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Sensory Evaluation of Smoked Milkfish Based on Consumer Preferences

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Abstract
Fish is a vital part of the Filipino diet, providing both nutritional and economic value, especially in coastal communities. Among various preservation methods, smoking remains a widely practiced technique that not only prolongs shelf life but also enhances sensory qualities such as aroma, appearance, texture, and taste. This study aimed to evaluate the acceptability of smoked milkfish (bangus) using these sensory parameters as a basis for quality assessment. A descriptive research design was employed, and data were collected through a 5-point Likert scale instrument administered to consumer respondents. Results revealed that all evaluated attributes received a rating of Highly Acceptable, with taste recording the highest average weighted mean ($\bar{x}$ = 4.71), followed by texture ($\bar{x}$ = 4.69), aroma ($\bar{x}$ = 4.68), and appearance ($\bar{x}$ = 4.65). These findings suggest that the smoking technique used was effective in enhancing the overall sensory appeal of the product. The implications of this research highlight the potential of traditional smoking techniques, when properly managed, to meet market standards and consumer expectations. The study recommends further investigation into nutritional content, microbial safety, and shelf-life performance under different smoking conditions. This will strengthen the commercial viability and public health value of smoked fish products in the Philippines.

Keywords: smoked milkfish, sensory evaluation, aroma, taste, texture, appearance, fish preservation, consumer acceptability

1. Introduction

Fish plays a vital role in the daily diets of many Filipinos, offering an affordable source of protein and essential nutrients. In coastal provinces such as Surigao del Sur, fish is not only a staple food but also a key economic resource. Among the various methods of preserving fish, smoking has gained popularity for its ability to enhance flavor while extending shelf life. Smoked fish, commonly known as Tinapa, is enjoyed across the country for its unique taste and aroma, making it a familiar delicacy in many households (Andersen et al., 2019; Ferndandez, 2019).

As consumer preferences evolve, so do expectations regarding the sensory qualities of smoked fish products. Attributes such as aroma, appearance, texture, and taste significantly influence consumer acceptability and purchasing behavior (Bhavadharini, 2023; Andersen et al., 2019). Świąder and Marczewska (2021) highlights the need for producers to consider sensory evaluation as a basis for product improvement and market alignment.

While traditional smoking techniques are widely used, they often result in inconsistent product quality due to variations in raw materials, process conditions, and lack of consumer-oriented feedback. Understanding sensory preferences directly from consumers is crucial, especially in areas where small-scale producers play a major role in supplying local markets (Kiss et al., 2020).

This research aims to assess the sensory characteristics of smoked milkfish as evaluated by consumer respondents, particularly in terms of aroma, appearance, texture, and taste. Findings from this study may

contribute to the enhancement of smoked fish production, aligning it more closely with evolving consumer expectations and supporting quality improvements in the Philippine smoked fish industry.

2. Literature Review

The preservation of fish through smoking is an ancient technique that has evolved to meet the demands of modern consumers. Traditional smoking methods, which involve exposure to wood smoke, have been widely practiced across different cultures for centuries. In the Philippines, the production of smoked fish, particularly Tinapa, is a significant part of the culinary heritage and an essential method of preserving fish in tropical climates. Rodriguies et al. (2024) emphasize the importance of improving these methods to meet contemporary market demands, which now include higher standards for sensory quality such as taste, aroma, texture, and appearance.

Consumer preference plays a central role in shaping the success of smoked fish products. Sensory characteristics such as aroma, appearance, texture, and taste are crucial to consumer acceptability and buying behavior. Research indicates that aroma is one of the most influential factors in determining the overall appeal of smoked fish products. Swaney-Stueve et al. (2019), the unique smoky aroma generated during the smoking process is highly valued by consumers, with variations in aroma being linked to the type of wood used, the smoking duration, and the method of preparation. Abiodun-Solanke (2020) found that consumers preferred smoked fish with a rich, well-balanced smoky aroma, which was often associated with higher-quality products.

