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Biscuit Formulation with Addition of Mozambique Tilapia Fish, Round Sardinella Fish and Brown Rice Flour

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Abstract: ***The focus of this study was the formulation of biscuit with the addition of Mozambique tilapia fish, round Sardinella fish, and brown rice flour which were widely accepted by the community. The objective of the study was to formulate biscuit added by Mozambique tilapia fish, Sardinella fish, and brown rice flour. The experiment was conducted in December 2016-January 2017 in Family Welfare Education Laboratory. Data collected was the quality of biscuit (color, flavor, texture, taste, and overall) and the preference. Data were analyzed by Mean and ANOVA. The result of research indicates that the highest score and most similar to the control biscuit was formula F79 which was composed of 8 g wheat flour, 3 g cornstarch, 2 g tapioca starch, 3 g Mozambique tilapia fish flour, 3 g Round sardinella fish flour, 28 g brown rice flour, 12 g margarine, 29 g yolk, and 12 g refined sugar.***

Keywords: Biscuit, Formulation, Fish flour

1. Introduction

Nutrition problem was associated with educational achievement and schooling period. Malnourished children caused an issue in their growth and development resulting in less educated, poor, less healthy, and more susceptible to diseases adult [1][2][1]. The result of the cohort study [3] concluded that small birth size and stunting was associated with low adult height, body fat mass reduction, low schooling period, impaired intellectual function, and later giving birth to low birth weight baby.

Optimization of nutrition improvement for school children was conducted through diversification of food developed formula. Diversification is considering nutrition aspect, health benefit, acceptance, shelf life and local food sources, namely freshwater fish (Mozambique tilapia fish/ *Oreochromis mossambicus*), marine fish (round sardinella/ *Sardinella aurita*), and brown rice (O*ryza nivara*). Fish was one of the food less preferred by the community due to the fishy smell and taste, and also many bones unless of high nutrient content, especially protein and calcium [4][5][6].
Fish contains collagen and the production of collagen extraction which can be extracted to produce gelatin. Collagen in fish is considered as a potential raw material for making gelatin. The spotted oceanic triggerfish as one type of fish as raw material for making gelatin. Approximately 49% of the weight of the fish as a source of gelatin and there are 51% of the fish is skin and bone hard [7]. The other potential source which was still limitedly used was brown rice. Brown rice contained an antioxidant which can prevent various degenerative diseases. Brown rice was still limitedly consumed since the characteristic was poorer than white rice [8].

Several studies showed that antioxidant content in brown rice could be used to prevent coronary. As an additive for food and beverage, brown rice has potential to improve antioxidant in the medicinal beverage of rice and herbs. Also, brown rice isolate can produce lovastatine which is potential to reduce blood cholesterol. Brown and black rice also can clear atherosclerosis plaque and improve antioxidant status in the rabbit. The production of brown rice was 0.03 million ton in 2011 and 0.05 million ton in 2012 [9].

Based on these facts, formulation of nutritious food using fish and brown rice in the form of the biscuit was important. The strength of biscuit was small size, relatively long shelf life, and good, acceptance by the community. Manufactured biscuit was currently not enriched by local food sources with high nutrients, such as fish and brown rice.

Use of fish and brown rice in biscuit was expected to be preferred so that the benefit was optimally obtained. Therefore, the study of biscuit formulation using those three sources was essential so that the aim of this study was to formulate biscuit with the addition of Mozambique tilapia fish, round Sardinella fish, and brown rice flour.

2. Method

2.1. Study Time and Place

The experiment was conducted in January - Maret 2017 in Culinary Art Laboratory of Universitas Negeri Makassar

2.2. Materials and Tools

The main ingredients in the study were wheat flour, cornstarch, tapioca starch, Mozambique tilapia fish four, Round sardinella fish flour, brown rice flour, yolk, sugar, vanilla extract, and baking powder. The tools were a spoon, spatula, knife, wash bowl, pan, frying pan, blender, mixer, biscuit print, flour strainer, kitchen scale, and oven.

