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Nutritional Value Analysis of Dried Noodles with the Addition of Tuna (Thunnus sp.) and Skipjack (Katsuwonus Pelamis)

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Abstract

Dried noodles are a popular food in Indonesia, but their nutritional value is often limited due to high carbohydrate content. This study aimed to develop nutrient-rich dried noodles by adding tuna and skipjack fish, evaluating their sensory quality and nutritional composition to support healthier diets and food diversification. The research used a completely randomized design to compare noodles made with tuna and skipjack fish. Fifteen panelists assessed taste, color, aroma, and texture on a scale from poor to very good, while nutritional content, including moisture, ash, protein, fat, and carbohydrates, was analyzed using standard laboratory methods. Results showed that skipjack noodles had higher protein (18.324%) and mineral content (1.735%) than tuna noodles (14.193% protein, 1.535% mineral), with both rated good to very good for sensory qualities, especially skipjack for its vibrant color. However, moisture levels (22–25%) exceeded industry standards, suggesting shelf-life challenges. In conclusion, both noodle types offer enhanced nutrition and consumer appeal, with skipjack noodles being more protein-rich, making them a promising option for improving dietary protein intake, though better drying methods are needed for commercial viability.

Keywords

Dried Noodles, Fish Protein, Nutritional Content, Organoleptic Quality.

1. Introduction

Noodles are one of the most popular wheat-based foods consumed worldwide, especially in Asia. In Indonesia, noodles are a staple for many, enjoyed as a main dish or a snack in various forms like fresh, instant, or dried noodles. According to Canti et al. (2020), dried noodles are fresh noodles dried to a moisture content of 8–10%, making them durable and resistant to mold and fungi. This drying process, done by sun-drying or using an oven, extends shelf life, allowing distribution across regions without rapid spoilage. Their versatility in preparation, such as boiling, frying, or stir-frying, makes them a favorite in East and Southeast Asia, including Indonesia, where they are a key part of the culinary culture (Ling, 2012).

Dried noodles offer practical benefits, but their nutritional value is often limited (Andriamahefazafy et al., 2020). Made primarily from wheat flour, they are rich in carbohydrates, which provide energy, but lack sufficient protein, vitamins, and minerals (Almagfirah & Laenggeng, 2022). To address this, researchers have explored adding nutrient-dense ingredients to improve noodle nutrition. For instance, incorporating protein-rich sources like legumes, tubers, or fish can enhance nutritional balance and appeal to health-conscious consumers. Fish, in particular, is a promising ingredient due to its high protein content, affordability, and abundance in Indonesia, a country with vast fishery resources (Iriani et al., 2020; Madyowati et al., 2023).

Fish is a rich source of essential proteins, vitamins, minerals, and omega-3 and omega-6 fatty acids that support brain, heart, and nervous system health (Gunawan, 2022). In Indonesia, fish is affordable and widely consumed, aligning with government programs to improve national nutrition (Roberts et al., 2023; Handayani et al., 2024). This makes it suitable for noodle fortification. However, most studies on fish-based noodles, such as those by Litaay et al. (2021), Fietri et al. (2021), and Deserlia et al. (2024), use freshwater species like tilapia and catfish, which, despite improving protein content, often face sensory challenges like fishy odor and texture issues. This indicates a research gap in exploring marine fish such as tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*) for dried noodle production, focusing on both nutritional and sensory qualities using local Indonesian resources.

According to Sumarto et al. (2022) and Suyono et al. (2022), fish-based noodles often face sensory challenges such as fishy aromas and altered textures, especially when using freshwater fish like catfish. Tumanggor et al. (2023) show that fish-based noodles can significantly increase protein content, ranging from 12–20% depending on fish type and quantity. Tuna and skipjack are abundant in Indonesia tuna as a high-value export and skipjack as an affordable, popular fish in eastern regions (Hariyanto et al., 2015; Patel et al., 2023; Lehel et al., 2023). Both species are rich in protein and fatty acids, making them ideal for enhancing noodle nutrition. However, tuna faces overexploitation risks, while skipjack offers a more sustainable alternative (Leha, 2013; Harmain et al., 2019).

Incorporating these fish into noodles can enhance both flavor and nutritional value, meeting modern demands for practical, nutrient-rich foods (Bhuker & Maurya, 2024). Fish proteins also improve noodle elasticity by strengthening gluten structure, though excessive amounts may cause brittleness (Suparmi & Dahlia, 2020). This innovation supports food diversification and reduces dependence on imported wheat flour by utilizing local fishery resources an important step for Indonesia's food security. The main challenge remains balancing nutritional enhancement with sensory quality, as excessive protein can produce undesirable textures or flavors (Litaay et al., 2022).

