in this study were students of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran who had experience in organoleptic assessment and were familiar with the products being tested.

The Observed Parameter

The parameters observed were the yield of bone flour and dry bread, chemical, physical, and organoleptic. The chemical parameters tested werevcalcium levels and moisture content in dry bread. The physical parameters tested were hardness and efflorescence level of dry bread. The organoleptic parameters to be tested are preference (hedonic) which includes several characteristics such as appearance, aroma, texture, and taste.

Data Analysis

The parameters observed were the yield of bone flour and dry bread, chemical, physical, and organoleptic. The chemical parameters tested were calcium levels and moisture content in dry bread. The physical parameters tested were the hardness and volume expansion level of dry bread. The organoleptic parameters to be tested are preference (hedonic) which includes several characteristics such as appearance, aroma, texture, and taste.

$$X^2 = \left[\frac{12}{NK\,(K+1)}\sum_{t=l}^{k}(Rj)^2\right] - 3N\,(K+1)$$

Explanation:

X^2 = Friedman Test Statistics

N = Reiteration

Rj = Total of *ranking* for every treatments

K = Treatment

If there is a same number, the correction factor (FK) is calculated using the following formula:

$$FK = 1 - \frac{\sum T}{NK\,(K^2-1)}$$

$$Ho = \frac{X^2}{FK}$$

Significant value of H observation price can be done using the Chi-Square critical price table with db = k -1: α = 0.05. Decision rules for testing hypotheses, namely:

Ho : the treatment did not give a significant difference at the level of α = 0.05

H_1 : the treatment gives a significant difference at the level of α = 0.05

If the price H <X ^ 2 α (k-1), then Ho is accepted and H1 is rejected, and if the price is H> X ^ 2 α (k-1), then Ho is rejected and H1 is accepted. If H1 is accepted, then the treatment gives a real difference and continues to find out the median value that is not the same or to find out the difference between treatments using the Multiple Comparison test with the following formula:

$$|Ri - Rj| \leq z\left[1\frac{\alpha}{K\,(K-1)}\right]\sqrt{\frac{NK\,(K+1)}{6}}$$

Explanation:

Ri – Rj = difference in average ranking

Ri = average rating of the sample i

Rj = average rating of the j^{th} sample

α = *experiment wise error rate* on 0,05

N = the number of combined observation data

K = the number of treatment

To decide the panelists' decision on the preferred product criteria pairwise comparison were done. Then proceed with the Bayes method in making the best decision from several alternatives or treatments by considering the weighting of criteria and median values.

RESULT AND DISCUSSION

Red Tilapia Bone Flour Yield

The yield is a percentage comparison between the weight of the part of the material that can be utilized with the total weight of the material (Putri 2011).

Table 1. The yield of Red Tilapia Bone Flour

Weight (g)		
Red Tilapia	**Wet Bone**	**Bone Flour**
10.000	694	222
Yield (%)	6,94	31,99

The fish used in this study amounted to 10 kilograms. Then the fish was filleted, separated from the bones, head, skin and stomach contents. The weight of the red tilapia's wet bone is 694 grams. The amount of red tilapia bone flour produced from the bone is 222 grams, so that the yield of red tilapia bone flour is 31.99%. In Ngudiharjo's research (2011) the yield of red tilapia bone flour was 33.73%. The yield is not much different because the fish used are the same type of fish, namely red tilapia and the making process uses the same procedure. Factors that influence the yield of bone flour include the smoothness of the material used. According to Triaksani (2006) the finer the material used, the higher the yield produced. The resulting bone flour is used as an ingredient added to dry bread as an effort to calcium fortification.

Dry Bread Yield

Based on the results of dry bread yield research, it was found that the more the bone flour addition increases the lower the yield. The yield of dry bread is presented in Table 2.

Table 2. Dry Bread Yield

Treatment (%)	**Weight (g)**		**Dry bread yield (%)**
	Dough	**Dry bread**	
0%	562	472	83,98
5%	576	483	83,85
7,5%	581	486	83,65
10%	592	493	83,27
12,5%	601	498	82,86
15%	627	516	82,30

The highest dry bread yield in the control treatment was 83.98% and the lowest was in the addition of bone flour by 15% which was 82.30%. This shows that the decrease in the percentage of dry bread yield is influenced by the level of addition of red tilapia flour. This is because the addition of red tilapia bone flour causes a decrease in water content because bone flour is absorbing water so that the divider for moisture content increases. The decrease in moisture content and calcium content is high enough to cause gluten elasticity to decrease, the binding capacity or structure of the dough built by gluten is less fused or less compact, causing dry bread to be a little hard, rough, uneven, and the amount of residual crumbs that make the yield decrease . In accordance with Kaya's statement (2008) the high content of calcium and phosphorus in bone flour affects the product texture which is getting harder.

