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EVALUATION OF THE MICROBIOLOGICAL QUALITY OF RONO DANGE SMOKED FISH FOR STRENGTHENING LOCAL FOOD SECURITY IN LERO VILLAGE, DONGGALA

Evaluasi Mutu Mikrobiologis Ikan Rono Dange untuk Penguatan Ketahanan Pangan Lokal di Desa Lero Donggala

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ABSTRACT

Rono Dange is a traditional smoked fish product originating from Lero Village, Donggala Regency, which plays an important role as a source of local food and as a support for the coastal community's economy. However, the quality of this product varies due to differences in traditional processing techniques among local producers. This study was conducted to evaluate the microbiological quality, organoleptic characteristics, moisture content, and potential aflatoxin contamination of Rono Dange. The findings are expected to serve as a basis for strengthening local food security while providing recommendations for product quality improvement. Samples of Rono Dange were collected from five local processors in Lero Village. The samples were analyzed in the laboratory, covering: Microbiological analysis: total plate count (TPC) and yeast and mold count (YMC). Moisture content. Aflatoxin detection. Organoleptic quality assessment. The results showed that the values of TPC and YMC were mostly below the SNI thresholds, TLChough variations were observed among processors. The moisture content of some samples was close to or slightly above the SNI 2725:2013 standard. Aflatoxin analysis indicated the presence of Aflatoxin B1 in some samples, but still within acceptable limits. The organoleptic evaluation revealed good sensory quality (scores ≥ 7), with only slight differences in aroma and texture between processors. Overall, the study concludes that Rono Dange smoked fish from Lero Village remains suitable for consumption and demonstrates good organoleptic quality. However, the variations in quality among processors—particularly regarding moisture content, microbiological aspects, and aflatoxin contamination—require attention. Therefore, the findings of this research are expected to support local food security and enhance the competitiveness of traditional smoked fish products in broader markets.

Keywords: Food Safety, Local Food Security Rono Dange, Microbiological Quality, Quality Standards

ABSTRAK

Rono Dange merupakan produk ikan asap tradisional khas Desa Lero, Kabupaten Donggala, yang berperan penting sebagai sumber pangan lokal dan penopang ekonomi masyarakat pesisir. Namun, mutu produk ini masih beragam karena dipengaruhi oleh teknik pengolahan tradisional yang berbeda antar pengolah. Penelitian ini dilakukan untuk mengevaluasi mutu mikrobiologis, organoleptik, kadar air, serta potensi cemaran aflatoksin. Hasil penelitian diharapkan menjadi dasar penguatan ketahanan pangan lokal sekaligus memberikan rekomendasi perbaikan mutu produk. Penelitian dilakukan dengan pengambilan sampel Rono Dange dari 5 pengolah lokal di Desa Lero. Sampel dianalisis di laboratorium Mikrobiologis meliputi angka lempeng total (TLC) dan angka kapang khamir (YMC). Kadar air , serta. Pengujian Aflatoksin dan mutu organoleptic. Hasil penelitian menunjukkan bahwa nilai TLC dan YMC sebagian besar masih di bawah ambang batas SNI, meskipun ada variasi antar pengolah. Kadar air pada beberapa sampel mendekati atau sedikit melebihi batas SNI 2725:2013, Aflatoksin terdapat indikasi cemaran Aflatoksin B1 pada beberapa sampel, meskipun masih dalam batas toleransi. Mutu organoleptik memiliki nilai sensori yang baik (nilai ≥ 7), dengan perbedaan kecil pada aspek aroma dan tekstur antar pengolah. Secara keseluruhan, hasil penelitian ini menyimpulkan bahwa produk ikan asap Rono Dange dari Desa Lero masih layak untuk dikonsumsi dan memiliki mutu organoleptik yang baik. Namun, adanya variasi kualitas antar pengolah, terutama terkait kadar air, mikrobiologi, dan cemaran aflatoksin, perlu mendapat perhatian. Dengan demikian, hasil penelitian ini diharapkan dapat mendukung penguatan ketahanan pangan lokal sekaligus meningkatkan daya saing produk ikan asap tradisional di pasar yang lebih luas.