This study addresses the research gap by developing dried noodles enriched with tuna and skipjack, focusing on their organoleptic quality and nutritional content using local fish from East Nusa Tenggara. It aims to create a product that is both nutritious and appealing to consumers. Specifically, the objectives are: to evaluate consumer preferences for dried noodles enriched with tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*) based on taste, color, aroma, and texture; and to analyze the nutritional composition, including moisture, ash, protein, fat, and carbohydrate content, of these noodles. The findings are expected to provide insights into consumer acceptance and nutritional benefits, supporting the development of affordable, nutrient-dense noodle products that enhance fish consumption and contribute to Indonesia's nutritional and food security goals.

2. Methods

This study used an experimental approach to develop dried noodles enriched with tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*), focusing on their organoleptic quality and nutritional content. The research was conducted from April to June 2024 at the Fishery Products Processing Laboratory, Institut Keguruan Dan Teknologi Larantuka, East Flores Regency, East Nusa Tenggara, chosen for its fishery processing facilities and access to fresh fish. Tuna and skipjack were sourced from local vendors at Larantuka's traditional market, cleaned by removing heads, gills, bones, and skin to obtain white flesh for noodle production. Nutritional analysis was performed at the Feed Chemistry Laboratory, Universitas Nusa Cendana, Kupang, to ensure accurate proximate testing using standard equipment.

Table 1. Formulation of Dried Noodles Made with Tuna (*Thunnus* sp.) and Skipjack (*Katsuwonus pelamis*)

Ingredients	Treatment 1	Treatment 2
Tuna Meat	350 g	0
Skipjack Meat	0	600 g
Wheat Flour	500 g	500 g
Tapioca Flour	100 g	100 g
Salt	1 tbsp	½ tbsp
Pepper	2 tsp	2 tsp
Egg	1 piece	1 piece
Water	300 mL	200 mL

The noodle-making process involved mixing ingredients according to the formulation in Table 1, which details the quantities of tuna or skipjack meat, wheat flour, tapioca flour, salt, pepper, egg, and water for each treatment. The dough was kneaded until smooth, rested for about five minutes to homogenize, and shaped into uniform strands using a noodle-making machine. The noodles were steamed for approximately 10 minutes to reduce fishy odors and partially cook the dough, then sun-dried for two days to achieve a moisture content of around 8–10%, typical for dried noodles. This drying process was conducted under natural sunlight, with regular monitoring to ensure consistent drying, though environmental factors like humidity were not controlled.

Tools used included knives, cutting boards, a noodle-making machine, spoons, and an oven for drying, while laboratory equipment comprised Erlenmeyer flasks, analytical balances, Kjeldahl flasks, furnaces, Soxhlet extractors, and other standard instruments. Materials included primary ingredients (tuna and skipjack meat) and supplementary ingredients (wheat flour, tapioca flour, eggs, salt, pepper, water), with chemical reagents like HCl, NaOH, and ether for nutritional analysis. Fifteen respondents, consisting of lecturers, students, and local community members, evaluated the noodles' taste, color, aroma, and texture using a scale from 1 (poor) to 4 (very good), chosen to represent diverse consumer perspectives.

Nutritional analysis covered moisture, ash, protein, fat, and carbohydrate content. Moisture and ash were measured using gravimetric methods, protein via the Kjeldahl method with a nitrogen conversion factor of 6.25, fat using the Soxhlet method with ether, and carbohydrates by difference, subtracting ash, protein, and fat from 100%. Data were analyzed descriptively to compare organoleptic ratings and nutritional composition between tuna and skipjack noodles, focusing on trends in consumer preferences and nutrient levels without statistical testing. This approach ensured a clear comparison of the two noodle types based on laboratory and sensory data.

3. Results

This study evaluated the organoleptic quality and nutritional composition of dried noodles enriched with tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*) to assess their potential as nutrient-rich food products. The results include sensory evaluations by 15 panelists and nutritional analyses conducted at a certified laboratory. Organoleptic tests focused on taste, color, aroma, and texture, while nutritional analysis measured moisture, ash, protein, fat, and carbohydrate content. The findings, presented in Table 3 and Figures 1–2, provide insights into consumer acceptance and nutritional benefits, highlighting differences between tuna and skipjack noodles. These results are described descriptively, comparing the two treatments to identify trends in sensory and nutritional outcomes.

