Pengembangan produk sosis bernilai tambah dari thryssa mystax pada industri rumah tangga di Surabaya
Development of value-added sausage products from thryssa mystax in a home industry setting in Surabaya

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Abstract

Background: The abundant *Thryssa mystax* resources in the Madura Strait hold strategic potential to support the local economy and food security. However, the traditional processing methods employed by IRT Jiddah and Barokah limit the enhancement of value-added and product competitiveness. This underscores the need for processing innovations, such as the development of fish sausage products, to improve quality, diversify products, and expand market opportunities.
Objective: This study aimed to develop the most acceptable fish sausage formulation through hedonic sensory evaluation, while also analyzing the nutritional and microbiological characteristics of the selected product.
Method: A completely randomized design was used with three treatments incorporating different proportions of *Thryssa mystax* (X1:250 g, X2:500 g, and X3:750 g). These were organoleptically evaluated by 40 semi-trained panelists to determine the best samples. The selected product was further analyzed for its nutritional composition and microbiological quality. Data were analyzed using one-way ANOVA at a 95% confidence level. This study was conducted in Surabaya from June to November 2024.
Results: The organoleptic test results showed that the addition of *Thryssa mystax* had a significant effect on aroma, texture, and overall acceptance (p = 0,000), but not on color (p = 0,365) and taste (p = 0,503). X2 formulation (500 g) obtained the highest overall acceptance score of 4,3. These findings indicate that the X2 formulation not only provides sensory characteristics preferred by consumers but also has the potential to increase protein content and ensure stable sensory quality, making it suitable for application in small-scale household industry.
Conclusion: Based on sensory evaluation across all attributes, the best formulation was X2. The X2 product contained 10,4% protein, 0,15% fat, 14,4% carbohydrates, 69,36% moisture, and 2,27% ash. Microbiological analysis showed a total plate count of $1,3 \times 10^5$ CFU/g, which exceeded the maximum limit set by SNI.

Keywords:
Sausage, *Thryssa mystax*, Nutritional Quality, Sensory Evaluation

Abstrak

Latar belakang: *Thryssa mystax* yang melimpah di perairan Selat Madura memiliki potensi strategis dalam mendukung perekonomian lokal dan ketahanan pangan. Namun, pengolahan yang dilakukan secara tradisional oleh IRT Jiddah dan Barokah membatasi peningkatan nilai tambah serta daya saing produk. Kondisi ini menegaskan urgensi inovasi pengolahan, salah satunya melalui pengembangan produk sosis ikan, guna meningkatkan mutu, diversifikasi produk, dan peluang pemasaran.
Tujuan: Penelitian ini bertujuan mengembangkan formulasi sosis ikan terbaik berdasarkan uji penerimaan menggunakan metode uji hedonik serta menganalisis kandungan gizi dan mikrobiologi pada produk terpilih.

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Metode: Penelitian ini menggunakan rancangan acak lengkap dengan tiga perlakuan penambahan proporsi *Thryssa mystax* (X1 250g, X2 500g, dan X3 750g), yang diuji secara organoleptik oleh panelis semi terlatih sejumlah 40 orang untuk menentukan sampel terbaik. Produk terpilih kemudian dianalisis kandungan gizi serta mikrobiologi. Produk terpilih kemudian dianalisis kandungan gizi dan mikrobiologi. Data dianalisis menggunakan ANOVA one way pada taraf kepercayaan 95%. Penelitian dilakukan di Surabaya pada bulan Juni – November 2024.

Hasil: Hasil uji organoleptik menunjukkan bahwa penambahan *Thryssa mystax* berpengaruh nyata terhadap parameter aroma, tekstur, keseluruhan (p=0,000), namun tidak berpengaruh pada warna (p=0,365) dan rasa (p=0,503). Produk X2 (500 g) memperoleh tingkat kesukaan tertinggi dengan skor 4,3 pada parameter keseluruhan. Temuan ini menunjukkan bahwa formulasi X2 tidak hanya memberikan karakteristik sensori yang disukai konsumen, tetapi juga berpotensi meningkatkan kandungan protein dan memastikan mutu sensori yang stabil, sehingga relevan untuk diterapkan dalam pengolahan skala industri rumah tangga.

