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Organoleptic Quality and Nutritional Content of Local Fish (Bleberan) Formulation Crackers as Snacks for Stunting Toddlers

Kualitas Organoleptik dan Kandungan Gizi Kerupuk Ikan Lokal (Bleberan) Formulasi sebagai Camilan untuk Balita Stunting

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ABSTRACT

Background: Toddlers commonly experience nutritional problems due to a variety of factors such as direct, indirect, main, and basic factors. Stunting is a chronic malnutrition problem that can have both long and short-term impacts on toddlers. The Bengkulu area is predominantly located along the coast, boasting an abundance of marine products. There are certain types of small fish that are considered byproducts and relatively inexpensive.
Objectives: This study aimed to assess the hedonic test for fish crackers with a variety of vegetables (mustard greens, carrots, and apple tomatoes) using a hedonic test.
Methods: This study was conducted in the Nutrition Laboratory for 1 month start with product manufacturing, organoleptic and acceptability tests carried out at selected public health centres that had the highest stunting criteria. The selected public health centres are Pasar Ikan, Beringin Raya, Sawah Lebar, Penurunan, Anggut Atas, Sukamerindu, and Jalan Gedang. This study was a completely randomized design (CRD). Data were analysed using the Stata 16, conducting univariate analysis (proportions and averages).
Results: The fish crackers with apple tomatoes variant, composed of 250 g of fish and 50 g of apple tomatoes, showed the highest average score among other variants. This formulation had 424.42 kcal and 0.96 g of protein. The difference test showed that there was a statistically different colour (p-value=0.008) between the four variants.
Conclusions: The formulation of bleberan fish crackers with tomato showed the highest preference score with an average value of 3.83, with a significant difference in the quality of the colour.

INTRODUCTION

The first 1000 days of life, from conception until age two, have a significant impact on physical development and growth. This period is widely regarded as a crucial phase, often referred to as the golden age, encompassing physical development, brain development, and mental health, all of which have a long-lasting impact on an individual's life[1].

The first short-term impact is impaired brain development, which can affect cognitive and educational abilities over time. The second short-term impact is intrauterine growth restriction (IUGR), which can lead to long-term stunting or impaired physical growth. The third short-term impact is the alteration of metabolic programs, which can lead to long-term risks of metabolic diseases such as hypertension, diabetes, obesity, coronary heart disease (CHD), and stroke[2–5].

Recent global data revealed a concerning statistic: approximately 155 million children under the age of five suffered from stunting, with the highest prevalence observed in the Asian region, affecting around 86.5 million children[6]. According to the findings of the National Basic Health Research (Riskesdas), in 2007, it was discovered that 36.8% of children were classified as stunted, indicating that they were very short or short in height. In 2013, this percentage increased to 37.2%. However, in 2018, there was a significant decrease as the percentage of stunted children decreased to 28.8%[7]. Furthermore, results from Indonesia's nutritional status monitoring (PSG) revealed that 29.0% of children were classified as stunted, indicating that they were very short or short in height. In 2016, there was a significant decrease to 27.5%. However, in 2017, this percentage increased again to 29.6%[8]. Additionally, Bengkulu Province nutritional status monitoring (PSG) discovered that in 2015, 18.1% of children were classified as stunted, indicating that they were very short or short in height. In 2016, this percentage increased to 22.9%. Meanwhile, in 2017, there was a significant increase to 29.4%[9].

The primary factors contributing to nutritional problems in toddlers are inadequate food consumption and the presence of infectious diseases. However, the

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main triggers for this problem are food insecurity in households, inadequate health services, unhealthy environments, and poor childcare. These main reasons are associated with economic, socio-political, legal, and cultural factors, with poverty being the primary factor that significantly affects the nutritional status of toddlers[3,6]. Moreover, the importance of parenting patterns is closely related to the role of mothers within the family, particularly in terms of providing food for family members, especially toddlers. The food adequacy and nutritional status of children can be significantly affected by the improper parenting of mothers[10–13]. According to research conducted by the United Nations Children's Fund (UNICEF) Indonesia, the major nutritional problem in children aged 6–24 months is the significant prevalence of stunting. One of the factors that contributes to this problem is the family's lack of knowledge, particularly regarding inadequate nutritional knowledge and practices. This includes inadequate adherence to exclusive breastfeeding practices and inconsistencies in the provision of complementary foods that align with children's nutritional needs[14,15].