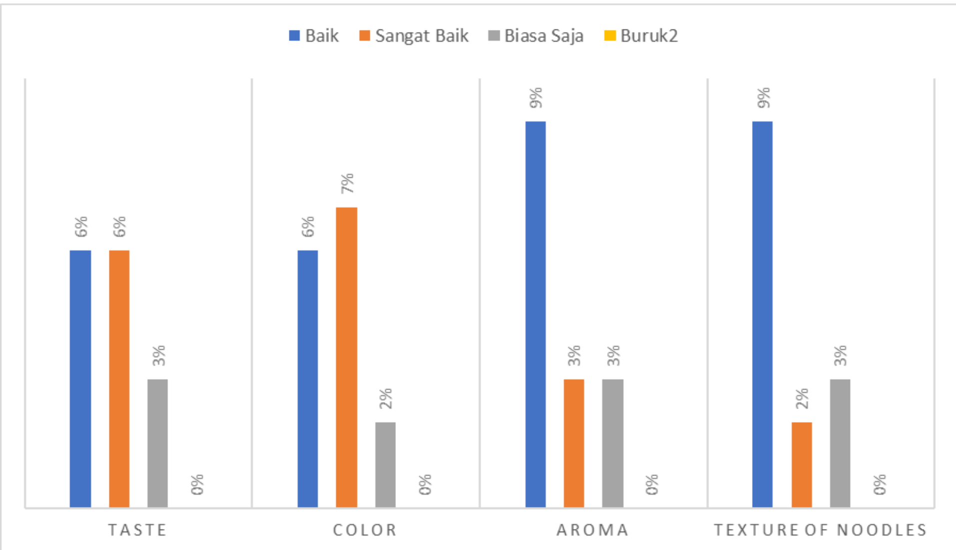

Figure 1. Organoleptic Test of Dried Tuna Noodles (Thunnus sp)

Organoleptic testing was conducted to assess consumer acceptance of dried tuna and skipjack noodles, focusing on taste, color, aroma, and texture. The evaluation involved 15 panelists, including lecturers, students, and community members, who rated the noodles on a scale from 1 (poor) to 4 (very good). Figure 1 illustrates the organoleptic ratings for dried tuna noodles (*Thunnus* sp.). Most panelists rated the noodles as good to very good across all attributes, with very few assigning fair ratings and almost none giving poor scores. The color of tuna noodles received the highest proportion of very good ratings, likely due to the appealing combination of wheat flour's natural hue and the subtle pigment from tuna flesh, which gave the noodles a fresh, distinct appearance. Aroma was predominantly rated as good, reflecting the mild fishy scent of tuna, which was acceptable but not exceptional to all panelists. Texture was also rated good, indicating that the noodles maintained elasticity and did not break easily after boiling. Taste ratings were similarly positive, with most panelists appreciating the savory flavor imparted by the tuna. These findings suggest that tuna noodles are well-accepted by consumers, with color being a standout attribute.

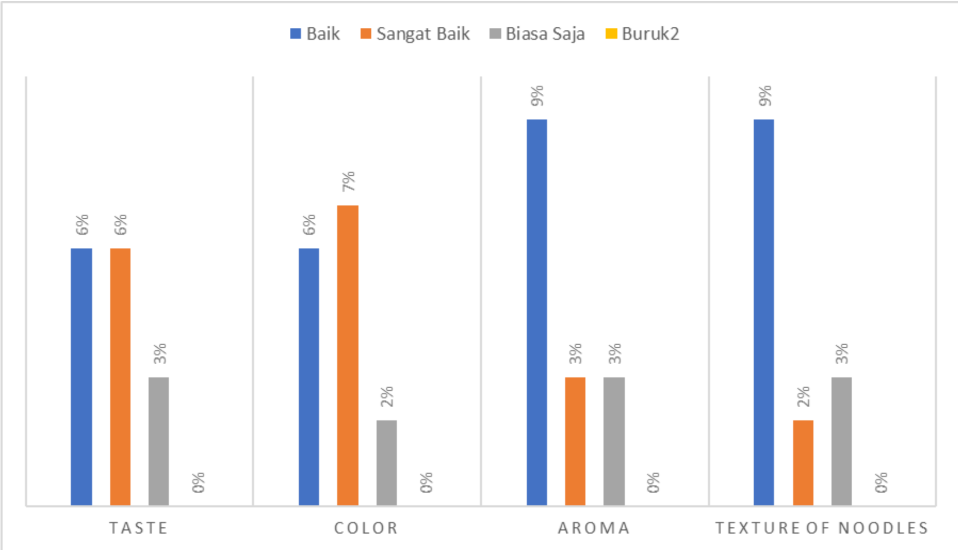

Figure 2. Organoleptic Test of Dried Skipjack Noodles (*Katsuwonus pelamis*)