Kesimpulan: Produk terbaik berdasarkan uji organoleptik untuk keseluruhan atribut sensori adalah produk X2. Produk X2 memilik kadar protein sebesar 10,4%, lemak 0,15%, karbohidrat 14,4%, kadar air 69,36%, serta kadar abu sebesar 2,27%. Uji mikrobiologi menunjukkan angka lempeng total sebesar $1,3 \times 10^5$ CFU/g, yang melebihi batas maksimum yang ditetapkan oleh SNI.

Introduction

One of the underutilized fishery resources in Indonesia is *Thryssa mystax*. This species is abundant in coastal waters and is commonly processed by home-based industries into value-added food products. However, household-level processing still faces challenges related to product quality, safety, and competitiveness. As an archipelagic nation endowed with abundant marine resources, the development of fish processing by home-based industries plays a vital role not only in ensuring the availability of animal protein for the population but also in strengthening the local economy through diversification of fishery products (Mokodompit, 2024).

Indonesia has an estimated sustainable fishery potential of approximately 12,54 million tons per year, along with 2,5 million hectares of coral reefs that have high ecological functions yet are vulnerable to environmental changes (Akbar, 2022). With the population projected to reach 280,73 million in 2024, the demand for high-quality fishery products continues to rise, especially in densely populated regions such as Java. One of the resource-rich areas is the Madura Strait, which separates the Java and Madura Islands. This region plays a vital role in supporting the local economy, particularly through the home-based fishery industries that thrive in its coastal communities (Qodar et al., 2018).

Thryssa mystax, locally known as *chicken feather fish*, is a small pelagic species that is abundant in the Madura Strait, particularly in the waters surrounding Surabaya. Characterized by its smooth, feather-like fins, this species contains approximately 21,3% protein, 2,7% fat, 69,9% moisture, 1,42% ash, and 1,4% carbohydrates, making it a highly nutritious food source with significant economic potential for the development of value-added fish products (Vijayakumar et al., 2014).

In Kedung Cowek Village, Surabaya, the Jiddah and Barokah home industries collaborate with local fishermen to process *Thryssa mystax* as part of a community-based economic initiative that supports local livelihoods. These two small-scale industries have contributed to local economic development since their establishment in Jiddah in 2001 and Barokah in 1999. With average annual incomes of approximately IDR 54,000,000 and IDR 57,600,000, respectively, both industries have the potential to increase their revenue through the adoption of appropriate technologies and innovative strategies.

Currently, these home industries rely on traditional processing methods, such as salting and drying. While salting extends the shelf life of fish, it tends to reduce its nutritional value because of the high sodium content. Similarly, conventional drying methods often lead to the loss of essential nutrients in fresh fish. Although widely practiced, these traditional methods are no longer sufficient to meet the demands of modern markets, which increasingly prioritize health and quality. Natsir's (2018) reported that salting processes reduce essential protein levels and important vitamins, such as vitamins A and D nutrients that are vital for human health. However, most existing studies on small-scale or household fish processing in Indonesia have focused on documenting traditional preservation methods, with

limited exploration of innovative techniques aimed at both preserving nutritional quality and improving market competitiveness of the products. This study addresses this gap by developing and evaluating a modernized processing method for *Thryssa mystax* tailored for household-scale operations that maintains nutritional integrity while enhancing product appeal for broader consumer markets.

Despite efforts to expand their market reach, Jiddah and Barokah home industries still face challenges. The primary issue is the low attractiveness of their products, which are mostly sold in traditional markets. Consequently, their market reach is limited and selling prices remain low. Data from several local markets indicate that traditionally processed fish products typically sell for IDR 15,000–25,000 per kilogram, whereas those with attractive packaging and nutritional labeling can fetch prices between IDR 35,000–50,000 per kilogram. This price gap highlights the opportunity to increase product value through improved processing, packaging, and marketing strategies in the future. Therefore, an innovative approach is necessary to enhance the competitiveness and marketability of fish products from these home-based industries.

This study aimed to identify the most acceptable fish sausage formulation using hedonic sensory evaluation and analyze the nutritional composition of the selected product. This study was designed to support the Jiddah and Barokah home industries in enhancing the quality and market competitiveness of *Thryssa mystax* products. The novelty of this study lies in the development of a modern processed product utilizing *Thryssa mystax*, a small pelagic species native to the Madura Strait that has traditionally been processed through salting and drying. This approach differs from common processing practices in the region by employing techniques that better preserve nutritional value, diversify local fishery products, and directly contribute to enhancing the capacity and income potential of household fish-processing industries in Kedung Cowek, Surabaya, Indonesia.