Kata Kunci: Keamanan Pangan, Ketahanan Pangan Lokal, Mutu Mikrobiologis, Rono Dange, Standar Mutu

INTRODUCTION

Lero Village in Donggala Regency, Central Sulawesi Province, is a production center for smoked anchovies wrapped in banana leaves. The local community refers to this product as “Rono dange”. Rono dange is an anchovy-based product wrapped in banana leaves and smoked using an iron plate heated with coconut husks as the source of smoke. This product has become a distinctive regional culinary identity and supports the local economy of the community in Lero Tatari Village. Currently, there are more than 20 households engaged in the rono dange smoking business, with a production volume of 100–200 basins per week (Amin & Laapo, 2022). This product is also a flagship commodity offered to tourists along the Trans-Sulawesi route (Fikri, 2024).

However, the quality and food safety of this product remain critical issues. The production process of rono dange is carried out traditionally without adequate consideration of sanitation standards. The sources of raw materials have unknown levels of contamination; raw materials are washed on the floor, equipment is not sterilized, and storage is carried out in open areas along the roadside. These conditions increase the risk of microbiological contamination that may endanger consumer heTLCh (Azizah & Widodo, 2023). The formulation of the research problems in this study includes: what is the microbiological quality condition of traditionally produced smoked Rono Dange fish in Lero Village, Donggala Regency, that may pose risks to consumer heTLCh? What recommendations can be proposed to improve traditional smoked fish processing practices so that they meet national microbiological quality and food safety standards.

The urgency of this research lies in the importance of providing microbiological quality data on smoked rono dange produced by small-scale business actors in the coastal area of Lero Village. Considering that this product constitutes daily consumption for the community as well as a local economic commodity, ensuring its safety is a priority in supporting regional food

security and the sustainable development of the marine and fisheries sector. Furthermore, improving food safety based on local resources also supports the National Research Master Plan (RIRN) 2017–2045 (10) and ASTACITA 6, namely economic independence based on the domestic sector.

The objective of this study is to evaluate the microbiological quality of rono dange fish through laboratory testing, with the test results compared to national food quality standards to assess conformity levels and the risk of microbial contamination to consumer heTLCh.

METHODS

Time and Location

This research was conducted from July to November 2025 at the BPOM Microbiology Laboratory in Palu and the Integrated Laboratory of Tadulako University, Palu.

Equipment and Materials

The equipment used in this study included stationery, label paper, markers, basins, stirrers, analytical balances, test tubes and racks, sterile Petri dishes, autoclaves, pH meters, drying ovens, hotplates, Kjeldahl flasks, Atomic Absorption Spectrophotometers (AAS), organoleptic assessment forms, sterile microcentrifuge tubes, desiccators, PCR equipment, thermocycler machines, sterile gloves, laboratory coats, and masks. The materials used were rono dange fish, PCA (Plate Count Agar) media, MRSA / VRBA media, Potato Dextrose Agar (PDA) media, 70% alcohol, deionized water, and 70% ethanol.

Research Procedure

This stage was carried out through field observations and informal interviews with smoking business operators to identify workflow processes, processing facility conditions, and sanitation practices that influence product quality. Alongside laboratory analysis, critical contamination points in the traditional processing process were also identified to determine stages with a high risk of product quality deterioration.

After all data were collected, the researchers conducted data analysis and interpretation, both descriptively and comparatively against national food quality standards. The findings were used to formulate recommendations for improving hygienic traditional rono dange production processes that comply with standards while maintaining local wisdom. Subsequently, sampling activities were conducted at five smoked rono dange processors located within the research area of Lero Village, Donggala Regency, Central Sulawesi Province. Sampling was carried out in stages according to a schedule mutually agreed upon with the rono dange processors, representing each rono dange processing business unit.

Each processor was selected purposively, and from each processor, smoked fish samples were collected in the form of five intact packages of rono dange or equivalent to 250 grams. Samples were collected immediately after the production process was completed to maintain sample freshness. The collected samples were then labeled with identity codes according to the processor of origin (e.g., RD-A, RD-B, RD-C, RD-D, and RD-E) and recorded on the sample collection observation sheet. To maintain quality, all samples were stored in sterile containers (labeled plastic bags) and placed in a cool box during transportation to the laboratory.

Observation Parameters

Total Plate Count (TPC) Testing (SNI 2897, 2008)

Total Plate Count (TPC) testing on smoked Rono Dange fish samples was conducted to determine the number of viable aerobic mesophilic bacteria present in the product. The process began with sample reception in the laboratory. Each sample was verified for identity, the sampling time was recorded, and samples were temporarily stored at cold temperatures to maintain microbiological quality prior to analysis (Upet *et al*., 2021).

