Asian Journal of Aquatic Sciences, April 2026. Vol 9, Issue (1) 18-29
e-issn: 2716-4608
p-issn: 2655-366X

HEDONIC TESTING OF MILKFISH COOKIES WITH ADDED MORINGA LEAVES AS COMPLEMENTARY FOOD FOR PREGNANT WOMEN TO PREVENT STUNTING IN NUNUKAN

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ABSTRACT

Chronic Energy Deficiency (CED) in pregnant women occurs due to nutritional deficiencies due to insufficient energy and nutrient intake, which can endanger the mother's health and cause fetal growth retardation. This condition can be prevented by providing supplementary feeding (PMT) to balance nutritional intake and to avoid stunting from in utero (1). Stunting can occur in utero and is only visible when the child is two years old. Based on data from the Central Statistics Agency (BPS) of Nunukan Regency, the number of babies born with low birth weight (LBW) increased from 225 babies (2022) to 353 babies (2023), while the number of babies with malnutrition increased from 192 babies to 391 babies in 2023 (2). The urgency of this study is the provision of complementary foods in the form of cookies for pregnant women from processed milkfish with additional nutritional value from moringa leaves for early stunting prevention in Nunukan Regency, North Kalimantan Province. Processed cookies are very important for pregnant women to achieve optimal nutritional adequacy. The purpose of this study is to test the hedonic (level of preference) and proximate testing on cookies made from milkfish (*Chanos chanos*) with the addition of moringa leaves (*Moringa oleifera*) as an effort to overcome the problem of malnutrition cases, especially about stunting that starts from mothers during pregnancy or pregnancy as an early prevention so that children are not born with a large birth weight (LBW), especially in Nunukan Regency, North Kalimantan. The research method was a survey to measure the level of preference or acceptance of milkfish cookies containing nutrients from moringa leaves among pregnant women, with 30 panelists. Complementary foods were analyzed for preference levels to assess the innovation's acceptance in the processing of these cookies. The results of the proximate analysis of this cookie product that still do not meet the requirements are the water and ash content. Meanwhile, the nutritional content of cookies according to SNI 01-7148-2005 (special drinks for pregnant and/or breastfeeding mothers) and SNI 2973.2022 (biscuits) has met the quality requirements for protein, fat, and carbohydrate levels. Meanwhile, hedonic testing using SPSS version 27 with Duncan analysis for color parameters yielded 4.40; aroma, 4.07; texture, 4.33; taste, 4.10; aftertaste, 4.13; and overall, 4.13. These results indicate that all sensory attributes, aroma, texture, taste, aftertaste, and overall acceptance, were categorized as "liked," suggesting that the product has a good level of acceptance among the panelists.

Keywords: Milkfish, Stunting, Hedonic, Pregnant Mother, Moringa Leaves

Received: 09 January 2026
Accepted: 26 March 2026

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1. INTRODUCTION

Stunting remains a serious problem in Indonesia, due to chronic malnutrition from pregnancy[1]. The health and nutrition of pregnant women significantly influence stunting prevention[2]. Nunukan Regency has the highest stunting rate in North Kalimantan, with 1,101 cases spread across 21 villages[3]. This research supports Presidential Regulation No. 72 of 2021[4] and Nunukan Regent Regulation No. 45 of 2019[5] concerning the acceleration of stunting reduction. It aligns with the ABAAS (Fathers and Mothers Fostering Stunting Children) program, a regional initiative to address this problem[6].

During pregnancy, mothers require sufficient nutrients such as protein, vitamins, and minerals for the health and development of the fetus. However, a lack of these intakes can negatively impact the birth[7]. Insufficient nutrition during pregnancy can inhibit fetal growth and increase the risk of low birth weight (LBW), a major factor in stunting[8]. Chronic Energy Deficiency (CED) is also still prevalent among many pregnant women in Indonesia[9]. Milkfish has a high protein and Omega-3 content at a more affordable price compared to other types of fish[10].