It is highly recommended to introduce food to children aged 3-5 years by providing it as an interlude between the main meals. This interlude food aims to supply additional nutrients that the body needs, as the levels of nutrients in the body usually decrease after 2-3 hours along with the child's physical activity. However, this interlude food should not be considered a replacement for the main meal, as it has a relatively low calorie content of around 150–200 kcal. Interlude foods must meet the following criteria: adequate nutrient and energy content, a small serving portion suitable for children, simple digestibility, and a reasonable consumption time interval from the main meal. By providing interlude foods that meet these criteria, we can ensure that children's nutritional needs are met and support their optimal growth and development[16].

The significance of providing adequate nutrition for babies extends beyond the amount of food consumed, encompassing both the composition and source of nutrients provided. One of the most important nutrients is protein. Protein plays a crucial role in supporting the growth of toddlers and increasing the absorption of other nutrients. This is because it contains essential amino acids such as lysine, which is found in abundance in fish. Ensuring an adequate protein intake is crucial for supporting the formation of body tissues, strengthening the immune system, and promoting brain development in infants and toddlers. Additionally, the complete nutritional content of fish, which includes lysine, can provide additional benefits by supporting the effective absorption of nutrients in the child's body[17]. Moreover, Indonesia has a promising opportunity to utilize fish as a dietary supplement due to its favorable geography and abundant fisheries resources. Indonesia has vast potential in the fisheries and marine sectors due to its 17,502 islands, 81,000 km^2 coastline, and around 5.8 million km2 fishery area. This fact shows the strategic economic significance of Indonesia's fisheries and marine sector, highlighting the need for further development. The potential to generate substantial income and improve the welfare of coastal and rural communities that depend on this sector is also present in the utilization of these resources, in addition to supporting the fulfillment of food needs[18]. Furthermore, about 70% of Bengkulu Province's regency/municipality area is located along the coast. According to research conducted by Mlauzi and Mzengereza, it has been found that the prevalence of nutritional problems among children in fishing areas was lower at 10.0% compared to non-fishing areas, where the percentage reached 25.5%. This suggests fishing-focused areas may have better access to protein- and nutrient-rich food sources, such as fish. This, in turn, can positively affect the health and nutritional status of children residing in these areas[19]. Fish protein plays a significant role in the growth and development of children. One of the key benefits is that fish protein is more easily digested by the body compared to other sources of animal protein. Good digestion is crucial, as it maximizes the use of nutrients for children's growth and development. In addition, fish also contains omega-3 fatty acids, which are beneficial for the development of children's brains and nervous systems. Therefore, the inclusion of fish in children's diets can provide significant nutritional benefits and contribute to their overall health.

The Bleberan fish (Thryssa sp.) can be found along the coast of Bengkulu Municipality throughout the year. Despite its affordability, this fish has not been optimally used. According to previous research, including local fish in the diet of coastal toddlers can effectively meet their nutritional needs and growth rate[20]. Therefore, this study aimed to assess the preference for a specific product, specifically crackers combined with a variety of vegetables, including mustard greens, carrots, and apple tomatoes, using a hedonic test.

METHODS

This study was conducted in the Nutrition Laboratory for 1 month. It involved various stages, including product manufacturing, organoleptic tests, and acceptability tests in the community. The tests were carried out at selected public health centers that had the highest stunting health center criteria. These public health centers included Pasar Ikan Public Health Center, Beringin Raya Public Health Center, Sawah Lebar Public Health Center, Penturunan Public Health Center, Anggut Atas Public Health Center, Sukamerindu Public Health Center, and Jalan Gedang Public Health Center. Furthermore, the Bleberan fish can be obtained from traditional markets or fishermen's markets in Bengkulu Province. Until now, the local community has been utilizing the potential of Bengkulu's aquatic fish resources as a source of livelihood. Utilizing various natural resources from fisheries has played a crucial role in supporting economic development and improving community welfare[21]. Moreover, the experimental design used in this study is a completely randomized design (CRD). This study focused on the innovation of local fish-based products. The analysis began by examining the organoleptic quality of four cracker formulations with different vegetable variants using panelist tests (leek, mustard greens, carrots, and apple tomato variants).