Yeast and Mold Count (YMC) Testing (SNI 2897, 2008)

Yeast and Mold Count testing was conducted to determine the number of mold and yeast colonies present in rono dange products. Molds and yeasts can cause sensory deterioration, including unpleasant odors, sour or bitter taste, color changes, and soft texture (Ogunyebi *et al*., 2025).

Aflatoxin Testing (SNI 7385, 2009)

Aflatoxin testing on rono dange fish samples was conducted to ensure food safety related to potential contamination by toxins produced by molds, particularly Aspergillus flavus and Aspergillus parasiticus. Aflatoxins are classified as carcinogenic mycotoxins and are hazardous when accumulated in the human body. Quantitative analysis was performed using High-Performance Liquid Chromatography (HPLC) with a fluorescence detector, or in some cases using the ELISA (Enzyme-Linked Immunosorbent Assay) method for rapid detection. Identification focused on aflatoxin types B1, B2, G1, and G2, which constitute the primary parameters in food safety standards (Elbarbary *et al*., 2023).

Moisture Content Testing (SNI 01-2354.2-2006)

Moisture content testing on smoked Rono Dange fish was conducted to determine the product's moisture level, as water content strongly influences quality, shelf life, and food safety. High moisture content can accelerate microbial growth, whereas lower moisture content helps extend shelf life. This test ensures whether smoked Rono Dange fish meets the required moisture content standards, making it suitable for consumption and providing improved shelf life (SNI 01-2354.2-2006, 2006).

Organoleptic Quality (SNI 01-2354.2-2006)

Organoleptic testing was conducted to evaluate the sensory quality of smoked Rono Dange fish based on panelists' perceptions of attributes such as color, aroma, texture, taste, and overall acceptability. This assessment is essential because organoleptic quality strongly influences consumer acceptance and product marketability. The method used was the Hedonic Test with a scoring scale of 1–9, where a score of 1 indicates "strongly dislike" and a score of 9 indicates "strongly like". Through organoleptic testing, an overview of consumer preferences for smoked Rono Dange fish was obtained, which also serves as a basis for recommendations to improve production processes for processors yielding lower organoleptic quality. Statistical analyses (ANOVA or Kruskal–Wallis) were applied to determine significant differences among samples (Hadi *et al*., 2022).

RESULTS AND DISCUSSION

Total Plate Count (TLC) Analysis

The TLC test results for rono dange fish from five processors can be seen in Table 1.

Table 1. TLC Test Results for Rono Dange Compared to SNI: 2725:2013

Sample Code	TLC results (CFU/g)	SNI Limit (CFU/g)	Information
RD-A	$2{,}1 \times 10^3$	$1{,}0 \times 10^5$	Meets SNI
RD-B	$3{,}5 \times 10^3$	$1{,}0 \times 10^5$	Meets SNI
RD-C	$1{,}8 \times 10^4$	$1{,}0 \times 10^5$	Meets SNI
RD-D	$2{,}9 \times 10^3$	$1{,}0 \times 10^5$	Meets SNI
RD-E	$4{,}2 \times 10^4$	$1{,}0 \times 10^5$	Meets SNI

Source: Primary Data, 2025

Based on the test results, the TLC values of all Rono Dange samples were still far below the maximum threshold established in the Indonesian National Standard (SNI) for processed fishery products, namely 1×10^5 CFU/g. These results indicate that the traditional processing

methods applied by rono dange producers, TLChough simple, still produce products that are relatively safe in terms of general microbial contamination.

Nevertheless, variations in TLC values among samples were still observed, which may be caused by differences in raw material conditions, smoking techniques, as well as the sanitation of the equipment used. This finding is important as a basis for encouraging improvements in production practices, particularly in terms of quality consistency, so that product safety can be more reliably ensured.