Dry Bread Expansion

The volume expansion of dry bread was measured based on the percentage difference in the volume of dry bread after baking and before baking it compared to the volume of dry bread before baking (Lestari 2003).

Tabel 3. Dry Bread Expansion

Treatment (%)	Dry Bread Expansion (%)
0	68,9
5	56,0
7,5	56,0
10	52,0
12,5	39,8
15	39,8

These results indicate that the decrease in the percentage of dry bread expansion is influenced by an increase in the addition of red tilapia bone flour. This is due to the bone flour which is absorbing water in the mixture. Decreasing water content causes the level of gluten formation to decrease. According to Purnomo (1994) in Rusdianto (2006) more dough that forms gluten has a higher volume because of the increasing holding capacity of CO_2 gas. The expansion volume decreases, thus the pore diameter of the bread will decrease. Mudjisihono (1993) in Suhartini (2006) states that gluten serves to equalize the uniformity of shapes or pores to the bread produced.

The expansion of a good volume of bread before the roasting process will make the bread rise, decreasing gluten content in the bread mixture will affect the dough so that the resulting bread becomes less rising (Lange 2004).

Dry Bread Moisture Content

Moisture content is the amount of water contained in food that can affect the texture, appearance, and taste of food (Winarno 1997).

Tabel 4. Moisture content

Treatment (%)	The Average of Moisture content (%)
0	4,95
5	4,40
7,5	3,80
10	3,48
12,5	3,10
15	2,65

According to SNI No. 01-2973-1992, the biscuit quality standard for the moisture content is a maximum of 5%, dry bread products uses biscuit quality standards because both are baked products and the ingredients are not much different. Overall the water content of dry bread with the addition of red tilapia bone flour is still in accordance with quality standards.

The measurement result of moisture content in dry bread showed that with the increase of red tilapia bone flour addition on dry bread ingredients reduced the moisture content on dry bread. The moisture level contained in dry bread with the addition of red tilapia bone flour is lower because bone flour is absorbing water so that it causes dry bread with the addition of red tilapia bone flour hard textured and not easily broken. In accordance with Maulida's statement (2005) the moisture content tends to decrease with the addition of bone flour because of the addition of Ca particles which will bind OH particles which are part of the water elements (H_2O). And also in the roasting process the moisture content will decrease due to the process of moving the water from the center of the product to the surface. While on the surface, the moisture content is very rapidly experiencing evaporation so that when the grill is finished, the moisture content of the material has been lost (Haryani et al. 2017).

Dry Bread Hedonic Testing

Testing of organoleptic characteristics aims to determine the level of preference for appearance, aroma, texture, and taste.

The Appearance of Dry Bread

Appearance is the first characteristic that consumers assess from a product. The appraisal of appearance aims to find out the acceptance of panelists assessed from the appearance of dry bread.

Table 4. Average Hedonic Test Based on Appearances

Treatment (%)	Median	Average of Appearance
0	7	7,2b
5	7	7,3b
7,5	7	7,3b
10	7	7,4b
12,5	5	5,3a
15	5	5,3a

The average value of dry bread appearance that tends to be preferred by panelists from all treatments was found in the fortification of red tilapia bone flour by 0%, 5%, 7.5%, and 10% because the appearance of the dry bread is intact and flat and the color is brownish yellow. The appearance of dry bread with the addition of 12.5% and 15% red tilapia bone flour has the appearance of brownish color. The color of the dry bread is brown due to the presence of non-enzymatic browning which is a chemical process that produces brown color in food in the absence of enzyme activity in the form of a Maillard reaction between reduction sugars and proteins forming Mellanoidin compounds (Indriyani 2007).

Based on the test, the fortification of red tilapia bone flour on dry bread did not give a significant difference in the appearance of 0%, 5%, 7.5%, and 10%, while the treatment of 12.5% and 15% was significantly different from other treatments where in the 12.5% treatment the color of the dry bread is brownish, while in the 15% treatment the color of the dry bread was too brown. In the making of the bread when roasting in the oven, some of the water is lost, starch is gelatinized and protein clumps so that it forms on the surface of the bread and caramel formation reaction occurs and forms a brown color on the bread (Fatmah 2005).

The Aroma of Dry Bread

Aroma assessment aims to determine the delicacy of food ingredients based on the sense of smell. According to Soekarto (1985) some food industries concluded that aroma testing is very important because it can provide a preferred or dispreferred assessment of food products.

Table 5. Average Hedonic Test Based on Aroma

Treatment (%)	Median	Average of Aroma
0	7	6,6a
5	7	6,7a
7,5	7	6,9a
10	7	6,9a
12,5	7	7,4a
15	5	6,5a

Based on the statistical tests on all treatments, there is no significant effect on the aroma of dry bread and the aroma of dry bread is still favored by the panelists up to 15% of red tilapia bone flour fortification. This is because red tilapia bone flour has a savorless aroma which causes no difference in the aroma from the addition of bone meal. In accordance with Baskoro's statement (2008) red tilapia bone flour has a savorless and faint fishy aroma.