Fish is one of the good foods consumed by pregnant women because it contains protein, Omega-3 fatty acids, vitamins, and minerals that are important for supporting fetal growth, improving brain development, and maintaining maternal health[11]. In addition, fish contain various essential amino acids needed by the body to activate enzymes and growth hormones[12]. Maternal protein requirements increase during each trimester of pregnancy. Pregnant women need to consume around 70 to 100 g of protein every day, depending on the mother's weight and current trimester of pregnancy[13]. Milkfish is also one of the leading commodities in Nunukan Regency.

Moringa leaves (*Moringa oleifera*) contain twice as much protein as yoghurt, three times more potassium than bananas, and four times more vitamin A than carrots[14]. Anemia in pregnant women, due to iron deficiency, can interfere with fetal growth and increase the risk of stunting in children[15]. Anemia can increase the risk of complications for both mother and fetus. Consuming moringa leaves, which are rich in iron and other essential nutrients, can be a natural way to prevent it, so pregnant women should consume them in certain amounts[16].

Cookies are foods made from wheat flour and other additives that are popular because they are affordable, Practical, nutritious, long-lasting, and easy to consume. This product is often used as a fortification medium with the addition of nutritious ingredients. In this study, some wheat flour was replaced with milkfish flour to increase nutritional value. This study developed milkfish and moringa leaf cookies as a complementary food for pregnant women to prevent stunting early in Nunukan Regency, North Kalimantan. These cookies are important for meeting optimal nutritional needs during pregnancy.

The purpose of this study was to examine the level of preference (hedonic test) and proximate testing of milkfish cookies with added moringa leaves as a solution to the problem of malnutrition, especially stunting.

2. RESEARCH METHOD

Time and Place

This study was conducted from April to December 2025 at Nunukan State Polytechnic, Indonesia.

Methods

The research began with a preparatory stage that included problem identification, preliminary observations, an assessment of the research area in Nunukan Regency, and a comprehensive review of relevant literature. The experimental phase employed a factorial Completely Randomized Design (CRD) with three replications. Three formulation treatments were developed: F1 (150 g wheat flour: 80 g milkfish flour: 20 g moringa leaf flour), F2 (150 g wheat flour: 85 g milkfish flour: 15 g moringa leaf flour), and F3 (150 g wheat

flour: 90 g milkfish flour: 10 g moringa leaf flour).

The experimental design incorporated two main factors: the levels of milkfish flour substitution and moringa leaf protein isolate substitution. This factorial arrangement enabled the evaluation of both the individual and interaction effects of the two factors on the characteristics of the final product.

Procedures

Cookies Processing

The preparation of milkfish flour involved several stages. First, the milkfish were cleaned, scaled, and eviscerated by removing the internal organs and gills. The fish were then steamed at 100°C for 20 minutes to reduce enzyme activity through heat inactivation. After steaming, the edible fish meat was separated from non-edible parts such as bones, spines, and skin. The fish meat was then dried in an oven at 150°C for 3 hours to produce dried fish meat that could be easily ground. The dried fish meat was subsequently ground using a blender and further refined using a hammer mill to obtain finer particles. The resulting fish flour was sieved through an 80-mesh sieve to obtain a uniform particle size. To remove residual moisture, the flour was dried again in an oven at 50°C for 20 minutes before being stored in airtight containers.

The preparation of moringa leaf flour began with washing and draining the leaves to remove impurities and reduce moisture. The leaves were sorted and blanched at 70°C for 5 minutes to maintain color and nutritional quality. After blanching, the leaves were drained and spread on trays for sun drying at approximately 30°C for about 6 hours until they became brittle and easily crushed. The dried leaves were then ground using a blender and sieved through an 80-mesh sieve to produce fine moringa leaf flour.