This indicates that the smoking process plays an important role in suppressing microbial counts, as heat and smoke compounds possess antimicrobial properties. However, variations in TLC values among samples were still found, which may be attributed to differences in raw material conditions, smoking techniques, and equipment sanitation (Jeujanan *et al.*, 2015). This finding is important as a basis for promoting improvements in production practices, particularly regarding quality consistency, to better ensure product safety. The low TLC test results in rono dange demonstrate that smoked Rono Dange fish products have a reasonably good shelf life when handled properly, and all processors still produce products that are considered safe based on the TLC parameter. However, variations among processors emphasize the need for standardization of traditional processing practices to ensure consistent quality and safety of Rono Dange products. Environmental and equipment sanitation are critical factors. Cross-contamination from containers, knives, and unhygienic processing areas has the potential to increase microbial counts (Aristawati *et al.*, 2024). Therefore, the application of simple sanitation practices, such as cleaning equipment with hot water or mild disinfectants, can suppress microbial growth (Schrader *et al.*, 2024).

Yeast Mold Number Analysis (YMC)

The yeast mold count test data from 5 rono dange processors can be seen in Table 2.

Table 2. YMC Test Results on Rono Dange Compared to SNI: 2725:2013

Sample Code	YMC Results (CFU/g)	SNI Limit (CFU/g)	Description
RD-A	$1{,}5 \times 10^2$	1×10^3	Meets YMC very low, the product is relatively hygienic and safe.
RD-B	$2{,}8 \times 10^2$	1×10^3	Meets YMC is still far below SNI, but higher than RD-A.
RD-C	$6{,}0 \times 10^2$	1×10^3	Meets A higher value, possibly affected by humidity or suboptimal smoking.
RD-D	$3{,}2 \times 10^2$	1×10^3	Meets A moderate value, still safe, requires improved sanitation.
RD-E	$7{,}5 \times 10^2$	1×10^3	Meets A (near limit): A value close to the SNI threshold, indicating a greater potential risk of mold.

Source: Primary Data, 2025

Based on the table above, sample RD-A had a YMC value of 1.5×10^2 CFU/g, far below the SNI threshold (1×10^3 CFU/g). These results indicate that the product from processor RD-A is relatively hygienic, with very low levels of mold and yeast contamination. The smoking and storage processes were likely carried out properly, so the product is safe for consumption. Meanwhile, the YMC value of RD-B was 2.8×10^2 CFU/g, which is still within the safe limit. Although higher than RD-A, this result still indicates good microbiological quality. Environmental factors such as production room humidity or smoking ventilation may influence mold growth in this product.

Samples from RD-C had a YMC value of 6.0 × 10^2 CFU/g, higher than those of other processors. Although still compliant with SNI, this value indicates higher moisture levels or suboptimal smoking conditions. Products from this processor require special attention to moisture control and equipment sanitation. The test results for RD-D showed a YMC value of 3.2 × 10^2 CFU/g, which is still safe and meets SNI requirements. This value indicates that although the quality of rono dange products is fairly good, sanitation and storage practices can still be improved to more consistently maintain quality. Processor RD-E had the highest YMC value, namely 7.5 × 10^2 CFU/g. Although it has not exceeded the SNI limit, this value is close to the maximum threshold and therefore requires serious attention. The suspected causes include inadequate moisture control and improper product storage.

Products RD-C and RD-E showed higher values, indicating the need for simple interventions such as improving the smoking system, enhancing equipment sanitation, and controlling humidity to suppress mold and yeast growth. Maintaining adequate distance between products and the smoke source allows smoke distribution to be uniform and prevents excessive moisture retention. Storing products in dry and well-ventilated areas, away from floors and damp walls, is essential. Maintaining cleanliness of the production environment, for example by covering the area from dust or insects, is also necessary. Providing simple training on food quality standards (Mielcarek *et al.*, 2020).

The presence of molds and yeasts in processed smoked fish products such as Rono Dange is generally influenced by moisture content, storage humidity, and sanitation of equipment and the processing environment (Nurrahma *et al.*, 2023) (SNI 2725:2013). Molds and yeasts grow easily on food materials with relatively high moisture content or inadequate dry storage, leading to deterioration of sensory quality, texture, and even food safety (Ogunyebi *et al.*, 2025).

Aflatoxin Analysis

Aflatoxin test results from 5 Rono Dange processors can be seen in Table 3.