According to Benita (2001) the aroma is not determined by just one component but by certain components that can cause a dis-

tinctive smell, for example from the fermentation process that can cause flavor-forming components (acetic acid, aldehydes, and esters) as well as ingredients used such as fat , flour, and eggs. The scent on dry bread is also affected by the baked aroma, this is because the Maillard reaction and the degradation of Strecker produce different scents according to the combination of free amino acids and sugar in certain foods. Each amino acid produces a distinctive aroma when heated with sugar given, because of the production of certain aldehydes (Fellows 2000).

The Texture of Dry Bread

Texture is one of the factors that determine the level of panelists' preference for food products. According to Man (1997) texture can affect food image and is important in food products.

Table 6. Average Hedonic Test Based on Texture

Treatment (%)	Median	Average of Texture
0	7	6,6ab
5	7	6,8ab
7,5	7	6,7ab
10	7	7,0ab
12,5	9	7,9b
15	7	5,7a

Dry bread treatment 0-15% is still said to be preferred because the median value is 7 which means it is preferred. Based on statistical tests on all treatments no significant effect on dry bread texture and dry bread texture is still favored by panelists up to 15% red tilapia bone flour fortification. In the 15% treatment there was a decrease in the average texture because the addition of red tilapia flour resulted in a decrease in gluten due to the high content of calcium and phosphorus. This causes the bonding capacity or structure of the dough built by gluten to be less compact so that the dry bread becomes a little hard and rough. In accordance with Maulida's statement (2005), the addition of bone flour results in an anti-elasticity reaction which decreases the elastic properties of gluten, making the product texture rather hard and ultimately not favored by panelists.

The Taste of Dry Bread

The acceptance of panelists towards a product is strongly influenced by the characteristics of taste, although other parameters are good, but the taste is dispreferred, the product will be rejected (Soekarto 1985).

Table 7. Average Hedonic Test Based on Taste

Treatment (%)	Median	Average of Taste
0	7	6,7a
5	7	6,7a
7,5	7	6,9a
10	7	6,9a
12,5	8	7,6a
15	7	6,6a

The dry bread with the treatment 0-15% is still said to be preferred because the median value is 7 which means it is preferred. Based on the statistical tests on all treatments, there is no significant effect on the taste of dry bread and the taste of dry bread is still favored by the panelists up to 15% red tilapia bone flour fortification. This is because red tilapia bone flour is tasteless and does not have a distinctive taste. It is in accordance with Baskoro's statement (2008) that red tilapia bone flour is tasteless and relatively ordinary. The addition of red tilapia bone flour affects the taste of dry bread due to the high content of calcium and phosphorus from bone meal resulting in a slightly calcareous after-taste of the product produced (Rich 2008).

Decision Making Using the Bayes Method

Decision making on the relative weight values of the criteria of appearance, aroma, texture, and taste of dry bread is done by pairwise comparison.

Table 8. Assessment Decision Matrix with the Bayes Method

Treatment (%)	Median Value				Final Score
	Appearance	Aroma	Texture	Taste	
0	7	7	7	7	7.00
5	7	7	7	7	7.00
7,5	7	7	7	7	7.00
10	7	7	7	7	7.00
12,5	5	7	9	8	**7.52**
15	5	5	7	7	6.68
Criteria Weight	0,16	0,12	0,12	**0,60**	

The result of the assessment data using Bayes method shows that taste is the most important criterion in the final decision of the panelist in choosing dry bread with a weight criterion of 0.61. Then followed by appearance with a weight criterion of 0.15 and for the aroma and texture with the same weight criteria is 0.12. Although the assessment of other characteristics is good, but if the taste of dry bread is not good or not preferred by panelists, then the dry bread product will be rejected by the panelists (Marisa 2009). This shows that the taste criterion is the main consideration in choosing dry bread products. Taste is the response of the tongue to a food. In oral stimulation, food ingredients that have properties stimulating the taste nerves in the tongue will cause certain sense (Winarno 2004).

Based on the calculation using Bayes method, it was found that dry breads with the addition of red tilapia bone flour were all received or favored by the panelists, but the treatment of 12.5% obtained a higher alternative value, namely 7.53 (preferred), then 0% treatment, 5 %, 7.5%, and 10% obtain alternative value 7 (preferred). The lowest alternative value is in the treatment of adding 15% red tilapia bone flour which is 6.54 (normal). Based on all parameters observed, the addition of 12.5% red tilapia bone flour was preferred the most by panelists compared to other treatments.