2.3. Biscuit Formulation

Biscuit formulations are based on the adequacy of energy and protein of children that 1.000-1.550 Kcal of energy and 25-39 g protein. Biscuit with the addition of Mozambique tilapia fish flour, sardenila fish flour, and brown rice flour are expected to help meet the energy and protein adequacy of children. Biscuit formula in this study is based on the difference of Mozambique tilapia fish meal, sardenila fish flour and brown rice flour to the total weight of wheat flour.

2.4. Nutrient Analysis

Nutrient analysis: Nutrient analysis conducted was protein content using semi micro Kjeldahl method, fat content using the Soxlet method, water content using the direct heating method, ash content with dry ashing method, carbohydrate content using by difference [10].

2.5. Experimental design

Biscuit formulation with the addition of Mozambique Mozambique tilapia fish, Round sardinella fish, and brown rice flour was conducted using completely randomized design. Acceptance test to the biscuit used 7-point hedonic quality test and 11-point hedonic organoleptic test.

2.6. Data Collection and Analysis

Data collection was conducted by collecting responses to the biscuit's color, flavor, texture, taste, and overall quality from 16 trained panelists using sensory evaluation of the hedonic test. The color was ranged from very light brown to very dark brown (scale 1-7), while the flavor was ranged from very good to very bad (scale 1-7). The texture was evaluated with ranged of very hard to very soft (scale 1-7), while the taste was ranged from very bad to very good (scale 1-7). The overall was very bad to very good (scale 1-7), while the preference was evaluated as highly unpreferred to highly preferred (scale 1-11). Data were analyzed using Mean and ANOVA with Duncan Posthoc Test [10].

3. Result and Discussion

3.1 Biscuit Formulation

Biscuit added by Mozambique tilapia fish, Round sardinella fish, and brown rice flour was expected to improve the nutrient content of the biscuit to help meeting energy and protein requirement of school children. The formulation in this study was based on the difference in composition of Mozambique tilapia fish, Round sardinella fish, and brown rice flour.

3.1.1. Biscuit Making Process

The process of making biscuits starts with the preparation of biscuit making equipment such as an oven, mixer, bowl, spatula. Preparation of controlled biscuit ingredients is wheat flour, margarine, egg, sugar, and vanilla. While nutritious solid biscuit ingredients are wheat flour, maize, starch, water, freshwater fish flour, marine fish flour, brown rice flour, margarine, egg yolks, refined sugar. The manufacturing process begins with margarine, egg, sugar, for 15 minutes using a mixer, then mixed with flour. For control biscuits using wheat flour, while for nutritional biscuits using freshwater fish powder, marine fish meal, and brown rice flour. The next process is printing, then baking for 20-25 minutes and cooled The process of making biscuits can be seen in Figure 1.

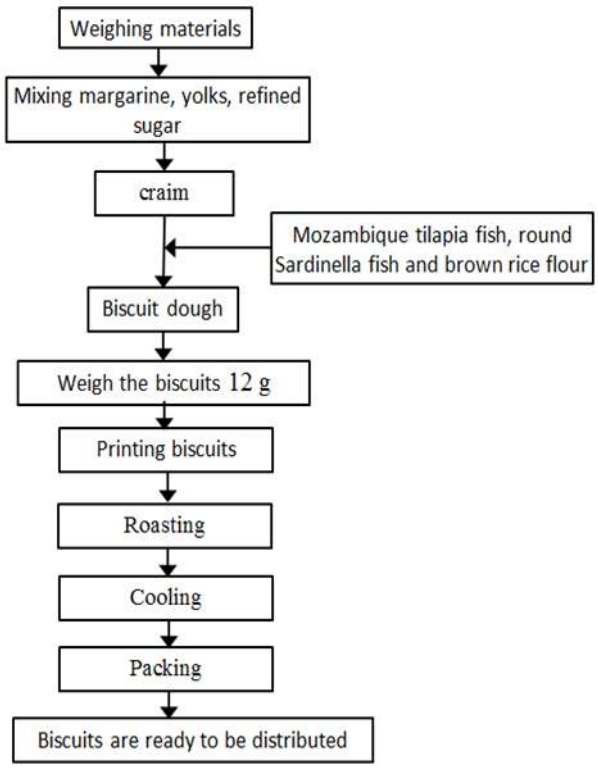

Figure 1: Biscuit Making Process

3.1.2. Biscuit Formulation

The biscuit formulations were presented in Table 1.