Methods

Research Design

This study employed a completely randomized design (CRD), in which the treatment was the variation in the proportion of *Thryssa mystax* added to the sausage formulation. Three treatment levels were used: 750 g (X1), 500 g (X2), and 250 g (X3) of *Thryssa mystax* (Table 1).

Organoleptic evaluations were conducted by semi-trained panelists to assess the sensory characteristics of the *Thryssa mystax* sausage and to identify the most preferred formulation (Nauman et al., 2022). The panelists performed sensory analysis based on attributes such as aroma, texture, taste, color, and overall acceptability of the samples. The best product, selected based on organoleptic results, was subsequently analyzed for its nutritional and microbiological content. The following methods were used for laboratory analyses: Protein content: Kjeldahl Method; Fat and carbohydrate content: SNI 2715:2013; Moisture content: Drying Loss Method; Ash content: AOAC Method 97.09.1995; Total Plate Count (TPC): BAM Online Method (2017).

Table 1. *Thryssa mystax* Sausage Recipe Formulation

Material	Weight (g)		
	X1	X2	X3
Ground *Thryssa mystax*	250	500	750
Tapioca flour	50	50	50
Red bean flour	50	50	50
White tofu	50	50	50
Egg	50	50	50
Red onion	10	10	10
Garlic	20	20	20
Salt	5	5	5
Sugar	2	2	2
Broth powder	2	2	2
Pepper	1	1	1
Vegetable Sauce	2	2	2
Sesame oil	2	2	2

Procedure for Making *Thryssa mystax* Sausage

The production process of *Thryssa mystax* sausage begins with cleaning the fish, which includes evisceration (removal of internal organs), descaling, and thorough washing to ensure that the raw materials are clean and hygienic. The cleaned fish were minced using a meat grinder until a smooth consistency was achieved.

Next, the ground fish is mixed with tapioca flour, red bean flour, eggs, white tofu, and a blend of herbs and spices to form a homogeneous sausage mixture. This mixture is then filled into sausage casings made of food-grade plastic. The sausages were boiled for approximately 25 min to ensure proper heat-induced ripening. After boiling, the sausages were allowed to cool. The cooling process lowers the product temperature, maintains structural integrity, and prepares sausages for packaging or further processing (Bozhko et al., 2021).

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Organoleptic Test Procedure

Organoleptic evaluation was conducted using a hedonic test to assess the acceptance level of the sausage products based on five sensory attributes: color, aroma, taste, texture (toughness), and overall acceptability. The hedonic scale ranged from 1 to 5, with the following criteria: 5 = Very Like, 4 = Like, 3 = Quite Like, 2 = Dislike, and 1 = Very Dislike.

The test involved 40 semi-trained panelists selected from an initial group of 67 candidates. The selection criteria included: good sensory sensitivity, interest in participating in sensory evaluations, consistency in decision-making, good health condition, and willingness to complete the panelist competency form. These criteria ensured that the selected panelists had sufficient capability and reliability to provide valid organoleptic data (Aykan et al., 2020).

Nutrient and Microbiology Test Procedures

The protein content was analyzed using the Kjeldahl method. In this method, the sample was digested with concentrated sulfuric acid and a catalyst to convert organic nitrogen into ammonium sulfate. The mixture was then distilled with sodium hydroxide (NaOH) to release ammonia, which was subsequently trapped and titrated using hydrochloric acid (HCl). The nitrogen content obtained was then converted to protein content using an appropriate conversion factor (AOAC, 2016b). The fat content was determined based on the SNI 2715:2013 method using Soxhlet extraction. In this procedure, the sample was extracted using n-hexane or petroleum ether as the solvent. The fat was separated through repeated cycles of heating and evaporation, and the remaining fat residue was weighed to calculate the fat content (BSN, 2013). Carbohydrate content was calculated by the difference method in accordance with SNI 2715:2013, where the percentage of carbohydrates was obtained by subtracting the percentages of protein, fat, moisture, and ash from 100% (BSN, 2013).

Moisture content was measured using the Drying Loss Method, in which the sample was dried in an oven at 105°C for several hours until a constant weight was achieved. The moisture content was then calculated based on the difference in weight before and after drying (AOAC, 2016a). Ash content was analyzed following the AOAC Method 97.09 (1995). The sample was incinerated in a muffle furnace at 550°C until all organic matter was combusted, leaving only mineral residue. The remaining ash was weighed, and its proportion was calculated relative to the original sample weight (AOAC, 1995).