Calcium Level

The calcium contained in the samples comes from the calcium contained in red tilapia bone flour and milk. Calcium is the most needed mineral in bones and teeth growth (Asni 2004). The dry bread tested in this study was dry bread without the fortification of red tilapia bone flour and the dry bread which was most preferred by panelists is the dry bread with the addition of bone flour as much as 12.5%.

Table 9. Calcium Levels

Treatment (%)	Calcium Levels (%)
0	0,053
12,5	1,614

The addition of red tilapia bone flour to dry bread can increase the calcium content of dry bread. The main elements of fish bones are calcium, phosphorus, and carbonate. Meanwhile, those found in small amounts are magnesium, sodium, chloride, hydroside, and sulfate (Maynard and Loosli 1956 in Ngudiharjo 2011).

The greater content of calcium in dry bread with the addition of red tilapia bone flour becomes its own advantage. This shows that the dry bread with the addition of red tilapia bone flour besides being preferred also has a nutritional content in the form of greater calcium content compared to dry bread without the addition of red tilapia bone flour.

Hardness Level

The level of hardness is related to crispness, which is whether it easy or not for the dry bread to be broken.

Table 10. Hardness Level

Treatment (%)	Average of dry bread hardness level (*g force*)
0	2803,01
12,5	6043,26

In the fortification of red tilapia bone flour of 12.5%, the hardness value is 6043.26 gf, which means that it is harder than the treatment without the addition of red tilapia flour, which is 2803.01 gf. The greater the average value of hardness means that dry bread is less easily destroyed (harder). In accordance with Nurafifah's statement (2015), the addition of the dry bone flour makes the product harder. The results of the research by Syadeto et al. (2017) showed an increase in the hardness value resulting from each increase in the treatment of adding red tilapia bone flour to the product. The level of hardness of dry bread added with bone flour will be higher due to the anti-elastic reaction (elastic properties of gluten decreases). The addition of bone flour results in the binding of OH particles which are part of the water element (H2O) so that the amount of water decreases and the gluten elasticity decreases. Gluten plays an important role as a building material for dough structures (Maulida 2005).

CONCLUSION

The result of the study of the panelists' preference for appearance, aroma, texture, and taste of dry bread shows that the dry breads in the treatment of fortification up to 15% are still preferred. The treatment of adding red tilapia bone flour of 12.5% is preferred compared to other treatments based on Bayes test. It has a higher alternative value of 7.52 with calcium levels of 1.614%, 3.1% moisture content, volume expansion rate of 39.8%, and violence of 6043.26 gf. Based on the hedonic test, the average value of appearance is 5.3, the aroma is 7.4, the texture is 7.9, and the flavor is 7.6.

SUGGESTION

Based on the results of the study several things can be suggested, including:

1. To get the preferred dry bread with the addition of red tilapia bone flour as a source of calcium, it is better to use the 12.5% red tilapia bone fortification.
2. It is necessary to conduct a research on the shelf life of red tilapia bone flour as well as dry bread with the addition of bone flour.
3. It is necessary to apply the addition of red tilapia bone flour to other forms of products such as other bakery products.

References

[1] Anggorodi, R. 1985. *General Fodder Science*. Gramedia Pustaka Utama. Jakarta,

[2] Baskoro, P. 2008. Red Tilapia's Bone Flour on Biscuit Characteristics. Sumedang. *Unpad Journal of Fisheries and Marine Science*.

[3] Kaya, A. 2008. Utilization of Patin Fish Bone (*Pangasius* sp.) as A Source of Calcium and Phosphorus in Biscuit. Bogor. *IPB Journal of Fisheries and Marine Science*.

[4] Maulida, N. 2005. Utilization of Madidihang's Bone Flour as Supplements in the Making of Crackers. Bogor. *IPB Journal of Fisheries and Marine Science*.

[5] Ngudiharjo, A. 2011. Red Tilapia's Bone Flour Fortification on Dry Noodle's Calcium Content and Acceptance Level. Sumedang. *Unpad Journal of Fisheries and Marine Science*. 2 (1) : 9 – 19.

[6] Nurafifah, S. 2014. Jambal's Bone Flour Fortification on Cookies's Acceptance Level. . Sumedang. *Unpad Journal of Fisheries and Marine Science*. 5(1).

[7] Rahmansyah. 2014. Jangilus's Bone Flour Fortification as A Source of Calcium on Biscuit's Acceptance Level. Sumedang. *Unpad Journal of Fisheries and Marine Science*. 5(1) : 44 – 50.

[8] Soekarto, S. T. 1985. Organoleptic Assessment for Food Industry and Agricultural Products. Bharata Karya Aksara. Jakarta.

[9] Standar Nasional Indonesia (SNI). 1996. SNI 01-3840-1995. *Roti*. Badan Standarisasi Nasional. Jakarta.