According to research conducted by Purnomo et al. (2019), three treatment comparisons were used. One

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of these comparisons used a 1:1 ratio of tapioca flour and snakehead fish. The results showed an average preference value of 5.25 for the taste of crackers, indicating that the panelists were quite fond of the taste of crackers. In this study, the formulation of crackers was made following cracker making standards using local fish (Thryssa sp.) and tapioca flour in a 1:1 ratio and modified vegetables of as much as 50 g each in the form of cider, or the vegetables were mashed and then mixed with other ingredients[22].

Ingredient Formulation

Crackers are dry foods made by combining starch with other ingredients to produce the final product. This food has the unique property of expanding and forming pores when fried, resulting in a low density. Crackers are commonly consumed as a snack or as a small meal complement, which is popular among the community. Despite the widespread popularity of crackers as a snack, their consumption does not provide a significant intake of nutritional value due to the main ingredient, starch flour. In terms of nutritional content, each 100 g of crackers contains 69.32 g of carbohydrates, 14.04 g of fat, and 5.51 g of protein. The nutritional content of crackers is mainly composed of carbohydrates, with a relatively low amount of protein and fat content[23]. Fortification with Bleberan fish (Thryssa sp.) is a beneficial solution for increasing the nutritional value of crackers, particularly the protein content. Thus, crackers can retain the taste that is loved by the community, particularly toddlers, while improving their nutritional value. Table 1 presents an example of the formulation of various crackers with the addition of local fish, Thryssa sp. (Bleberan):

Table 1. Formulation of Local Fish Crackers, Thryssa sp.

Grocery Name	Unit	F1 (Green Onion)	F2 (Fresh Leaves)	F3 (Carrot)	F4 (Apple Tomato)
Ground Fish	g	250	250	250	250
Tapioca Flour	g	250	250	250	250
Vegetable Variants	g	50	50	50	50
Garlic	g	50	50	50	50
Fine Salt	g	5	5	5	5
Sugar	g	5	5	5	5
Fine Pepper	g	2	2	2	2
Baking Soda	g	2	2	2	2
Water	ml	20	20	20	20

Procedure

All ingredients were mashed and processed gradually in each formulation. There are two stages in the process of making crackers. The first stage involved making the basic cracker dough, while the second stage focused on processing the dough into crackers. Each stage of the manufacturing process is presented in the flowchart at each stage.

Manufacturing Process Stage I

The process of making basic dough involved mixing each ingredient according to the formulation using simple tools until it was mixed to form a dough that could be shaped. This process was completed in approximately 10 minutes. After the base dough was made, it was immediately steamed using the prepared steaming equipment. The equipment used is simple equipment that is commonly available in the community.

Figure 1. The Process of Making Cracker Base Dough

Information:
A = Ground Fish
B = Tapioca Flour
C = Vegetable Variant
D = Garlic
E = Fine Salt
F = Granulated Sugar
G = Fine Pepper
H = Baking Soda
I = Water

Manufacturing Process Stage II

The next stage of the manufacturing process is storing the basic dough ingredients in the form of tubes, which were stored in the refrigerator (refrigeration). The aim of refrigeration is to reduce moisture content and avoid contamination from bacteria or other animals, such

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as flies or other animals. This is due to the fish content contained in the formulation. The equipment used is simple equipment that is commonly available in the community.