Cookie preparation followed a standard mixing and baking procedure. First, 10 g of egg yolk and 1 whole egg were beaten with 50 g of white sugar and 100 g of brown sugar. Subsequently, 125 g butter, 15 g margarine, 20 g powdered milk, 0.2 g baking powder, 1 g salt, and 1 g vanilla were added and mixed using a mixer for 5–10 minutes until a homogeneous mixture was obtained. Then, 250 g of the flour mixture was added according to the formulation treatment (for example, F1 consisted of 150 g wheat flour, 80 g milkfish flour, and 20 g moringa leaf flour). Next, 60 g of almonds and 50 g of chocolate chips were added and mixed thoroughly. The dough was refrigerated for approximately 3 hours. After chilling, the dough was shaped into cookies and weighed at approximately 15 g per piece. Chocolate chips were added as decorative toppings. The cookies were baked in a preheated oven at 150°C for 30 minutes until they were dry and golden brown.

Sensory Evaluation and Proximate Analysis

A hedonic sensory evaluation was conducted involving 30 pregnant women selected using purposive sampling. The sensory test used a five-point Likert scale ranging from "dislike very much" to "like very much" to assess consumer acceptance of the cookies in terms of color, aroma, taste, texture, and overall preference. Proximate analysis of the cookies was carried out to determine their nutritional composition, including moisture, ash, crude fibre, fat, protein, and carbohydrate levels, using standard methods of the Association of Official Analytical Chemists.

Statistical Analysis

The sensory evaluation data were analyzed using Analysis of Variance (ANOVA) at the 95% confidence level to determine significant differences among treatments. When significant differences were detected, the means were further compared using Duncan's Multiple Range Test (DMRT) to identify differences between treatment groups.

3. RESULT AND DISCUSSION

The development of nutrient-dense food products has become an important strategy to address malnutrition in pregnant women and improve quality, particularly in developing regions. Milkfish, a rich source of protein, combined with moringa leaves, known for their high micronutrient content, offers significant potential for functional food innovation. However, limited studies have simultaneously evaluated both the nutritional composition and consumer acceptability of such fortified products, especially in the form of cookies. Therefore, this study aims to analyze the proximate composition and sensory acceptance of milkfish-based cookies containing moringa leaves. The results are presented in Table 1, which summarises the proximate composition, and in Table 2, which shows the average hedonic scores for sensory parameters.

The proximate composition of milkfish cake enriched with moringa leaves was analyzed to determine its nutritional content, and the results are presented in Table 1.

Table 1. Proximate test results on milkfish cookies with the addition of moringa leaves

No	Sample code	Parameter Analysis	Result (%)			Average
			Test 1	Test 2	Test 3	
1	335	Water (%)	6.7	6.18	6.42	6.43
	503		6.8	6.18	6.34	6.44
	533		5.97	6.34	6.21	6.17
2	335	Ash (%)	2.01	2.02	2.04	2.02
	503		2.04	2.02	2.04	2.03
	533		2.12	2.11	2.12	2.12
3	335	Protein (%)	21.59	21.52	21.3	21.47
	503		21.59	21.54	21.37	21.50
	533		22.23	22.28	22.11	22.21
4	335	Fat (%)	22.17	22.17	20.37	21.57
	503		22.17	22.17	20.37	21.57
	533		21.68	21.5	21.68	21.62
5	335	Carbohydrate (%)	47.39	48.04	49.88	48.44
	503		47.41	48.09	49.88	48.46
	533		48.01	47.77	47.89	47.89

Table 1 presents data from a proximate analysis of milkfish cookies containing moringa leaves as a complementary food for pregnant women to prevent stunting in Nunukan Regency. Based on the data analysis, the highest protein content was observed in F3, F2, and F1, respectively. Formula 1 contains 80 g of milkfish flour and 20 g of moringa leaf flour; formula 2 contains 85 g of milkfish flour and 15 g of moringa leaf flour; and formula 3 contains 90 g of milkfish flour and 10 g of moringa leaf flour. The nutritional content of cookies that meet the SNI 01-7148-2005 standard (drinks and food for pregnant and/or breastfeeding mothers). The most important factor to observe is the protein content (about 5 times the required limit of 4.5%). Meanwhile, the nutritional content of cookies according to SNI 2973.2022 (biscuits) has met the quality requirements. The water content does not meet the two SNI requirements (more than 5%). Meanwhile, the results of the hedonic test, conducted with a sample of 30 semi-trained panelists and analyzed using Duncan's statistical method, are presented in Table 2.