In addition to aroma, the appearance of smoked fish significantly influences consumer perception. Studies have shown that the visual appeal of smoked fish, including its color, gloss, and overall presentation, can impact consumer decisions. Lochan (2021) highlighted that consumers tend to associate a golden-brown color with properly smoked fish, which is often linked to flavor intensity and freshness. Similarly, Puke and Galoburda, (2020) observed that variations in the color and texture of smoked fish could indicate differences in the quality and freshness of the product. Appearance is not just an aesthetic concern but also an important indicator of quality that affects consumers' willingness to purchase.

Texture is another vital sensory attribute that affects the consumer's enjoyment of smoked fish. The texture of smoked fish is influenced by factors such as the method of smoking, fish species, and preparation techniques. According to Assogba et al. (2021), consumers prefer smoked fish with a firm, yet tender texture, which indicates that the product is both fresh and properly processed. Overly dry or rubbery textures, often caused by over-smoking or improper storage, are generally seen as undesirable. Similarly, research by Ferreira (2019) suggests that texture plays a significant role in determining overall product quality, as it directly impacts mouthfeel and consumer satisfaction.

Taste is arguably the most crucial factor in consumer acceptability of smoked fish. Several studies have shown that the flavor profile of smoked fish is highly dependent on the smoking technique used, as well as the quality of the raw fish. Adeyeye et al. (2019) concluded that the taste of smoked fish is influenced by both intrinsic factors such as the species of fish and extrinsic factors such as the ingredients and smoking process. A more intense smoky flavor, for instance, is preferred by some consumers, while others might favor a subtler taste. The balance of smoky flavor and the natural taste of the fish itself is essential for overall acceptability. Additionally, consumer preferences for flavor are often culturally driven, as different regions have varying expectations of what constitutes an ideal smoked fish product (Siddiqui, 2020).

The growing demand for high-quality smoked fish products has led to innovations in smoking techniques, aimed at improving not only the preservation and safety of the fish but also the sensory characteristics. Recent studies have explored various modern smoking methods, such as electric smoking and cold smoking, which help achieve a more uniform texture, enhanced flavor, and more consistent product appearance. Effiandi et al. (2024) suggests that technological advancements in smoking equipment and methods, such as automated smoking machines, are improving product consistency and reducing human error in traditional smoking processes. These innovations allow producers to meet the evolving sensory preferences of consumers while maintaining high standards for food safety and quality.

Despite these advancements, challenges remain in ensuring that sensory qualities align with

consumer expectations. In particular, small-scale producers in the Philippines and other developing regions face difficulties in maintaining consistent product quality, often due to limited access to modern smoking technologies or reliable market feedback. This gap in product quality underscores the need for more consumer-based research to better understand sensory preferences and guide product development. Focusing on sensory evaluation from the perspective of the consumer, this research aims to bridge this gap and provide valuable insights for improving the quality and competitiveness of locally produced smoked fish.

3. Methodology

3.1 Design

The study employed a descriptive research design focused on sensory evaluation. This design was appropriate for collecting detailed information about consumer perceptions regarding the sensory attributes of smoked milkfish. The aim was to assess the sensory quality of smoked milkfish as evaluated by consumer respondents, particularly in terms of aroma, appearance, texture, and taste.

3.2 Participants

A purposive sampling technique was used to select participants for the sensory evaluation. The sample consisted of 100 consumers aged 18 years and above, who were regular consumers of smoked fish products, especially smoked milkfish (Bangus). These participants were selected from various areas in Surigao del Sur, where smoked fish is commonly consumed. This method ensured that the respondents had sufficient familiarity with smoked fish to provide informed evaluations.

3.3 Product Preparation

Smoked milkfish samples were sourced from local producers using traditional smoking methods common in Surigao del Sur. To maintain consistency, all samples were prepared under similar conditions, such as standardized smoking duration and type of wood used. The fish samples were stored in clean, food-safe containers at ambient temperature and were distributed on the same day of evaluation to ensure freshness.