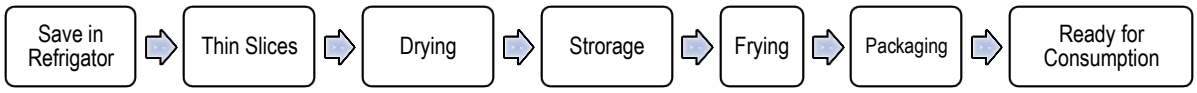

Figure 2. Cracker Processing Process

Information:
Tube shape (diameter: 3-5 cm) @200 g
Steaming for 30 minutes
Cooling for 10–20 minutes
Store in the refrigerator for 1-2 nights
3–4 days of drying (sun-dependent)

Organoleptic Test

The organoleptic test was carried out by 30 students from the Department of Nutrition at the Health Polytechnic of the Ministry of Health Bengkulu, who have received training in the fields of food and organoleptic quality. The trained panelists involved in this organoleptic test were selected based on their ability to distinguish the taste, aroma, texture, and color of food. The process of selecting trained panelists typically includes assessing their ability to distinguish basic tastes and aromas, their threshold ability to distinguish degrees of concentration, and their ability to recall the tastes and aromas tested. These trained panelists play a crucial role in ensuring that the products being tested are assessed consistently and accurately in terms of their organoleptic attributes. They are able to recognize subtle differences in taste, aroma, texture, and color, enabling an objective assessment of the food product being tested[24]. Furthermore, in the organoleptic test, the hedonic test method was used. Hedonic testing is a commonly used method to measure the level of preference for food products, in which respondents provide an assessment based on their level of satisfaction or liking for the product being tested. Hedonic scales may include options such as “very like, like, slightly like, neutral, slightly dislike, dislike, very dislike,” and so on. The length of the hedonic scale can be modified or changed to the desired scale during data processing. The results of this sensory study were then analyzed using scoring techniques to produce a more structured and well-interpretable assessment. The use of this method allows for gaining in-depth insights into how food products were enjoyed and assessed by our trained panelists from the Department of Nutrition at the Health Polytechnic of the Ministry of Health Bengkulu[25]. Moreover, the scoring method was used to analyze organoleptic tests using a hedonic scale with the following response options: very dislike was given a score of 1, dislike was given a score of 2, slightly like was given a score of 3, like was given a score of 4, and very like was given a score of 5. This method enables structured data collection, in which each respondent was assigned a numerical rating that accurately indicated their level of preference or liking for the food product being tested. Subsequently, these scores were processed and analyzed in order to evaluate the overall level of preference as well as identify variations in preference among the trained panelists participating in this study. The use of scale scoring enabled the generation of more measurable data and a more in-depth statistical analysis of the results from organoleptic tests.

Data Analysis

An analysis was conducted to compare the results of the organoleptic tests for different formulations. The Kruskall-Wallis test was employed to analyze the differences between formulations, while the Friedman test was employed to analyze the results for each product. The selection of this statistical unit was adjusted to the number and nature of the data measurement results obtained. In addition, the Kruskall-Wallis test provides information on differences between cracker formulations, while the Friedman test provides information on differences in organoleptic quality in each cracker formulation.

Laboratory Analysis

After the highest average score of the crackers from the organoleptic test was obtained, the crackers underwent laboratory analysis to assess their nutrient content, such as energy, fat, protein, calcium, carbohydrates, vitamin A, and vitamin C. The laboratory analysis was carried out at the Mathematics and Natural Sciences Laboratory of the University of Bengkulu by a third party selected for its capabilities and facilities in accordance with established standard operating procedures. The accuracy and consistency of the results were ensured by adhering to laboratory procedure standards during the procedures and analysis of energy and nutrient content. By collaborating with a third party that has adequate facilities and capabilities, laboratory analysis could be ensured to be carried out with professionalism and reliability. The laboratory analysis findings provide detailed information regarding the nutritional content of the highest-scoring crackers. Additionally, this information was used to support a more thorough understanding of the product’s nutritional value and its potential contribution to promoting a healthy diet.

Research Ethics

The submission of research ethics with the title organoleptic quality and nutritional content of Bleberan

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fish crackers (Thryssa sp.) as a snack for stunted toddlers was addressed to the Health Research Ethics Commission of the Health Polytechnic of the Ministry of Health Bengkulu in 2022. Following a thorough ethical review process for about one month, this study received approval from the ethics commission of the Health Polytechnic of the Ministry of Health Bengkulu with the KEPK number BKL/095/03/2023 on March 20, 2023. This ethical approval was one of the administrative requirements when organoleptic tests were carried out in the target community.