The Total Plate Count (TPC) was determined to assess the microbiological quality of the sample, based on the BAM Online 2017 method. The sample was diluted in a peptone buffer solution, subjected to serial dilutions, and inoculated onto Plate Count Agar (PCA). The inoculated media were incubated at 35–37°C for 24–48 hours, after which the number of bacterial colonies was counted and expressed as colony-forming units per gram (CFU/g) ((FDA), 2017).

Data analysis

Data were analyzed using SPSS version 22. Normality testing was performed using the Shapiro–Wilk test, whereas homogeneity of variance was assessed using the Levene test. To determine significant differences between treatment groups, a one-way Analysis of Variance (ANOVA) was conducted, followed by a Least Significant Difference (LSD) post hoc test. All statistical tests were conducted at a 95% confidence level (P < 0,05).

Results

The data were normally distributed with homogenous variances. One-way ANOVA indicated that the addition of *Thryssa mystax* significantly affected aroma, texture, and overall acceptability (p = 0,000), but not color (p = 0,365) or taste (p = 0,503). The mean preference scores and standard deviations for each sausage formulation are presented in Table 2. The final sausage product is illustrated in Figure 1.

Table 2. Distribution of Likeability Levels for *Thryssa mystax* Sausages

Attribute	Average Formula Acceptability Score			P-Value
	X1	X2	X3	
Color	4,02 ± 0,57[a]	4,15 ± 0,66[a]	4,22 ± 0,65[a]	0,365
Aroma	4,02 ± 0,57[a]	4,00 ± 0,50[a]	3,47 ± 0,64[b]	0,000
Flavor	4,07 ± 0,69[a]	4,22 ± 0,57[a]	4,22 ± 0,69[a]	0,503
Texture/Elasticity	3,55 ± 0,50[b]	4,20 ± 0,46[a]	4,25 ± 0,43[a]	0,000
Overall	3,52 ± 0,55[b]	4,30 ± 0,60[a]	4,07 ± 0,72[a]	0,000

The acceptability scores for color and flavor across all formulations (X1, X2, X3) were relatively high, ranging from 4,02 to 4,22, indicating a positive reception within the like to very like range. The LSD test revealed no significant differences among the three formulations for these two parameters, suggesting that variations in fish content did not affect the panelists' perception of color and flavor.

In contrast, aroma, texture, and elasticity showed significant differences. Formulas X1 and X2 had comparable aroma scores (4,02 and 4,00, respectively), while X3 scored significantly lower at 3,47. This suggests that increasing the amount of *Thryssa mystax* to 750 g may negatively affect aroma acceptability. For texture, X1 (3,55) was rated significantly lower than X2 (4,20) and X3 (4,25), indicating that a higher fish proportion contributed to better texture and elasticity.

Regarding overall acceptability, X2 scored the highest (4,30), followed by X3 (4,07), and X1 scored the lowest (3,52). These results demonstrate that the 500 g formulation (X2) was the most favorable among the panelists. Therefore, X2 was selected for further nutritional and microbiological analyses (Table 2).

Table 3. Results of Nutrient and Microbiological Content Tests for Formula X2

Test	Method	Average Results
Protein	Kjeldahl	10,4% b/b $\pm$ (0,21%)
Fat	SNI 2715:2013 (Soxhlet Extraction**)**	0,15% b/b $\pm$ (0,6%)
Carbohydrate	SNI 2715:2013 (By Difference)	14,4% b/b $\pm$ (3,7%)
Water Rate	Drying Shrinkage Method	69,36% b/b $\pm$ (0,17%)
Ash Rate	Method AOAC 97.09.1995	2,27% b/b $\pm$ (0,7%)
Total Plate Numbers	BAM Online 2017	1,3 x 10^5 Cfu/g

Figure 1. *Thryssa mystax* (*Thryssa mystax*) Sausages

Discussion

Organoleptic Results of Hedonic Test for *Thryssa mystax* Sausages

Color
Although numerical differences were observed among the three formulations, statistical analysis showed no significant differences in color acceptability scores. This suggests that varying amounts of *Thryssa mystax* incorporated into the sausage formulation did not perceptibly alter the visual characteristics of the final product. One possible explanation is that the inherent appearance of *Thryssa mystax* does not strongly influence the coloration of the sausage matrix, particularly when combined with other dominant ingredients such as tofu, flour, and spices.