The organoleptic results for dried skipjack noodles (*Katsuwonus pelamis*) are shown in Figure 2. Similar to tuna noodles, most panelists rated skipjack noodles as good to very good across all attributes, with almost no poor ratings. Notably, the color of skipjack noodles received an even higher percentage of very good ratings compared to tuna noodles, likely due to the brighter, more vibrant flesh of skipjack, which enhanced the visual appeal of the noodles. The aroma was rated good by most panelists, indicating that the characteristic skipjack scent was well-received, though slightly less distinctive than tuna's aroma. Texture ratings were predominantly good, showing that skipjack noodles retained chewiness and structural integrity after cooking. Taste was also well-accepted, with panelists noting a robust fish flavor that complemented the noodle base. These results highlight that skipjack noodles excel in visual appeal, particularly in color, while maintaining strong sensory quality across other attributes, making them highly competitive with tuna noodles.

Table 3. Nutritional Analysis of Dried Tuna (*Thunnus* sp.) and Skipjack (*Katsuwonus pelamis*) Noodles

Sample	Moisture Content (%)	Ash Content (%)	Protein Content (%)	Fat Content (%)	Carbohydrate Content (%)
Dried Tuna Noodles (*Thunnus sp.*)	25.123	1.535	14.193	0.209	83.881
Dried Skipjack Noodles (*Katsuwonus pelamis*)	22.513	1.735	18.324	0.217	79.301

Nutritional analysis results for both noodle types are presented in Table 3, which compares moisture, ash, protein, fat, and carbohydrate content. Dried tuna noodles contained 25.123% moisture, 1.535% ash, 14.193% protein, 0.209% fat, and 83.881% carbohydrates, while skipjack noodles had 22.513% moisture, 1.735% ash, 18.324% protein, 0.217% fat, and 79.301% carbohydrates. The high moisture content in both noodle types, exceeding the Indonesian National Standard of 8% for dried noodles, is a notable concern, as it likely results from the high water content in fresh fish meat (Amalia et al., 2024). Tuna noodles had slightly higher moisture than skipjack noodles, possibly due to tuna's softer flesh retaining more water during processing.

This elevated moisture level suggests a shorter shelf life compared to commercial dried noodles, as high water content promotes microbial growth, necessitating improved drying or packaging techniques.

Ash content, reflecting mineral levels, was 1.535% for tuna noodles and 1.735% for skipjack noodles, indicating that skipjack noodles contain slightly more minerals. These minerals, including calcium, phosphorus, and selenium, likely originate from the fish, wheat flour, and salt used in the formulation. The slightly higher ash content in skipjack noodles aligns with the higher proportion of fish meat in their formulation (600 g vs. 350 g for tuna, as shown in Table 1). This suggests that skipjack contributes more mineral content, enhancing the nutritional profile of the noodles. The ash content falls within the expected range for fish- and flour-based products, supporting their role as a source of essential minerals for bone health and metabolism.

Protein content was a key focus of this study, as fish was added to enhance the nutritional value of the noodles. Skipjack noodles had a higher protein content (18.324%) than tuna noodles (14.193%), reflecting the larger amount of skipjack meat used and its naturally higher protein density. This difference highlights skipjack's potential as a superior protein source for noodle fortification, addressing the need for protein-rich diets in Indonesia (Litaay et al., 2024). The protein levels in both noodle types are significantly higher than those in standard wheat noodles, which typically contain 8–10% protein (Nurul, 2009). These results suggest that fish-based noodles can contribute to improved nutrition, particularly in regions with low animal protein consumption.

Fat content was low in both noodle types, with tuna noodles at 0.209% and skipjack noodles at 0.217%. This low-fat content is advantageous, aligning with consumer preferences for healthier, low-fat foods that reduce the risk of obesity and cardiovascular issues (Liu et al., 2017). Tuna and skipjack are lean fish compared to fattier species like salmon, making them ideal for creating nutrient-dense noodles without significantly increasing fat levels. The minimal difference in fat content between the two noodle types suggests that the choice of fish does not substantially affect the fat profile, allowing both to be marketed as low-fat options.