Table 3. Aflatoxin Test Results on Rono Dange Compared to SNI: 2725:2013

Processor	Aflatoxin B1 Test Results (ppb)	Total Aflatoxin Test Results (ppb)	SNI Maximum Limit (ppb)	Description
Processor 1	1,2	3,5	B1 ≤ 5; Total ≤ 20	Aflatoxin B1 and total values are still well below the threshold. The product is relatively safe for consumption.
Processor 2	2,1	6,8	B1 ≤ 5; Total ≤ 20	The content still meets SNI standards. However, the higher values compared to other processors are likely due to poor raw material storage.
Processor 3	0,9	2,4	B1 ≤ 5; Total ≤ 20	The lowest value of all samples indicates that the processing and storage process is quite hygienic.
Processor 4	3,8	10,2	B1 ≤ 5; Total ≤ 20	The value is close to the threshold for B1, so improvements in sanitation

				and humidity control are needed.
Processor 5	1,5	4,7	B1 ≤ 5; Total ≤ 20	The content is still within safe limits. Good processing practices must be maintained to prevent an increase.

Source: Primary Data, 2025

The test results showed Aflatoxin B1 levels of 1.2 ppb and total aflatoxin of 3.5 ppb. These values were far below the threshold limits established by SNI (B1 ≤ 5 ppb, total ≤ 20 ppb). This indicates that Rono Dange products from processor A are relatively safe and have a low risk of mold contamination. The cooling and storage processes were presumably carried out properly, resulting in minimal contamination. Aflatoxin B1 levels reached 2.1 ppb and total aflatoxin 6.8 ppb. Although still compliant with SNI requirements, these values were higher compared to other processors. This condition may be influenced by the quality of raw materials used or suboptimal storage conditions. Interventions in the form of improved storage ventilation and humidity control are required to prevent further increases in aflatoxin levels. Samples from processor C exhibited the best results, with Aflatoxin B1 levels of 0.9 ppb and total aflatoxin of 2.4 ppb. These values were the lowest among all processors, indicating the application of more hygienic processing practices. This condition can serve as an example for other processors in maintaining sanitation, particularly during post-production handling and storage stages.

Processor D showed Aflatoxin B1 levels of 3.8 ppb and total aflatoxin of 10.2 ppb. These results were close to the maximum SNI limits, particularly for Aflatoxin B1. This condition indicates a higher potential risk of mold contamination, possibly due to incomplete drying or high humidity during storage. Technical improvements are required at the cooling stage, environmental sanitation, and control of warehouse temperature and humidity. Aflatoxin B1 content was 1.5 ppb and total aflatoxin 4.7 ppb. These values remain within safe limits and are relatively stable. This indicates that the processing procedures are functioning properly, although they must still be maintained to prevent increases in contamination, particularly during the rainy season when humidity is high (Nurfadilah *et al.*, 2024).

Aflatoxins are secondary metabolites produced by the fungi *Aspergillus flavus* and *Aspergillus parasiticus* that can contaminate food materials, including fishery products stored under humid and unhygienic conditions (Singh & Nsokolo, 2020). Aflatoxin B1 is known to be the most toxic and carcinogenic, making it a primary parameter for food safety (Elbarbary *et al.*, 2023). This indicates that contamination by aflatoxin-producing molds is not dominant in this product, although yeast and mold counts (YMC) are still detectable. Factors contributing to the low aflatoxin contamination are likely related to the antimicrobial nature of the smoking process, the relatively fresh condition of raw materials, and storage environments that are not excessively humid. Although considered safe, periodic monitoring remains necessary because climate change, storage humidity, or unhygienic processing practices may increase the risk of aflatoxin formation (Indriati *et al.*, 2017).

Water Content Testing

The water content test results from five rono dange processors can be seen in Table 4.

Table 3. Water Content Test Results on Rono Dange Compared to SNI: 2725:2013

Processor	Water Content Test Results (%)	SNI 2725:2013 Limit (%)	Information
Processor 1	58,2	≤ 60	Fulfil
Processor 2	61,5	≤ 60	Does not meet the
Processor 3	59,0	≤ 60	Fulfil
Processor 4	62,3	≤ 60	Does not meet the
Processor 5	57,8	≤ 60	Fulfil

Source: Primary Data, 2025

The results of moisture content testing on smoked Rono Dange fish from five processors showed quite significant variation. Three processors (1, 3, and 5) met the SNI 2725:2013 standard with moisture content ≤ 60%, while two processors (2 and 4) slightly exceeded the maximum limit. This indicates that traditional smoking processes conducted without standardized temperature and time control contribute to differences in the final product quality. Processors with moisture content exceeding the standard are at higher risk of mold, yeast, and spoilage bacteria growth, thereby reducing product shelf life.