The consistently high color acceptability scores across all treatments indicate that the panelists did not exhibit visual aversion to any sausage sample. Color plays a critical role in consumer perception and is often the first quality cue influencing food acceptance (Nadja & Halimah, 2023). In this study, the color of *Thryssa mystax* sausage was visually appealing or at least consistent with consumer expectations, regardless of the fish proportion used.

Therefore, it can be concluded that color was not a determining factor in differentiating the sensory preferences of the products. Other sensory attributes, such as aroma, texture, and overall mouthfeel, likely had a more significant

impact on the panelists' evaluations. This finding supports the notion that visual uniformity can be achieved even with variable proportions of unconventional protein sources, as long as the formulation maintains a consistent color.

Aroma

The decrease in aroma scores observed in formula X3 indicates that an excessively dominant fishy smell can reduce the overall attractiveness of the product. This is particularly evident when the aroma is not balanced by the presence of spices or other additional ingredients that could mask or harmonize the strong fish odor. In contrast, formulas X1 and X2 were more favorably received in terms of aroma.

Aroma is a crucial factor in the acceptance of food products, as it greatly influences the initial sensory impression before consumption (Sharif et al., 2017). Panelists generally prefer aromas that are well-balanced and not overpowering. In this study, the formulations containing 250 g (X1) and 500 g (X2) of *Thryssa mystax* were more acceptable than the 750 g (X3) formulation, which likely produced a stronger, less pleasant odor according to the panelists' preferences.

Therefore, optimizing the amount of *Thryssa mystax* in sausage formulations is essential to enhance the protein content and maintain a sensory profile that aligns with consumer preferences. The results indicate that moderate amounts of *Thryssa mystax* (as in X1 and X2) are better received in terms of aroma. Product developers should consider the balance between the main protein ingredients and seasoning or processing techniques to ensure that the aroma remains appealing and acceptable.

Flavor

The consistency of the flavor acceptability scores across all formulations indicates that the panelists accepted the taste of *Thryssa mystax* sausages regardless of the amount of fish used. This suggests that increasing the quantity of *Thryssa mystax* in the formulation did not significantly affect the flavor profile of the product. The use of spices and other supplementary ingredients in the sausage formulation likely contributed to maintaining a balanced and pleasant taste, minimizing dependence on fish content alone.

Flavor is a critical determinant of food acceptability, and the results of this study demonstrate that *Thryssa mystax* sausages were generally well liked by the panelists (Clark, 1998). Despite differences in fish content, all formulations yielded products with flavors that remained within the acceptable range. This may be attributed to the effective processing techniques that successfully harmonized the flavors of the ingredients. Additionally, *Thryssa mystax* may possess a relatively mild or neutral flavor profile, such that increasing its quantity does not drastically alter the overall taste of sausage.

These findings indicate that variations in the amount of *Thryssa mystax* used did not significantly affect the taste of the final product. Therefore, future product development should prioritize other sensory attributes, such as aroma and texture, to further enhance overall consumer acceptance. By ensuring an optimal balance of seasonings and appropriate processing methods, *Thryssa mystax* sausages can maintain a desirable taste without relying solely on the quantity of fish used.

Texture/Toughness

The higher texture scores in the X2 formulation may be attributed to the role of fish protein in forming a denser and more elastic gel structure during cooking. In contrast, X1, which contains a smaller amount of fish, tended to produce a less firm and chewy texture, possibly due to an insufficient protein and fat composition to develop an optimal gel matrix (Riyanto et al., 2022).

Texture plays a crucial role in the acceptability of processed meat or fish products, as it directly affects the chewing experience and overall consumer satisfaction (Garmyn, 2020). In this study, the panelists preferred sausages with a firmer and more elastic texture, as observed in the X2 and X3 formulations. These results suggest that increasing the amount of *Thryssa mystax* positively contributes to the textural qualities of the product without negatively affecting other attributes, such as flavor or color.

Overall, the findings indicate that a higher inclusion of *Thryssa mystax* in the sausage formulation enhances the texture and toughness. To achieve a sausage texture that aligns with consumer preferences, a minimum of 500 g of *Thryssa mystax* (X2) or more is recommended. Thus, sausage formulations can be optimized to balance taste, aroma, and texture, ultimately improving the overall product acceptability.

Overall

The higher overall acceptability scores of formulations X2 and X3 were most likely influenced

by improvements in texture and flavor. As previously discussed, increasing the amount of *Thryssa mystax* in the formulation enhanced the chewiness and overall texture of the sausage, while the flavor remained well accepted across all treatments. In contrast, X1, which contained the lowest amount of fish, received lower overall scores, likely due to its less optimal texture, which may have reduced the panelists' satisfaction during consumption.