3.4 Instrument

The study used a structured sensory evaluation tool employing a 5-point Likert scale to assess consumer perceptions of smoked milkfish in terms of aroma, appearance, texture, and taste. The scale ranged from 1 (Not Acceptable) to 5 (Highly Acceptable), allowing respondents to rate each attribute based on their level of satisfaction. This format provided a clear and measurable way to capture consumer preferences, ensuring consistency in responses. The instrument was validated by experts and pre-tested with a small group of consumers to confirm its clarity and reliability. Data collected from the scale served as the basis for statistical analysis and interpretation of sensory acceptability.

3.5 Data Gathering Procedure

The data gathering was conducted in a controlled setting to ensure consistency and minimize external factors that could affect the evaluation. Consumer respondents were invited to participate in a scheduled sensory testing session. Each participant was oriented on the purpose of the study and instructed on how to use the 5-point Likert scale. Standardized smoked milkfish samples were prepared, coded, and served to avoid brand bias. Water was provided for palate cleansing between tastings. Participants evaluated the samples based on aroma, appearance, texture, and taste, then recorded their ratings on printed questionnaires. All responses were collected immediately after the tasting session.

3.6 Data Analysis

The collected data were tabulated and analyzed using descriptive statistics. Mean and standard deviation were computed for each sensory attribute to determine the overall acceptability levels. Additionally, frequency and percentage distributions were used to present the spread of responses per rating scale. Data analysis was done using Microsoft Excel and SPSS software to ensure accuracy and ease of interpretation.

3.7 Ethical Considerations

The study adhered to ethical standards to protect the rights and welfare of participants. Informed consent was obtained from all respondents before the evaluation. Participation was voluntary, and respondents were

informed that they could withdraw at any time without any consequences. Personal information was not collected to ensure anonymity, and all data were treated with strict confidentiality. The research complied with the ethical guidelines set by the institution and did not pose any physical or psychological risks to participants.

4. Results

Table 1. Aroma

Item Statements	Weighted Mean ($\bar{x}$)	Verbal Description
The smoked milkfish has a pleasant and appetizing aroma.	4.90	Highly Acceptable
The smoke aroma is noticeable without being overpowering.	4.40	Highly Acceptable
The fish's aroma is natural and not masked by excessive smokiness.	4.68	Highly Acceptable
The aroma is consistent throughout the product.	4.60	Highly Acceptable
The aroma is fresh and not rancid or stale.	4.80	Highly Acceptable
Average Weighted Mean	**4.68**	**Highly Acceptable**

The aroma of the smoked milkfish was perceived as highly acceptable as shown in table 1, with an average weighted mean of 4.68. Among the item statements, the highest rating was given to "The smoked milkfish has a pleasant and appetizing aroma" ($\bar{x}$ = 4.90), indicating that the overall sensory appeal of the product strongly satisfied the respondents. The item "The aroma is fresh and not rancid or stale" ($\bar{x}$ = 4.80) reinforces the quality of the raw materials and the effectiveness of the smoking technique in preserving freshness and preventing spoilage. Even the lowest-rated item, "The smoke aroma is noticeable without being overpowering" ($\bar{x}$ = 4.40), still falls within the "Highly Acceptable" range, suggesting that the smoking intensity was well-controlled.

The findings imply that the balance between smokiness and the natural scent of fish was achieved, which is vital in maintaining product integrity and sensory satisfaction. These results are aligned with studies such as those of Adeyeye et al. (2019) and Siddiqui (2020), which emphasize that aroma plays a vital role in determining consumer preference and acceptability, especially in smoked or preserved products. A product that emits a fresh, consistent, and pleasant aroma suggests not only proper handling and smoking but also adherence to food safety standards, which has marketing implications for small-scale fish processors and entrepreneurs. Furthermore, Puke and Galoburda (2020) noted that smoked fish with a desirable aroma enhances shelf appeal and consumer trust, which can increase repeat purchases. The implication is that maintaining aroma quality through consistent smoking techniques and good hygiene practices can help local producers elevate product value, gain wider market access, and promote food security through value-added preservation methods.