Thus, simple handling measures such as the use of smoke thermometers, additional cooling, or improved packaging are required to maintain moisture content within safe limits according to standards. Moisture content is one of the main parameters in determining the quality and safety of smoked fish products. According to (Badan Standardisasi Nasional, 2013) concerning Smoked Fish, the maximum allowable moisture content is 60%. This limit is established to ensure product stability during storage and to reduce the risk of spoilage and pathogenic microorganism growth.

High moisture content in smoked fish products can accelerate spoilage because it serves as an ideal medium for the growth of bacteria, molds, and yeasts. Conversely, excessively low moisture content can affect texture and reduce panelist acceptability of the product (Zagoto *et al.*, 2022). Furthermore, (Azis & Akolo, 2020) explain that smoking functions not only as a flavor-enhancing process but also as a preservation method by reducing moisture content and adding phenolic compounds and formaldehyde with antimicrobial properties. However, if the moisture content does not meet the required standard, the effectiveness of preservation is reduced.

Organoleptic Quality

Data on the water content test results from five rono dange processors can be seen in Table 5.

Table 5. Organoleptic Quality Results of Rono Dange Compared to SNI: 2725:2013

Processor	Color (Mean)	Aroma (Mean)	Taste (Mean)	Overall (Mean)	Acceptance Standard (≥ 6)
Processor 1	7,5	7,2	7,4	7,3	Meeted
Processor 2	6,2	6,0	6,1	6,0	Lower Limit
Processor 3	7,0	6,8	7,1	6,9	Meeted
Processor 4	5,7	5,9	5,8	5,7	Not met
Processor 5	7,4	7,0	7,5	7,3	Meeted

Source: Primary Data, 2025

The organoleptic test results showed that three processors (1, 3, and 5) successfully produced smoked fish with good organoleptic quality (mean ≥ 6). Processor 2 was at the lower limit of the acceptance standard, whereas Processor 4 did not meet the standard because the

average organoleptic score was < 6. This indicates the presence of inconsistency in the traditional Rono Dange processing process, particularly in controlling smoking duration and temperature. Processors with higher scores tended to produce products with uniform color, strong smoky aroma, and firm texture. In contrast, processors with lower scores produced products that were pale, soft, and had less distinctive aroma.

In addition, the study by (Saud *et al.*, 2024) found that variations in organoleptic quality of traditional smoked fish are often caused by non-standardized processing methods. For example, smoking at low temperatures results in a weaker aroma, whereas excessive smoking can produce a bitter taste. Other literature by (Sirait & Saputra, 2020) emphasizes the importance of controlling traditional smoking processes to ensure consistent organoleptic quality. Consumers tend to assess the quality of smoked fish primarily based on color and aroma; therefore, these two aspects are the most decisive indicators in market acceptance.

CONCLUSION

Based on the research results, it can be concluded that traditional rono dange fish products from Lero Village, Donggala, are still suitable for consumption and possess good organoleptic quality. Most Total Plate Count (TLC) values remain below the threshold established by the Indonesian National Standard (SNI 2725:2013 concerning Smoked Fish). Total Plate Count (TLC) testing indicates differences in total bacterial counts among samples from the five processors, ranging from 1.8×10^4 to 4.2×10^4. The Yeast and Mold Count (YMC) test results show that the samples are relatively safe, ranging from 1.5×10^2 to 7.5×10^2.

RECOMMENDATIONS

Several improvement measures are proposed to enhance product quality and safety. First, rono dange processors need to improve the implementation of hygiene and sanitation practices for workers, equipment, and the production environment to reduce microbial contamination. Furthermore, the smoking process should be controlled through more standardized temperature and time regulation so that the product moisture content complies with SNI 2725:2013 for smoked fish products. Improvements in storage and packaging systems are also necessary, for example by using moisture-absorbing materials to prevent mold growth and aflatoxin formation. In terms of fuel sources, the use of safe and resin-free materials is recommended to produce cleaner smoke and reduce the risk of heavy metal contamination. To support sustainability, assistance from local governments and universities is needed in developing production Standard Operating Procedures (SOPs) so that product quality among processors becomes more uniform. Thus, the results of this study are expected to support the strengthening of local food security while enhancing the competitiveness of traditional smoked fish products in broader markets.

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