The overall acceptability parameter reflects a combined evaluation of color, aroma, taste, and texture. Although the aroma score for X3 was slightly lower than that of X1 and X2, the cumulative effect of other sensory attributes, particularly texture and flavor, compensated for this drawback. This supports the idea that a balanced integration of sensory factors is more critical to overall acceptability than the excellence of any single attribute (Adawiyah et al., 2024).

Based on these findings, the X2 formulation, which contains 500 g of *Thryssa mystax*, is considered the most preferred due to its optimal balance of sensory characteristics. However, X3 also demonstrated good acceptability and may serve as a viable alternative for consumers who prefer a firmer texture, despite the slightly stronger fish aroma.

Nutritional and Microbiological Content of Selected Formulas (X2)

The best-performing product in this study was formula X2, which incorporated 500 g of *Thryssa mystax*. Based on the results of the nutritional and microbiological tests, this formulation meets most of the quality and safety requirements established by the Indonesian National Standard (SNI 7755:2013) for fish sausage. In terms of protein content, formula X2 contains 10,4% w/w, which exceeds the minimum SNI standard of 9,0% (SNI 7755, 2013). This indicates that *Thryssa mystax* sausage is a good source of protein and may provide meaningful nutritional benefits.

The water content of formula X2 was 69,36% w/w, slightly above the maximum allowable limit of 68,0% set by the SNI. Elevated water content may negatively impact texture, product stability, and shelf life (Tapia et al., 2020). Therefore, optimization of the formulation or improvements in the drying process are necessary to bring the moisture level within an acceptable range. To address this issue, formulation adjustments should be made, such as reducing the proportion of ingredients with high moisture content, increasing the use of water-binding agents, and implementing

more effective cooking methods. The ash content of 2,27% w/w remained within the SNI limit of 2,5%, while the fat content of 0,15% w/w was well below the maximum permitted limit of 7,0%, classifying this product as low fat and potentially more desirable for health-conscious consumers.

From a microbiological standpoint, the Total Plate Count (TPC) for formula X2 was recorded at $1,3 \times 10^5$ CFU/g, which exceeds the SNI limit of 5×10^4 CFU/g. This suggests a potential risk of microbial contamination that may compromise the safety and quality of the product. Improvements in sanitation, processing hygiene, and storage conditions are essential to reduce microbial load and ensure consumer safety (Mahunu et al., 2024). However, data on specific pathogenic microbes such as *Escherichia coli*, *Salmonella spp.*, *Vibrio cholerae*, and *Staphylococcus aureus* were not available in this study. Further microbiological testing is necessary to confirm the absence of these harmful bacteria and to validate the microbiological safety of the product.

In summary, formula X2 exhibited favorable nutritional properties, particularly regarding its protein content, which exceeded the national standards. Nonetheless, improvements in water content regulation and microbial control are required to fully comply with the SNI guidelines. Recommended measures include adjusting ingredient ratios or incorporating natural water-binding agents (e.g., tapioca starch or carrageenan) to inhibit microbial growth, applying natural preservatives such as garlic or vinegar to maintain microbial safety without compromising sensory quality, and providing hygiene and sanitation training for home-based producers to ensure compliance with good manufacturing practices (GMP). With further optimization of the formulation and processing, *Thryssa mystax* sausage can be developed into a high-quality, nutritious, and safe food product with strong market competitiveness.

Conclusion

The addition of *Thryssa mystax* in varying proportions significantly influenced the aroma, texture/chewiness, and overall acceptability of the fish sausages, whereas it had no significant effect on color and flavor attributes. Based on the hedonic test results, the sausage formulation containing 500 g of *Thryssa mystax* (X2) was

identified as the most preferred product, achieving an overall acceptability score of 4,3 on a 5 point scale (indicating like to very like). Nutritional and microbiological analyses of formula X2 revealed the following composition: protein content of 10,4%, fat content of 0,15%, carbohydrate content of 14,4%, moisture content of 69,36%, ash content of 2,27%, and a total plate count of $1,3 \times 10^5$ CFU/g, which exceeds the maximum limit set by SNI. While the product demonstrated favorable nutritional characteristics, especially in terms of high protein and low fat content, improvements are required in moisture regulation and microbial control to meet the food safety standards.

Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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