RESULTS AND DISCUSSIONS

The results of the organoleptic quality test provided by the panelists, which assessed color, aroma, texture, and taste, are presented in Table 2.

Table 2. Proportion of Panelists' Preference (Color, Aroma, Texture, and Taste) for Cracker Formulation

Favorite Aspects	Cracker Formulation							
	F1		F2		F3		F4	
	n	%	n	%	n	%	n	%
Color								
Very dislike	0	0	2	7	0	0	0	0
Dislike	3	10	7	23	4	13	3	10
Slightly like	4	13	9	30	10	33	4	13
Like	12	40	10	33	7	23	12	40
Very like	11	37	2	7	9	30	11	37
Aroma								
Very dislike	2	7	0	0	0	0	0	0
Dislike	2	7	3	10	3	10	2	7
Slightly like	10	33	6	20	7	23	6	20
Like	9	30	13	43	12	40	13	43
Very like	7	23	8	27	8	27	9	30
Texture								
Very dislike	0	0	0	0	0	0	0	0
Dislike	1	3	1	3	6	20	3	10
Slightly like	5	17	5	17	3	10	6	20
Like	10	33	13	43	11	37	9	30
Very like	14	47	11	37	10	33	12	40
Taste								
Very dislike	2	7	1	3	1	3	2	7
Dislike	5	17	1	3	7	23	4	13
Slightly like	7	23	7	23	12	40	7	23
Like	9	30	10	33	4	13	8	27
Very like	7	23	11	37	6	20	9	30

According to Table 2, the highest percentage of the "like" category for the color characteristics of the cracker formulation product with variations of leeks and apple tomatoes is 40%. Furthermore, the cracker formulation product with variations of mustard leaves and tomatoes had the highest percentage in the "like" category for the aroma characteristics (43%). Moreover, the cracker formulation product with leek variation had the highest percentage in the "very like" category for the aroma characteristics (47%). In addition, the cracker formulation product with carrot variation had the highest percentage in the "slightly like" category for the aroma characteristics (40%).

According to the organoleptic test of the color of the cracker formula with the scallion variant, it was discovered that the percentage of the "like" category was 40% of the 30 panelists, with an average score of 4.03, while the cracker formula with mustard greens and apple tomato variants was 43%, with an average score of 3.97. The olfactory tissues contain aromatic compounds that are present in the air we breathe through our nostrils. Olfactory is also a sense of long-range taste, which plays a crucial role in determining the taste of food, enabling us to identify whether it is delicious or not. In the food industry, aroma plays an essential role in determining whether or not panelists like the food[26].

According to the organoleptic test of the color of the cracker formula with the mustard greens variant, it was discovered that the percentage of the "like" category was 43% of the 30 panelists, with an average score of 4.23. The organoleptic texture plays an important role in the level of crispiness, particularly after the frying process. However, if the texture of food is too hard or chewy, it can also lead to dislike. Additionally, based on the organoleptic test of the taste of the cracker formula with the mustard greens variant, it was discovered that the percentage of the "like" category was 40% of the 30 panelists, with an average score of 3.97. Tasting is a sensory experience that specifically involves the tongue, one of the five senses. Moreover, food ingredients with the ability to stimulate the taste buds cause certain sensations. The consistency of an ingredient affects the taste it produces. Taste in food is a stimulus caused by the food eaten by the sense of taste. The taste of a food plays a crucial role in influencing the consumer's decision whether to accept it or not. Regardless of the satisfactory values of other qualities, the product will be rejected if it possesses an unpleasant taste[27]. Therefore, scoring

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resulted in average results in terms of favorability. The following figure shows each formulation:

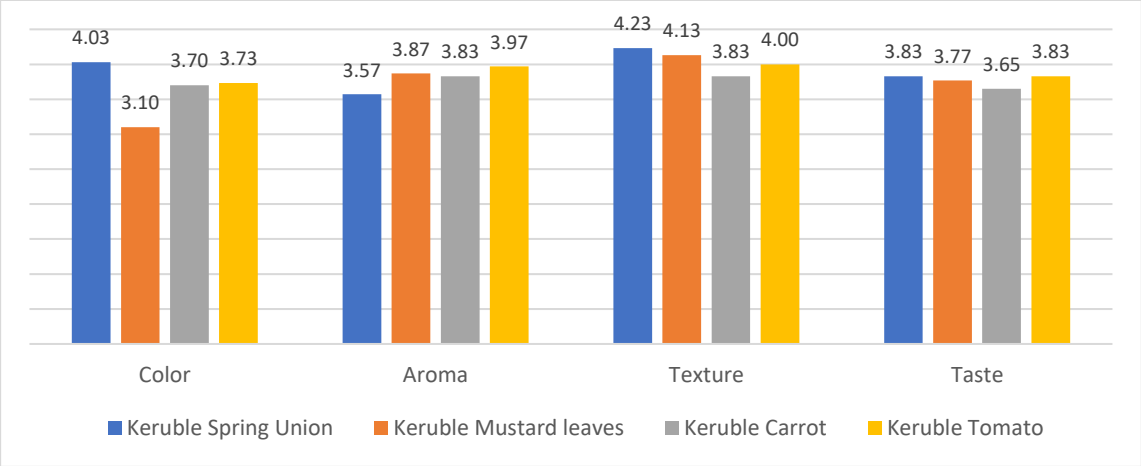

Figure 3. Overview of the Average Organoleptic Quality Score of Cracker Formulations

Figure 3 shows the organoleptic test's highest average score (3.83) for cracker formula with variations of leeks and apple tomatoes. Furthermore, by considering the proportion of organoleptic test types, crackers with variations of apple tomatoes were analyzed for nutrients in the laboratory. The nutrient content of fried crackers is presented as follows:

Table 3. Differences in Organoleptic Quality between Local Fish Cracker Formulations Thryssa sp.

Organoleptic Quality	Mean Rank (Kruskall-Wallis Test)				p-value
	F1	F2	F3	F4	
Color	73.42	44.10	61.77	62.72	0.008*
Aroma	53.48	62.18	60.92	65.42	0.554
Texture	66.30	61.80	54.70	59.20	0.579
Taste	57.93	72.08	50.02	61.97	0.083

*a significance level of 0.05

Table 3 shows that there was a significant difference in color organoleptic quality between cracker formulations. There was a statistical difference in color between the four organoleptic qualities (F1, F2, F3, and F4) and local fish raw materials (p-value=0.008). Furthermore, the nutrient content and frying technique had a significant effect on the color. Some nutrients, such as carbohydrates, changed color (light brown) when subjected to prolonged frying. Darker colors can also affect taste, such as the onset of bitterness[28].

Table 4. Energy and Nutrient Content per 100 g of Apple Tomato Variant Cracker Formulation

Energy and Nutrients	Unit	Sum
Energy	With	425.42
Fat	g	1.48
Protein	g	0.96
Carbohydrates	g	180.48
Calcium	mg	2.97
Vitamin A	mg	2.87
Vitamin C	mg	4.4

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Product Appearance


Dried Crackers


Fried Crackers

Packaged Crackers for Consumption

Figure 4. Appearance of Apple Tomato Variant Cracker Formulation

The organoleptic test is a testing method carried out on food products by relying on the level of perception of individuals, known as panelists, of various product attributes. This test falls under the category of sensory tests, in which the human senses are used as the primary measure to evaluate the acceptance of a product. A commonly used method in organoleptic tests is the hedonic method, in which panelists rate a product based on their level of preference for attributes such as color, aroma, texture, and taste. The panelists were given product samples one by one, and they were asked to give an assessment of each of these attributes. The parameters tested in the organoleptic test include: color, which is the visual appearance of the product perceived by the panelists; scent, which is the perception of the scent produced by the product when it is inhaled; texture, which is the physical sensation felt by the mouth when consuming the product, such as crispness, softness, or consistency; and taste, which is the sensation produced by the interaction between the ingredients in the product on the tongue of the panelist. Each panelist provided their assessment using a hedonic scale, which allowed them to assign a score ranging from "very dislike" to "very like", or used other numerical scales that conformed to established protocols. It was expected that the results of these organoleptic tests provide valuable information about consumer preferences for products, allowing manufacturers to make formulation adjustments or improvements to increase market acceptance.