Carbohydrate content, calculated by difference, was higher in tuna noodles (83.881%) than in skipjack noodles (79.301%). This variation is likely due to the higher proportion of fish meat in skipjack noodles, which reduces the relative amount of wheat flour, the primary carbohydrate source. Carbohydrates remain the dominant nutrient in both noodle types, providing energy, but the addition of fish increases protein and mineral content, creating a more balanced nutritional profile. The lower carbohydrate content in skipjack noodles reflects the trade-off between fish and flour, emphasizing their higher protein contribution compared to tuna noodles.

The results indicate that both tuna and skipjack noodles are well-accepted by consumers, with skipjack noodles showing a slight edge in color appeal and higher protein and mineral content. The sensory evaluations in Figures 1 and 2 demonstrate strong consumer preference for both noodle types, particularly for their color and texture. Table 3 highlights the nutritional advantages of skipjack noodles, with higher protein and lower moisture content, though both noodle types exceed standard moisture levels, posing challenges for shelf life. These findings provide a foundation for further development of fish-based noodles, with considerations for optimizing drying processes to meet industry standards and enhance market viability.

The development of tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*) enriched dried noodles offers a promising nutrient-rich product with strong consumer acceptance. Organoleptic tests showed both types rated good to very good across taste, color, aroma, and texture. As Hoppu et al. (2021) note, sensory qualities like color and texture critically influence consumer acceptance and purchase decisions. Skipjack noodles excelled in visual appeal due to brighter flesh color, while tuna noodles were preferred for their mild, pleasant aroma. Wang et al. (2023) highlight that balanced aromas enhance satisfaction in fish-based products, though managing fishy odors remains challenging. Both noodles maintained good texture and elasticity post-cooking, suggesting fish proteins enhance gluten structure (Zang et al., 2022).

Nutritionally, skipjack noodles showed superior protein content (18.324%) versus tuna noodles (14.193%), reflecting higher skipjack meat content and protein density. Nurul (2009) confirms that increasing fish content directly boosts protein levels, offering alternatives for protein-deficient diets. Skipjack noodles also had higher ash content (1.735% vs. 1.535%), indicating greater mineral levels. Both types had low fat content (below 0.25%), aligning with health-conscious consumer demands, as lean fish add minimal fat (Mathew et al., 2022). However, moisture content (25.123% for tuna, 22.513% for skipjack) exceeded the Indonesian National Standard of 8%, requiring improved drying techniques or vacuum packaging to prevent microbial growth and extend shelf-life.

The study's novelty lies in comparing marine fish species in dried noodles, which are underexplored compared to freshwater alternatives. Deserlia et al. (2024) found that tilapia-based noodles face sensory challenges, suggesting marine fish offer better profiles. Using locally abundant fish from East Nusa Tenggara supports Indonesia's food diversification goals. Challenges include optimizing fish aroma and managing fluctuating prices. These findings position fish-based noodles as practical, nutrient-rich options for schoolchildren, workers, and coastal communities, supporting national nutrition programs and opening opportunities for further innovation with vegetables or spices, plus commercial development through improved processing and packaging for market competitiveness.

4. Conclusion

This study showed that dried noodles enriched with tuna (*Thunnus* sp.) and skipjack (*Katsuwonus pelamis*) were well-received by consumers, offering both good sensory quality and high nutritional value. Organoleptic tests revealed that tuna noodles were rated good to very good in taste, color, aroma, and texture, while skipjack noodles earned particularly high praise for their vibrant color. Nutritional analysis confirmed that skipjack noodles had higher protein (18.324%) and mineral content (1.735% ash) compared to tuna noodles (14.193% protein, 1.535% ash), making them a stronger option for addressing protein deficiencies. Both noodle types had low fat content (below 0.25%), aligning with healthy eating preferences, but their high moisture levels (25.123% for tuna, 22.513% for skipjack) exceeded industry standards. These findings highlight the potential of fish-based noodles as a nutritious, consumer-friendly food that enhances dietary diversity using local fish resources.

The development of tuna and skipjack noodles offers practical benefits for improving nutrition in Indonesia, especially in coastal areas where fish is abundant, by providing a convenient source of protein and minerals for schoolchildren, workers, and families. However, the high moisture content limits shelf life, posing a challenge for commercial production. This may result from the use of fresh fish meat and inconsistent sun-drying conditions. Future research should explore advanced drying methods, such as oven-drying with controlled temperature, or vacuum packaging to extend storage. Additionally, testing other marine fish species or adding ingredients like vegetables could further enhance flavor and nutrition. These improvements would support the creation of a market-ready product that promotes local fish consumption and meets consumer demands for healthy, affordable foods.

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Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement
The data that support the findings of this study are available from the corresponding author upon reasonable request.