Table 2. Average hedonic test value of cookies with the addition of fish flour and moringa leaves based on sensory parameters

Variables	F1 (b=80 g; k=20 g)	F2 (b=85 g; k=15 g)	F3 (b=90 g; k=10 g)	N
color	4.40	3.97	3.87	30
aroma	4.07	4.00	3.60	30
texture	4.07	4.33	4.30	30
flavor	3.77	3.90	4.10	30
aftertaste	4.13	3.87	4.13	30
overall	4.07	4.13	4.13	30

Table 2 presents data from hedonic testing of milkfish cookies containing moringa leaves as a complementary food for pregnant women to prevent stunting in Nunukan Regency. Based on test data analysis using a purposive sample of 30 semi-trained panelists, a 5-point Likert scale, and parameters of color, aroma, texture, taste, aftertaste, and overall, with an average value of 4 (like).

Proximate Testing of Milkfish Cookies with Added *Moringa oleifera* Leaves

Proximate testing will describe the moisture, ash, protein, fat, and carbohydrate content of the cookie product. However, there is no specific Indonesian National Standard (SNI) specification for cookies as a food additive or supplement for pregnant women. Based on SNI 01-7148-2005 concerning drinks specifically for pregnant and/or breastfeeding mothers, cookie products can refer to this SNI. Additionally, another SNI that can be used as a reference is the latest SNI for biscuit/cookie products, SNI 2973:2022.

Water content analysis is a method used to calculate the water content in a product[17]. Water content also affects the acceptability, freshness, appearance, and taste of a food ingredient. Water is removed to extend a product's shelf life[18]. The results of the analysis showed that the average water content of milkfish cookies with the addition of moringa leaves, with three replications, was 6.43, 6.44, and 6.17. This water content does not meet the maximum limit required by SNI 2973-2022, which is 5% (mass fraction). The test results showed that treatments F1, F2, and F3 decreased water content. The crispness of the biscuits is directly related to water content and water activity.

Products with a water content above 4–5% will lose their desired crispy texture and become soft during storage[19]. The ratio of ingredients containing protein sources affects a product, as protein can bind water molecules due to its hydrophilic properties[17]. Wheat flour is also added to the product. Wheat flour contains starch. Starch has hydrophilic properties similar to those of proteins, allowing it to bind large amounts of free water[20].

However, adding protein and starch can reduce water absorption. This is demonstrated by the test analysis results above, which show that substituting milkfish with moringa leaves further reduces the product's water content. According to Astuti & Anayuka[21], the combination of protein and starch will create a complex surface on granule particles, reduce viscosity, and reduce gel strength. Starch and protein form a starch-protein matrix, which hardens cookies through hydrogen bonding between amino and hydroxyl groups. The formation of a starch-protein matrix will reduce the product's water absorption capacity.

Ash content is an analysis used to determine the mineral content of a food ingredient. Ash content is an inorganic substance left over from the combustion of organic materials[22]. It is also related to a product's mineral content. Ash content also indicates the purity and hygiene of the resulting food ingredient[23]. The results of the ash content analysis showed 2.02, 2.03, and

2.12, respectively. According to SNI 01-7148-2005, the ash content must not exceed 6 g/100 g, thereby meeting the standard. The analysis data show that the higher the addition of milkfish flour, the higher the resulting ash content. This is due to the mineral composition of milkfish flour, especially the phosphorus content: 150 mg per 100 g[24].