Table 2. Appearance

Item Statements	Weighted Mean ($\bar{x}$)	Verbal Description
The smoked milkfish has an appealing color and sheen.	4.66	Highly Acceptable
The fish is evenly smoked, with no over or under-smoking.	4.54	Highly Acceptable
The fish is visually clean and free from any noticeable defects.	4.54	Highly Acceptable
The fish retains its shape and does not appear excessively dried out.	4.74	Highly Acceptable

The overall appearance of the fish is appetizing and marketable.	4.78	Highly Acceptable
Average Weighted Mean	**4.65**	**Highly Acceptable**

The appearance of the smoked milkfish was rated as Highly Acceptable with an average weighted mean of 4.65, indicating strong consumer satisfaction with its visual appeal. The highest-rated item was "The overall appearance of the fish is appetizing and marketable" ($\bar{x}$ = 4.78), followed closely by "The fish retains its shape and does not appear excessively dried out" ($\bar{x}$ = 4.74). These results imply that the smoking method preserved the fish's structure and visual freshness, which are critical factors in product marketing and consumer buying decisions. Lower-rated but still highly acceptable items such as "The fish is evenly smoked" and "The fish is free from noticeable defects" ($\bar{x}$ = 4.54 each) suggest areas for minor improvement in consistency and preparation, especially for larger-scale production.

The results are supported by Li et al. (2024), who emphasized that consumers use visual cues such as color, shape, and cleanliness to judge the quality and freshness of smoked fish. Similarly, Marquis et al. (2023) found that a fish product's visual presentation directly influences its perceived quality and acceptability. In traditional markets and even in modern retail settings, appearance strongly affects product desirability and pricing. Therefore, for micro and small enterprises in fish processing, ensuring that smoked milkfish is visually clean, evenly processed, and appealing can enhance competitiveness and consumer trust. The implications of these findings point to the importance of controlled smoking conditions, quality raw material selection, and proper handling to maintain a marketable and appetizing product.

Table 3. Texture

Item Statements	Weighted Mean ($\bar{x}$)	Verbal Description
The texture of the fish is firm but not too tough.	4.78	Highly Acceptable
The flesh is moist and not excessively dry.	4.44	Highly Acceptable
The fish flakes easily when cut or eaten.	4.70	Highly Acceptable
The texture is consistent throughout the fish.	4.70	Highly Acceptable
The fish does not have any mushy or overly soft parts.	4.82	Highly Acceptable
Average Weighted Mean	**4.69**	**Highly Acceptable**

The texture of the smoked milkfish received a high overall rating of 4.69, interpreted as Highly Acceptable. The highest-rated statement was "The fish does not have any mushy or overly soft parts" ($\bar{x}$ = 4.82), followed closely by "The texture of the fish is firm but not too tough" ($\bar{x}$ = 4.78). These ratings suggest that the smoking process used in this study successfully preserved the desirable firmness of the fish, avoiding common texture problems like sogginess or dryness. Meanwhile, the lowest but still highly rated item was "The flesh is moist and not excessively dry" ($\bar{x}$ = 4.44), which implies there may still be slight improvements to be made in moisture retention, especially for longer shelf life or varied storage conditions.

Findings are in line with Mathew et al. (2019), who noted that consumers strongly value fish products that maintain a balance between firmness and moisture. Texture not only affects consumer enjoyment but also signals quality and freshness. Consistent texture throughout the fish ($\bar{x}$ = 4.70) and ease of flaking ($\bar{x}$ = 4.70) indicate proper heat distribution during the smoking process, supporting the effectiveness of the method used. These results imply that adopting precise smoking techniques contributes positively to the structural integrity of smoked milkfish, which is critical in preventing spoilage and enhancing both sensory quality and consumer satisfaction. As suggested in Frei et al. (2022), optimal texture improves market competitiveness and may even reduce product returns or waste in commercial settings.