Crackers are foods that have dry, light, and porous properties and are generally made from tapioca flour as the main raw material. Traditionally, the nutritional value of crackers was often undervalued, but nowadays there is a growing trend to create various variants of crackers with better flavor and nutritional value. One of the innovations in cracker development is the inclusion of fish into the recipe in addition to tapioca flour, called fish crackers. The use of fish not only aims to improve the aroma and taste but also to increase the nutritional value of crackers, particularly their protein content. Moreover, the amount of fish added is typically about 20% of the total cracker dough. The selection of fish type is crucial in making fish crackers, as it must have a strong aroma and taste to effectively enhance the taste of the crackers. Some types of fish that are commonly used for fish crackers include mackerel, snapper, cod, and other types of fish that have characteristics that are suitable for processing into crackers. The development of fish crackers not only provides an appetizing variety of flavors but also increases the nutritional value with the addition of protein from fish, making it an attractive option for consumers who prioritize nutritional value in their daily dietary intake.

The complexity of a taste is produced by a variety of natural perceptions consisting of several main factors. Taste itself is influenced by three main factors, namely smell, taste, and sensations felt in the mouth (such as hot and cold). Odors can be detected by the sense of smell, while tastes and sensations in the mouth can be detected by sensory cells on the tongue. The moisture content in food products, such as crackers, also plays an important role in determining the product's storage quality and texture. According to the Indonesian National Standard (SNI) 01-2713-2009 on fish crackers, the maximum allowable moisture content is 12%. Too high a moisture content can cause crackers to become mushy or easily damaged, while too low a moisture content can make the crackers too hard and difficult to consume. Therefore, in the development of fish crackers and other food products, moisture content control is a key factor to ensure that the product has excellent storage quality and maintains the texture desired by consumers[30].

According to previous research that investigated the use of rice field snail flour as an ingredient in making crackers, it was discovered that rice field snail flour had a significant influence on several parameters of the hedonic test based on the results of the Kruskal-Wallis test. p-value<0.05 showed that there was a significant difference in the panelists' perceptions of certain attributes of crackers using rice field snail flour. The results of the Kruskal-Wallis test for each hedonic test parameter revealed a p-value of 0.000, which indicates that there was a significant difference in the assessment of cracker color between various treatments or variations using rice field snail flour. Moreover, a p value of 0.29 indicates that there was no significant difference in aroma assessment between the different treatments. Nonetheless, it is important to consider these results in

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relation to the overall research. The p-value of 0.00 showed that there was a significant difference in the assessment of cracker texture between treatments using rice field snail flour. Furthermore, the p-value of 0.00 indicates that there was a significant difference in the assessment of cracker taste between treatments using rice field snail flour. These results showed that the use of rice field snail flour had a significant effect on crackers' hedonic test characteristics, particularly in terms of color, texture, and taste. This shows that rice field snail flour not only affected the nutritional or technical aspects of making crackers but also how consumers enjoy this product in terms of organoleptics[31]. The advantages of this research include: 1) raising the use of local fish raw materials that are easy to obtain (availability and price); 2) can be done at the household level; 3) can be used as a home business; 4) Economically, it can be s an impact on family income. In addition to the advantages, this study still has weaknesses: 1) nutrient analysis has not been carried out; 2) no storage capacity test has been carried out: 3) no cost analysis has been carried out.

CONCLUSIONS

According to the results of this study, it can be concluded that the formulation of Bleberan fish crackers with tomato variations showed the highest average score (3.83) based on the level of hedonic quality (color, taste, aroma, texture). The statistically significant difference in organoleptic quality was shown by the color aspect (p-value=0.008). This illustrates that the organoleptic quality of the panelists' perceptions was different from the color aspect, while the other organoleptic quality aspects were not different (relatively the same).

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

MM: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology; AR, A: project administration, resources, software, supervision, validation; MM, A: visualization, roles/writing-original draft, writing-review, and editing.

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