

Analysis of Physical Characteristics and the Presence of Formalin in Salted Fish at Kuala Simpang City Market, Aceh Tamiang

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The misuse of formaldehyde in salted fish remains a food safety issue due to potential health risks. From an Islamic perspective, Imam Ash-Syafi'i explains in his book *Al-Umm* that the default ruling for food is that it is *halal* (permissible) unless there is evidence of harmful elements; Thus, food consumed must be both safe and *tayyib* (wholesome). This study aimed to analyze the physical characteristics and the presence of formalin in salted fish at the Kuala Simpang City Market, Aceh Tamiang. A descriptive study design with a cross-sectional approach was employed. Eighteen samples were selected using purposive sampling and tested qualitatively using Schiff's reagent. The results showed that 6 samples (33.3%) tested positive for formalin, while 12 samples (66.7%) tested negative. The majority of samples were white (94.4%), had an abnormal odor (61.1%), and possessed a hard texture (94.4%). It is concluded that physical characteristics serve only as preliminary indicators; therefore, the presence of formalin must be confirmed through laboratory analysis.

Keywords: Salted fish, Formalin, Physical characteristics, Food safety.

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1. Introduction

Food is a basic human need that plays a vital role in maintaining health, supporting growth, increasing intelligence, and boosting productivity. Therefore, the food consumed must be nutritious, hygienic, and free from biological, chemical, and physical contaminants that could harm health. Food safety is a crucial aspect in efforts to improve public health, as food that does not meet safety standards can cause various illnesses and even death (1).

Food safety remains a public health issue in many countries. The World Health Organization (WHO) reports that approximately 420,000 people die each year from consuming unsafe food, while in Southeast Asia, foodborne diseases are estimated to affect approximately 150 million people, resulting in approximately 175,000 deaths annually (2). In Indonesia, the Food and Drug Monitoring Agency (BPOM) also recorded a high number of food poisoning outbreaks, indicating that food safety monitoring still needs to be improved (3). In Aceh Province, although the number of food poisoning cases showed a downward trend during the 2022-2024 period, these incidents continue to be found, necessitating ongoing prevention and monitoring efforts (4).

Fish is a widely consumed food because it contains high-quality protein and various nutrients the body needs (2). However, fish is a food that is easily damaged by enzyme activity and microorganism growth. To extend its shelf life, various preservation methods are used, one of which is salting, which produces salted fish. However, the quality of salted fish can still decline during storage, so some producers use various methods to maintain the quality of their product (3).

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One practice that is still found is the misuse of formalin as a preservative. Formalin is actually a chemical used for non-food purposes, such as a preservative for biological specimens and a disinfectant, so its use in food has been banned because it can be harmful to health (6). Short-term exposure to formalin can cause irritation to the digestive tract, skin, eyes, and respiratory tract, while long-term exposure has the potential to cause organ damage and increase the risk of cancer (7,8). However, formalin is still misused because it is relatively cheap, easy to obtain, and can extend the shelf life of food products (9).

Several previous studies have shown that formalin is still found in salted fish sold in various regions in Indonesia. Research in Jambi City reported that all salted stonehead fish samples tested tested positive for formalin (10). Meanwhile, research in Langsa City, Aceh Province, also found formalin in all salted fish samples tested (11). These findings indicate that the misuse of formalin in salted fish remains a problem that requires attention in efforts to protect public health.

Kuala Simpang City Market is one of the food trading centers in Aceh Tamiang Regency. Based on a preliminary survey, several salted fish were found with unusual physical characteristics, such as a paler color, a hard texture, and a very long shelf life without experiencing physical changes. These conditions raise suspicions of formalin use. To date, no research has specifically examined the relationship between the physical characteristics of salted fish and the presence of formalin in Kuala Simpang City Market. Therefore, this study was conducted to analyze the physical characteristics and the presence of formalin in salted fish sold at Kuala Simpang City Market, Aceh Tamiang Regency, as an effort to support food safety monitoring and protect public health.