According to Hidayah[25], phosphorus is useful for providing energy in fat and starch metabolism, plays a role in bone formation, supports healthy gums and teeth, and helps DNA synthesis. The heating process in products that have mineral ingredients at high temperatures will form a higher ash content. This is in accordance with the statement of Sholihah et al.[26] that heating food ingredients containing minerals at high temperatures will produce more ash, because ash is composed of minerals. During processing, heating occurs, namely during drying or baking. Moringa leaves are a source of iron[27] and have nutritional content such as ascorbic acid, flavonoids, phenolics, and carotenoids.

In fact, moringa leaves contain higher iron content than other vegetables, namely 17.2 mg/100g[28]. They are the largest suppliers of iron from vegetables (9.9%)[29]. Moringa leaves are rich in minerals such as calcium, potassium, zinc, magnesium, iron, and copper. Vitamins such as vitamin A, B vitamins such as folic acid, pyridoxine, and nicotinic acid, vitamins C, D, and E, and β-carotene[30], so that the addition of moringa leaf flour can cause an increase in ash content because the composition of moringa leaves itself is rich in minerals. This results in milkfish cookies with the addition of moringa leaves, further increasing the product's ash content.

Fat content functions to absorb fat-soluble vitamins (FA), facilitate metabolism, and produce hormones[31]. Furthermore, fat in food contributes to the product's texture and flavour[32]. Data from the F1, F2, and F3 treatments, conducted three consecutive repetitions, showed the following values: 21.57, 21.57, and 21.62, respectively. Based on SNI 01-7148-2005, the fat content requirement is 18-25 g/100 g, which still meets product quality requirements.

The data show that treatments F1, F2, and F3 further increased the product's (cookies') fat content. The fat content of cookies is influenced by ingredients such as butter, egg yolks, powdered milk, chocolate chips, almonds, and milkfish meal. Moringa leaves contain 28.66% protein, 2.32% zinc, 715.32% phosphorus, 11.41% iron, and 1014.81% calcium[33]. Therefore, the more milkfish flour you add, the higher the fat content in these cookies.

Protein is a building block and regulator in the body. As a building block, protein continuously forms new tissues and maintains existing ones[32]. Proximate testing for the protein content of milkfish cookies was conducted with three treatments (F1, F2, and F3) and three consecutive repetitions: 21.47, 21.50, and 22.12. According to SNI 2973:20234[2] (biscuits), biscuits must have a minimum protein content of 4.5%, ensuring that the resulting cookies meet product quality requirements.

Meanwhile, according to SNI 01-7148-2005[35] (drinks and food for pregnant and/or breastfeeding mothers), the protein content is 18-25 g/100 g, ensuring that the cookies meet the established standards. Based on the results of the F1, F2, and F3 treatment tests, it was shown that the higher the proportion of milkfish flour and the lower the addition of moringa leaf flour, the higher the protein content of the cookies produced. This is because milkfish flour has a high protein content of around 56.60%. Therefore, the higher the milkfish substituted, the higher the protein content in the cookies.

According to Husain et al.[36], protein content is inversely related to fat content in fish; fish with lower fat content, on average, have higher protein content. High-quality foods contain various amino acids. In milkfish, there are around 17 types of amino acids; the highest amino acid composition is glutamic acid at 1.386%, lysine at 0.674%, and leucine 0.782%[37]. Moringa leaves

contain protein (28.66%), Zn (2.32%), phosphorus (715.32%), Fe (11.41), and Ca (1014.81)[33], so that the addition of Moringa leaf flour in the F2 and F3 treatments also affects the protein content in cookies, but the difference is not significant.

Based on research by Hermawan et al.[38], moringa leaf cookies had a protein content of 10.622%. Compared with the test data for milkfish cookies containing Moringa leaves, the average protein content was 20.6%, indicating that the addition of milkfish flour has a much greater effect than that of Moringa leaves. Protein amino acids are needed for growth, maintenance of body cells, and the stimulation of brain cell growth. In infants and children, growth occurs gradually, which can be seen from body size, namely, weight and height. Protein requirements for babies should be high-quality[39].