Table 1: Formulation of biscuit added by Mozambique tilapia fish, round sardinella fish, and brown rice flour (100 g)

Composition	F0	F71	F72	F73	F74	F75	F76	F77	F78	F79	F710	F711	F712
Wheat flour	30	17 (36%)	16 (33%)	14 (31%	14 (29%)	13 (27%)	11 (24%)	11 (24%)	10 (20%)	8 (18%)	8 (18%)	7 (14%)	5 (11%)
Cornstarch	10	6 (12%)	5 (10%)	5 (10%)	5 (10%)	4 (9%)	4 (9%)	4 (9%)	3 (8%)	3 (8%)	3 (8%)	2 (5%)	2 (5%)
Tapioca starch	7	4 (8%)	4 (8%)	3 (7%)	3 (7%)	3 (7%)	3 (7%)	3 (7%)	2 (6%)	2 (6%)	2 (6%)	2 (6%)	1 (3%)
Mozambique tilapia fish flour	0	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)
Round sardinella fish flour	0	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)	1 (2%)	2 (4%)	3 (6%)
Brown rice flour	0	19 (40%)	19 (40%)	19 (40%	24 (50%)	24 (50%)	24 (50%)	28 (60%)	28 (60%)	28 (60%)	33 (70%)	33 (70%)	33 (70%)
Margarine	12	12	12	12	12	12	12	12	12	12	12	12	12
Yolk	29	29	29	29	29	29	29	29	29	29	29	29	29
Refined sugar	12	12	12	12	12	12	12	12	12	12	12	12	12
Total (100g)	100	100	100	100	100	100	100	100	100	100	100	100	100

The change condition in the use of materials from wheat flour, cornstarch, tapioca starch. Mozambique tilapia fish flour. Sardine fish flour, brown rice flour based on existing formulations but for margarine, yolk, and refined sugar have not changed for all formulations; this relies on calculations from the existing formulation

3.1.3. Quality of Biscuit

Organoleptic test of those 12 biscuit formulas and one control was conducted for their color, flavor, texture, taste, overall and preference. The details were presented in Table 2.

Table 2. Mean Score of Organoleptic Test of the Biscuit

Indikator	F0	F71	F72	F73	F74	F75	F76	F77	F78	F79	F710	F711	F12	*p.Value*
Color	3.5^{de}	3.3^{bcd}	3.5^{de}	3.6^{ef}	3.8^{f}	3.5^{de}	3.4^{cd}	3.2^{abc}	3.2^{ab}	3.1^{a}	3.3^{abcd}	3.5^{de}	3.3^{abcd}	0.000^{**}
Flavor	5.6^{c}	4.9^{ab}	4.9^{ab}	4.7^{a}	4.9^{ab}	5.0^{ab}	5.0^{ab}	4.8^{a}	4.9^{ab}	5.6^{c}	5.3^{ab}	5.0^{ab}	4.7^{a}	0.000^{**}
Texture	3.5^{abc}	3.5^{abc}	3.6^{bcd}	3.7^{cd}	3.8^{d}	3.6^{cd}	3.5^{abc}	3.5^{abc}	3.4^{abc}	3.3^{a}	3.5^{abc}	3.5^{abc}	3.4^{ab}	0.001^{**}
Taste	5.8^{c}	4.8^{b}	4.7^{ab}	4.4^{a}	4.5^{ab}	4.8^{b}	4.8^{b}	4.6^{ab}	4.6^{ab}	5.9^{c}	4.9^{b}	4.6^{ab}	4.3^{a}	0.000^{**}
Overall	5.7^{c}	5.2^{b}	5.2^{b}	5.1^{ab}	5.3^{b}	5.3^{b}	5.2^{b}	5.1^{ab}	5.1^{ab}	6.7^{d}	5.3^{b}	5.2^{b}	4.9^{a}	0.000^{**}
Preference	8.7^{c}	7.2^{b}	7.2^{b}	7.1^{ab}	7.3^{b}	7.3^{b}	7.2^{b}	7.1^{ab}	7.1^{ab}	8.7^{c}	7.3^{b}	7.2^{b}	6.9^{a}	0.000^{**}