According to Imam Ash-Syafi'i in Al-Umm, the basic law of food is halal as long as there is no evidence or evidence that shows the presence of elements that are forbidden or harmful to health. He also emphasized that the food consumed must provide benefits for humans and avoid all forms of harm. In line with this principle, Allah SWT says in QS. Al-Baqarah [2]: 168 which means: "O mankind, eat what is lawful and good from what is on earth, and do not follow the steps of Satan. Indeed, Satan is a clear enemy to you." Based on this verse, the food consumed must not only be halal, but also *thayyib*, namely nutritious, clean, safe, and not harmful to health. Therefore, the food consumed must be of good quality, free from harmful substances, and able to support human health and productivity (5).

2. Literature Review and Problem Statement

Literature Review

Food safety is a crucial aspect of maintaining public health, particularly for food products consumed daily, such as salted fish. Salted fish is a processed fishery product preserved through salting and drying, thus extending its shelf life. However, the quality of salted fish is not solely determined by the processing process, but also by storage, distribution, and handling during marketing. Physically, salted fish that is safe to consume generally has a natural color appropriate to the type of fish, a texture that is not too hard, a distinctive salted fish aroma that is not overpowering, and is not slimy. Conversely, salted fish that exhibits unnatural physical characteristics, such as excessively bright colors, a very hard texture, and no flies, often raises suspicions of the use of hazardous chemicals, one of which is formaldehyde.

Formalin is a chemical used as a preservative, disinfectant, and industrial raw material. Therefore, its use in food is prohibited due to its potential health risks. Short-term consumption of food containing formalin can cause digestive tract disorders, while long-term exposure risks organ damage and is carcinogenic. Various studies have shown that salted fish products still test positive for formalin in a number of traditional markets in Indonesia due to weak supervision and low awareness of food safety among some producers and traders. Therefore, analyzing the physical characteristics combined with checking for the presence of formalin is

crucial to provide information on the safety of salted fish circulating in the community and support consumer protection efforts.

Problem Statement

Salted fish is a popular food product due to its relatively affordable price, distinctive taste, and long shelf life. However, concerns remain about the safety of salted fish on the market due to the alleged use of formaldehyde as a preservative. The presence of formaldehyde is often difficult for the public to detect directly, as the apparent appearance of salted fish does not necessarily guarantee that the product is free from harmful chemicals. On the other hand, some consumers still use physical characteristics, such as color, texture, and aroma, as primary indicators of salted fish quality, without understanding the relationship between these characteristics and the potential presence of formaldehyde.

Kuala Simpang City Market, Aceh Tamiang Regency, is a trading center that supplies various types of salted fish from various regions. To date, scientific information regarding the physical characteristics of salted fish and the presence of formaldehyde in products sold at the market remains limited. This situation results in the lack of data that can describe the safety level of salted fish circulating in the community. Therefore, research is needed to analyze the physical characteristics and detect the presence of formaldehyde in salted fish sold at Kuala Simpang City Market, Aceh Tamiang. The results of this study are expected to provide information for the public, traders, and relevant agencies in improving food safety monitoring and protecting consumers from the risks of consuming food containing formaldehyde.

3. Method

This research is a quantitative, descriptive study using a cross-sectional approach. The sampling location was Kuala Simpang City Market, Aceh Tamiang Regency, while formalin testing was conducted at Samudra University's Basic Laboratory using Schiff's reagent. The study was conducted from January 2026 until completion.

The study population consisted of all salted fish sold at Kuala Simpang City Market. The sample was selected using a purposive sampling technique, taking two samples from each of nine vendors, resulting in a total of 18 salted fish samples. Primary data were obtained through physical characteristics observations (color, aroma, and texture) and laboratory examinations, while secondary data were obtained from literature review.

Qualitative formalin testing was performed using Schiff's reagent. Salted fish samples were ground, distilled water was added, then filtered, and reacted with sulfuric acid and Schiff's reagent. Samples were declared positive for formalin if the solution changed color from pink to purple. Data were then analyzed descriptively and presented as frequency distributions and percentages.