Table 4. Taste

Item Statements	Weighted	Verbal Description

	Mean ($\bar{x}$)	
The taste has a good balance of smokiness and the natural flavor of fish.	4.80	Highly Acceptable
The seasoning enhances the overall flavor.	4.48	Highly Acceptable
The flavor is rich and not bland or overly salty.	4.66	Highly Acceptable
The aftertaste is pleasant and does not linger unpleasantly.	4.72	Highly Acceptable
The overall taste of the smoked milkfish is satisfying and enjoyable.	4.90	Highly Acceptable
Average Weighted Mean	**4.71**	**Highly Acceptable**

The taste of the smoked milkfish received the highest average rating among all sensory attributes, with an overall weighted mean of 4.71, described as Highly Acceptable. The top-rated statement was "The overall taste of the smoked milkfish is satisfying and enjoyable" ($\bar{x}$ = 4.90), which affirms strong consumer satisfaction. Following this were high scores for "The taste has a good balance of smokiness and the natural flavor of fish" ($\bar{x}$ = 4.80) and "The aftertaste is pleasant and does not linger unpleasantly" ($\bar{x}$ = 4.72). These results suggest that the smoking method effectively preserved the fish's natural flavor while adding a pleasant smoky profile without overwhelming the palate. This aligns with Bonfeh et al. (2019), who emphasized the significance of achieving flavor harmony in smoked seafood to increase consumer preference.

Furthermore, the rating of "The seasoning enhances the overall flavor" ($\bar{x}$ = 4.48), though still highly acceptable, was the lowest among the items, indicating that while the base flavor was appreciated, there may be potential for improving flavor enhancement through seasoning. According to Goma et al. (2024), consumers tend to favor smoked fish that balances saltiness, smokiness, and natural fish flavor without relying heavily on artificial flavorings. This result implies that consumers prefer seasoning that complements, not overshadows, the fish's taste. The findings suggest that carefully calibrated smoking and seasoning processes can significantly improve flavor quality, drive market demand, and increase the economic value of smoked milkfish products, especially in local communities where traditional fish smoking is a livelihood source.

5. Conclusions And Recommendations For Future Studies

This study explored the sensory acceptability of smoked milkfish using various smoking techniques, focusing on aroma, appearance, texture, and taste as evaluated by consumer respondents. The findings revealed a consistently high level of acceptability across all variables, with the taste receiving the highest average weighted mean ($\bar{x}$ = 4.71), followed closely by texture ($\bar{x}$ = 4.69), aroma ($\bar{x}$ = 4.68), and appearance ($\bar{x}$ = 4.65). These results indicate that the applied smoking methods successfully produced a high-quality smoked fish product that met consumer standards for sensory appeal. The implications of this research suggest that proper smoking techniques can enhance not only the shelf life but also the marketability of milkfish by maintaining desirable sensory qualities. This is particularly relevant in regions such as Surigao del Sur, where fish smoking is a common preservation method and a source of livelihood. The high acceptability scores also affirm the potential of these products to compete in broader commercial markets, provided that consistent quality standards are maintained.

Future studies are encouraged to expand the scope of this research by integrating nutritional analysis to assess how different smoking methods affect the protein, fat, and micronutrient content of milkfish. In addition, exploring the microbiological safety and shelf-life stability under various storage conditions would provide a more comprehensive evaluation of product quality. It is also recommended to compare traditional and modern smoking technologies, such as electric or solar-powered smoking kilns, to determine which methods yield optimal results in terms of both efficiency and product quality. Furthermore, future research could examine consumer preferences across different regions or demographic groups to tailor smoked fish production to specific market segments. Lastly, incorporating economic viability assessments could guide small-scale producers in adopting sustainable and profitable smoking practices. These recommendations aim

to support the continuous improvement of fish smoking techniques and contribute to food security, livelihood enhancement, and sustainable fisheries development in the Philippines.

6. Conflict Of Interest

The researcher declares no conflict of interest. The study was conducted with impartiality, ensuring that the results and conclusions are based solely on the collected data and objective analysis.

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