Notes: ** = p <0.01 : very significant. Similar superscript letters in one row showed no difference. Color (1-7) = very dark-very light; Flavor (1-7) = very bad-very good; Texture (1-7) = very hard-very soft; Taste (1-7) = very bad-very good; Overall (1-7) = very bad-very good; Preference (1-11) = highly unpreferred-highly preferred.

Based on Table 2, formula F79 had the highest score and most similar to the control formula (F0). Biscuit formulated in this study was short dough with the characteristic of inelastic dough [11][12] . Quality of the resulting biscuits

Color plays a major role in determining consumer acceptance because it is the first impression obtained by consumers. The color of a brown biscuit is produced due to the addition of brown rice. Brown rice that gives the red color is due to the antioxidant content in the form of anthocyanin which gives the color brown. The brown color of brown rice is increasingly visible when the brown rice gets warmed up. The brown color is also influenced by the caramelization of the sugar in both the real sugar present in the material and the sugar content found in the other ingredients. The color change other than the material used is also affected by the processing time. The color of biscuits can be seen in Figure 2.

Figure 2: The color of biscuit addition of Mozambique tilapia fish flour, sardenila fish flour, and brown rice flour

The fragrant aroma of the resulting biscuits is the result of protein breakdown, and the occurrence of sugar caramelization also gives a distinctive aroma to the biscuit. In this study the more fish meal more fragrant biscuits produced but the taste is decreasing. A similar study was also presented suggesting that fish flavors and flavors are in contrast, due to protein content in fish with a distinctive aroma [13][14][15].
The texture of the biscuit is strongly influenced by the composition of the starch material used, the higher the gluten content of the flour used, causing the texture of the biscuit to

become harder. For that reason the use of red rice flour can make the texture quality of biscuits better, this brown rice gluten content is very small. Similar results were also reported by Losio that excessive use of gluten-free flour causes the quality of biscuits to become crumbs, but if using gluten-high gluten flours causes the biscuits to become hard [16][17].

The delicious and tasty flavor of the biscuits produced is due to a combination of margarine and fat, proteins present in the main ingredients and additives. The right blend causes the taste to be savory and can eliminate the fishy taste of sardines. Addition of sardine flour if excessive causes flavor in the biscuit is reduced / uncomfortable. Similar with previous research that addition of fish bone meal gives a better flavor compared to that not give[18][19][20][21].

Gluten formation was minimized in the dough creation to form kneaded dough. The first stage in biscuit formulation was mixing process. The mixing process was divided into two steps, namely cream formulation and dry ingredient mixing. In the cream formulation stage, margarine was stirred at medium speed and then added with refined sugar. After stirred well, the yolk was added and then stirred again in high speed. After the cream was browning, baking powder and vanilla extract were added [22][23][7].

The next step was adding wheat flour and other flours into the cream which then stirred until kneaded. Overkneading enables gluten matrix formation. Therefore, to create biscuit with good quality, the stirring was done minimally [11][24][25][26].