4. Results and Discussion

Results

Univariate Analysis

Table 1. Characteristics of Salted Fish Traders

Variables	Frequency	Presentation (%)
Gender		
Man	4	44.4
Woman	5	55.6
Total	9	100.0
Age		

Variables	Frequency	Presentation (%)
20-35	1	11.1
35-50	3	33.3
50-65	5	55.6
Total	9	100.0
Last education		
Elementary School	2	22.2
JUNIOR HIGH SCHOOL	2	22.2
SENIOR HIGH SCHOOL	5	55.6
Total	9	100.0
Selling Period		
>10 years	5	55.5
<10 years	4	44.5
Total	9	100.0

Of the total 9 traders, it is known that 5 traders are female (55.6%) and 4 traders are male (44.4%). 1 trader with an age range of 20-35 is 1 person (11.1%), 3 traders with an age range of 35-50 are 3 people (33.3%), and 5 traders with an age range of 50-65 are 5 people (55.6%). In terms of education, 5 traders have graduated from high school (55.6%), then 2 people have graduated from junior high school (22.2%), and 2 people have graduated from elementary school (22.2%). Then in terms of length of trading, 5 traders have been selling for >10 years (55.5%), and 4 traders have been selling for <10 years (44.5%).

Table 2. Frequency Distribution of Color Characteristics of Salted Fish and the Presence of Formalin in Salted Fish

Salted Fish Color	Frequency	Presentation (%)
Brownish (formaldehyde negative)	1	5.6
White (formaldehyde negative)	11	61.1
White (formaldehyde positive)	6	33.3
Total	18	100.0

Based on the table of color characteristics of salted fish and the presence of formalin, of the 18 samples examined, the majority of salted fish were white, with 11 samples (61.1%) showing negative results for formalin. Meanwhile, 6 samples (33.3%) showed positive results for white salted fish. Furthermore, one sample (5.6%) showed a brown color, which indicated a negative result for formalin. These results indicate that white color is more commonly found in salted fish samples, both those showing negative results for formalin and those showing positive results for formalin. However, the presence of white color cannot be the only indicator of formalin, because white color is also found in samples that do not contain formalin. The brown color tends to indicate the characteristics of natural salted fish without the addition of formalin.

Table 3. Frequency Distribution of Characteristics of Salted Fish Aroma and the Presence of Formalin in Salted Fish

Aroma of Salted Fish	Frequency	Presentation (%)
Normal (formaldehyde negative)	6	33.4
Normal (formaldehyde positive)	1	5.6
Abnormal (formaldehyde negative)	6	33.3
Abnormal (formaldehyde positive)	5	27.7
Total	18	100.0

Based on the table of salted fish aroma and the presence of formalin, of the 18 samples, a normal aroma with a negative result for formalin was found in 6 samples (33.4%), while a normal aroma with a positive

result for formalin was only found in 1 sample (5.6%). Furthermore, a normal aroma with a negative result for formalin was found in 6 samples (33.3%), and an abnormal aroma with a positive result for formalin was found in 5 samples (27.7%). These data indicate that the aroma of salted fish varies between samples tested positive and negative for formalin. Abnormal aroma is relatively more common in samples containing formalin than in samples with a normal aroma containing formalin.

Table 4. Frequency Distribution of Textural Characteristics of Salted Fish and the Presence of Formalin in Salted Fish

Salted Fish Texture	Frequency	Presentation (%)
Hard (formaldehyde negative)	11	61.1
Hard (formaldehyde positive)	6	33.3
Fragile (formaldehyde negative)	1	5.6
Total	18	100.0

Based on the table of salted fish texture and the presence of formalin, of the 18 samples examined, most of the salted fish had a hard texture, with 11 samples (61.1%) testing negative for formalin. Furthermore, 6 samples (33.3%) with a hard texture tested positive for formalin. Meanwhile, only 1 sample (5.6%) had a brittle texture and tested negative for formalin. These results indicate that a hard texture dominates in all salted fish samples, both those that tested positive and those that tested negative for formalin. Therefore, a hard texture is not always a definite indicator of the presence of formalin, as this texture is also found in samples that do not contain formalin.

Discussion

Frequency Distribution of Color Characteristics of Salted Fish and the Presence of Formalin in Salted Fish

Based on the research results, it was found that 7 samples (38.9%) had a normal aroma, consisting of 6 samples (33.3%) negative for formalin and 1 sample (5.6%) positive for formalin. Meanwhile, 11 samples (61.1%) had an abnormal aroma, consisting of 6 samples (33.3%) negative for formalin and 5 samples (27.8%) positive for formalin. These results indicate that abnormal aromas were more commonly found in salted fish samples than normal aromas.