Carbohydrates are a source of energy for humans. Energy is essential for the brain's thought processes. Carbohydrates play a role in the capture and storage of data in the brain's memory. Carbohydrate requirements depend on energy requirements[40]. Carbohydrates also provide energy, serve as food reserves, and contribute to the sweet taste of food[41]. Test results showed that milkfish cookies substituted with moringa leaf flour, with three treatments and three consecutive repetitions, yielded 48.44, 48.46, and 47.89.

The carbohydrate content in this proximate test met the SNI 01-7148-2005 carbohydrate standard for special drinks for pregnant and/or breastfeeding women, which is a maximum of 65 g per 100 g. Based on the test data, the treatment in F3 (150 g wheat flour formulation, 90 g milkfish flour, and 10 g moringa leaf flour) showed the lowest carbohydrate content, namely 47.89. From the three treatments, no significant differences were seen.

According to Simanjuntak[42], wheat flour has a fairly high carbohydrate content of 77.3 g per 100 g, and milkfish flour has a carbohydrate content of 18.86 g per 100 g [43]. In addition, substituting moringa leaf flour also affects the product's carbohydrate content. According to Hidayah's[25] research, MP-ASI biscuits that substituted dumbo catfish flour did not meet the standard of 57.85%, but could be declared to have met the standard because carbohydrates were partially replaced with high-protein and low-carbohydrate sources. Other nutrients, such as fat and protein, Influence carbohydrate testing. As nutrients (fat and protein) increase, carbohydrate content decreases; as nutrients (fat and protein) decrease, carbohydrate content increases[44].

Hedonic Testing of Milkfish Cookies with the addition of Moringa leaves

Hedonic testing is a method for assessing consumer preferences for a product. This is done to determine whether the processed product has the potential for sustainability and large-scale production. Furthermore, this cookie product can impact the wider community, especially as an alternative snack for pregnant women.

Sensory test results for cookies fortified with milkfish flour and moringa leaf flour showed the highest color acceptability score of 4.40 (liked) for formula F1 (80 g of milkfish flour and 20 g of moringa leaf flour). The other two formulas, F2 and F3, did not differ significantly, with scores of 3.97 and 3.87, respectively. The green colour of the cookies comes from moringa leaf flour, which panellists preferred because it contrasted with the typical yellow-brown colour of cookies.

The hedonic aroma test results for the cookies showed a significant difference between formulation 1 and the other two. Formulas 1 and 2 scored 3.77 and 3.90, respectively. Of the three formulas, panelists preferred formula 3, scoring 4.10 and adding the highest amount of milkfish flour, 90 g. This indicates that the cookies did not have a strong fishy odor despite containing 90 g of fish flour. This is likely due to the fresh fish, the main ingredient, being directly processed into fishmeal without prior storage in a refrigerator or proper processing

to produce optimal fishmeal. This processing significantly impacts the resulting cookies. Aroma compounds play a crucial role in the production of flavorings used in the foodservice industry to enhance flavor and increase the appeal of food products[45].

The hedonic texture test results of the cookies were analyzed using SPSS version 27. The analysis results obtained from the three samples showed no significant differences, as evidenced by the sample values of 0.05. The hedonic values for the cookie textures were 4.07, 4.33, and 4.30, respectively. The most preferred texture was Formulation 2 (85 g milkfish and 15 g moringa leaves). The higher the protein content in cookies, the greater the rehydration capacity because protein can retain water[46]. The resulting cookie texture was too brittle, likely due to a short baking time, leaving the cookie's hardness and structural density unoptimized. The difference in cookie hardness or softness is influenced by ingredient formulation; baking conditions and duration are important factors in the final texture[47].