The next process was weighing and printing to get similar size, which was 0.3 cm and 12 g. After that, the baking process for 30 minutes at a temperature of 150°C was conducted. Baking process made a change in texture to the preferred one, change in surface color, and reduction of moisture. The size of the baked biscuit was reduced due to the moisture loss during the baking process. Several factors are affecting the size of flour particle, dough creation, and use of margarine in the baking tray. After baking process, the biscuit was immediately chilled to reduce temperature and harden the product due to condensed sugar and fat [11] [27] [4].

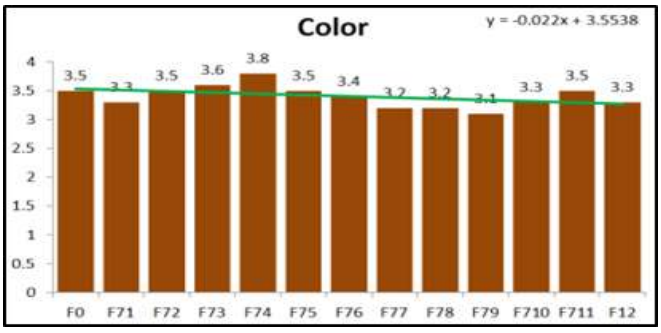

Figure 9: Mean color score of organoleptic test of the biscuit

Color test results with organoleptic tests showed dark brown biscuit color ratings and the color tended to be younger with reduced use of brown rice flour [10]. Anova color biscuit test showed very different but based on advanced test Duncans each biscuit formula is no different

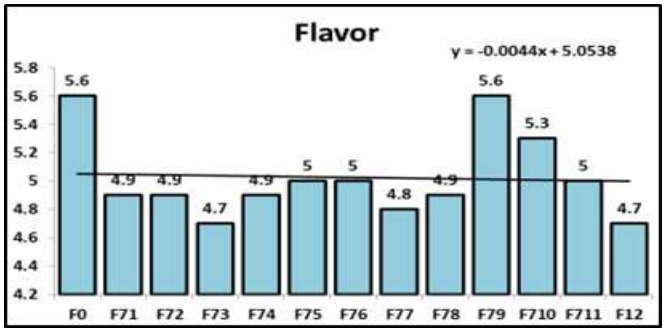

Figure 10: Mean flavor score of organoleptic test of the biscuit

The results of aroma test with organoleptic test showed the value of aroma of the biscuit is not scented and rather fragrant and the aroma tends to aroma is reduced / not fragrant. The reducing aroma is due to the increase of fish flour and decreasing of brown rice flour [28][29]. Anova aroma biscuit test showed very different and based on advanced test each biscuit formula showed F79 different from others.

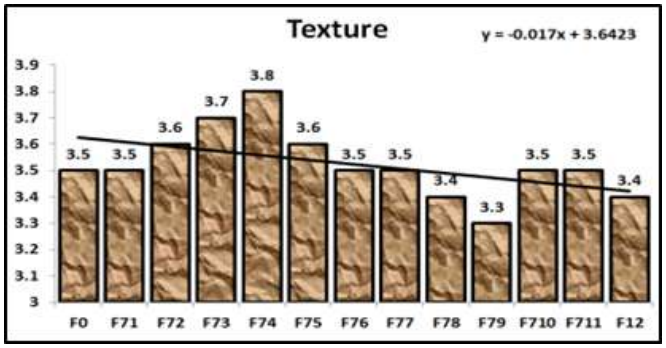

Figure 11: Mean texture score of organoleptic test of the biscuit

The results of taste test with organoleptic test showed the usual value-rather unpleasant tend to be uncomfortable. The uncomfortable taste is due to the decrease of flour and other flour [28][29]. The Anova taste biscuit test showed very different and based on advanced test each biscuit formula showed F79 distinct from the others

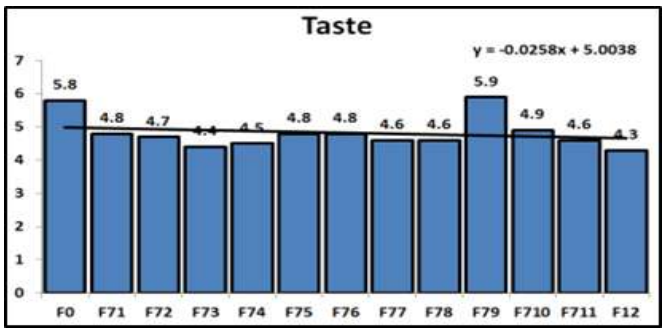

Figure 12: Mean taste score of organoleptic test of the biscuit

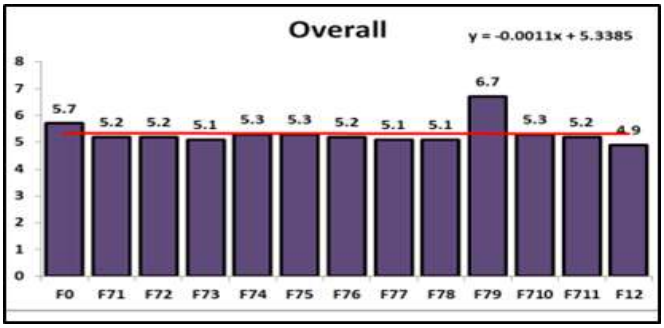

Figure 13: Mean overall rating of organoleptic test of the biscuit

Overall test results with organoleptic tests showed rather good, not good. The leads to the decline of wheat flour and added another flour [28][29]. Anova flavor biscuit tests are very different and based on a follow-up trial each biscuit formula shows F79 as distinct from the others

3.2 Acceptance of Biscuit

The panelist's favorite level of the resulting biscuits can be seen in Figure 1 below Based on picture 1. personal biscuit data with the addition of Mozambique tilapia fish, sardenila fish, and red rice flour showed that all the biscuit produced received by the panelist. The preference is based on the average of the preferred rate above the mean + 1 (6.5). An analysis of the variance shows 12 biscuit formulas showing no difference, and further testing of Duncan also reinforces that the degree of biscuit sushi is no different

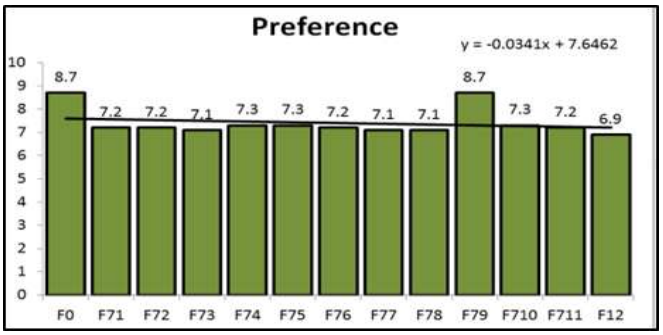

Figure 14. Mean Acceptance of biscuit

The result of acceptance test with organoleptic test shows the 'like' value tend the value 'not like.' Anova biscuit acceptance test showed very different and based on advanced test each biscuit formula showed F79 differ from others.

Based on the most preferred average values, the highest F9 biscuit formula and the lowest F12 but still accepted categories. Increasingly the addition of additional ingredients indicates the level of preference decreases.

The level of favorite biscuits is strongly influenced by the level of one's habit of consuming food. The more often a person consumes the food it will form a habit of the food, thus allowing the joy of food be substantial. The formation of fish food habits of the coastal community is higher than in the mountains, this is due to the availability of materials around more and facilitate the processing and fulfilled the needs of society [10]

Limitations of the study that there was not description about durability of biscuits with various packaging and its effect on one's nutritional status

4. Conclusion

The best biscuit formula added by Mozambique tilapia fish, Round sardinella fish, and brown rice flour was formula 79 which was composed of 8 g wheat flour, 3 g cornstarch, 2 g tapioca starch, 3 g Mozambique tilapia fish flour, 3 g Round sardinella fish flour, 28 g brown rice four, 12 g margarine, 29 g yolk, and 12 g refined sugar.

5. Acknowledgment

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