Flavor is the most important sensory quality in food. The human olfactory system initially detects aroma compounds. During mastication, food is further broken down into small pieces, releasing aroma and taste compounds[48]. Taste is a determining factor in consumer acceptance of food products. The tongue primarily assesses taste. Taste plays a crucial role in consumer product selection. Even if the nutritional content is good, if the taste is unacceptable, the goal of improving public nutrition will not be achieved, and the product will not sell. Taste primarily involves the five senses of the tongue[49].

Generally, Perspective identifies four or five basic human taste qualities: sweet and sour, salty, bitter, and umami, which has been proposed as an additional flavor[50]. The sample showed no significant difference between formulas 1 and 2, but formula 3 (90 g milkfish flour and 10 g moringa leaves) showed a significant difference, with a score of 4.10. Panelists' acceptance of the milkfish cookies' flavor was positive, with the highest score being 66.67%.

Aftertaste is the sensation, taste, or aftertaste that remains in the mouth after a product is swallowed or spit out[51]. Aftertaste is an important factor in product acceptance and quality[52]. The aftertaste assessment of the three samples showed that formula 3 had the highest aftertaste score, 4.13. There was no significant difference between the three samples, with formula 1 scoring 3.83 and formula 2 scoring 4.03. Although the cookies were made with fish, the results showed that the salty taste of milkfish flour remained acceptable to some panelists. After eating the cookies, panelists still accepted them. According to Hermanto & Susanty[53], adding fishmeal to biscuits imparts a distinctive fishy aroma (slightly fishy). This characteristic aroma is difficult to remove, even with the addition of other additives during processing.

Furthermore, it is possible that, in addition to the salty taste, a bitter aftertaste remains after consuming the cookies. However, some panellists did not notice either a salty or a bitter taste, leading to the preferred formulas. Formulas 2 and 3 were the most preferred, with an average score of 4.13, indicating they fall within the "like" hedonic scale.

The overall hedonic test measures general consumer acceptance of milkfish cookies with the addition of moringa leaves. Research[54] shows that although fish fortification improves nutrition, it can reduce the overall hedonic score if the fishy odour or taste becomes too strong. Therefore, formulation balance is key to maintaining overall liking. Based on hedonic testing using SPSS version 27, there was no significant difference between the three samples. The results of the hedonic testing assessment (F1, F2, and F3) were 4.07, 4.13, and 4.13, respectively. From additional questions posed to the panellists, it was stated that these cookies were still accepted overall, and there was a high likelihood that they would continue to be produced in the

future. It was also noted that pregnant women had great enthusiasm and interest in this product.

4. CONCLUSION

Based on the research results, the following conclusions can be drawn. First, the processing of milkfish cookies with the addition of moringa leaves was carried out through three stages, namely the production of milkfish flour, the preparation of moringa leaf flour, and cookie processing. Second, the analysis showed that the average moisture content of milkfish cookies for formulations F1, F2, and F3 was 6.43%, 6.44%, and 6.17%, respectively. The average ash content was 2.02%, 2.03%, and 2.13%, while the average fat content was 21.57%, 21.57%, and 21.62%. The average protein content was 21.47%, 21.50%, and 22.21%, and the average carbohydrate content was 48.44%, 48.46%, and 47.87%, respectively.

The nutritional composition of the cookies meets the requirements of SNI 01-7148-2005, particularly for protein, fat, ash, and carbohydrate content. In addition, according to SNI 2973:2022, the nutritional composition of the cookies complies with the established quality standards. However, the moisture content does not meet the requirements of either standard. Hedonic testing, analyzed using IBM SPSS Statistics with Duncan's test, showed mean scores of 4.40 for color, 4.07 for aroma, 4.33 for texture, 4.10 for taste, 4.13 for aftertaste, and 4.13 for overall acceptance. These results that all sensory attributes, aroma, texture, taste, aftertaste, and overall acceptance, were categorized as "liked," suggesting that the product has a good level of acceptance among the panelists.

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