The results of this study are supported by research by Anugrah et al. (2022) which showed that only 1 in 10 salted fish samples tested positive for formalin and had a brighter color than the samples that tested negative for formalin. Therefore, color can only be used as an initial indicator and needs to be confirmed through laboratory examination (35). This finding is also in line with research by Aditiya (2024) which stated that salted fish containing formalin tend to be bright white because formalin can maintain its color during storage. However, assessment based on color alone is not sufficient to confirm the presence of formalin, so laboratory examination is still necessary (36).

However, the results of this study are inconsistent with those of Isa et al. (2024), who reported that all fish samples examined (100%) were negative for formalin, although some samples still had good physical characteristics. This study showed that physical appearance, including bright colors, is not always caused by formalin use. This condition can be influenced by the freshness of the raw material, post-catch handling methods, and proper preservation (37).

According to Imam Ash-Syafi'i in Al-Umm, a judgment or legal determination should not be based on conjecture or outward appearance, but must be based on clear evidence and proof (bayyinah). He also explained that the original law of a food is halal until there is evidence indicating the presence of elements that are harmful or change its legal status. This principle emphasizes the importance of caution in assessing the safety of a food so as not to establish a law without a justifiable basis. In line with this, Allah SWT says in QS. An-Nisa verse 135: "O you who believe! Be upholders of justice, bearing witness to Allah." This verse

teaches that every decision must be based on correct evidence and carried out fairly. This is in accordance with the results of research that the white color of salted fish does not necessarily indicate the presence of formalin, so that observation of color cannot be used as a basis for declaring a sample positive for formalin. Therefore, the presence of formalin must be confirmed through laboratory tests so that the assessment is carried out objectively, fairly, and in accordance with the principles of Islamic law.

Frequency Distribution of Characteristics of Salted Fish Aroma and the Presence of Formalin in Salted Fish

Based on the research results, it was found that 7 samples (38.9%) had a normal aroma, consisting of 6 samples (33.3%) negative for formalin and 1 sample (5.6%) positive for formalin. Meanwhile, 11 samples (61.1%) had an abnormal aroma, consisting of 6 samples (33.3%) negative for formalin and 5 samples (27.8%) positive for formalin. These results indicate that abnormal aromas were more commonly found in salted fish samples than normal aromas.

The results of this study are consistent with those of Ratulangi and Widyan (2024), who found that 7 of 15 samples of dried seafood at Pagesangan Market, Mataram City, tested positive for formalin, while 8 samples tested negative for formalin. Samples that tested positive for formalin generally had an odor that was not typical of seafood preserved with salt (38). These findings suggest that formalin can inhibit the decomposition process, thus preserving seafood for longer. However, odor can only be used as an initial indicator to suspect the presence of formalin and still needs to be confirmed through laboratory tests to obtain more accurate results.

This research is also supported by research by Anugrah et al. (2022) on 10 samples of salted fish at a traditional market in Pontianak City, which showed that only one sample tested positive for formalin, while the other nine samples tested negative for formalin. The samples that tested positive for formalin had an uncharacteristic odor or a reduced salted fish aroma compared to the samples that tested negative for formalin. These findings suggest that odor can be used as an early indicator to suspect the presence of formalin, but laboratory testing is still required to confirm its presence (35).

According to Imam Ash-Syafi'i in Al-Umm, information or suspicion cannot be used as a basis for establishing a law before going through a process of accountable proof. He emphasized that every decision must be based on valid arguments and strong evidence to avoid errors in judgment. This principle shows that suspicion (zhann) cannot replace the position of real evidence in determining a case. In line with this, Allah SWT says in QS. Al-Hujurat verse 6: "O you who believe! If a wicked person comes to you with news, then verify (tabayyun) its truth lest you harm a people out of ignorance, and then become regretful of your actions." (QS. Al-Hujurat: 6). This verse teaches the importance of conducting tabayyun or verification before making a decision. This is in line with the results of research that the abnormal smell of salted fish can only be an initial indicator of suspected formalin and cannot be used as definitive evidence. Therefore, the presence of formalin cannot be determined solely based on the aroma, but must be confirmed through laboratory examination so that the assessment results are more accurate and in accordance with the principles of tabayyun in Islamic law.

Frequency Distribution of Textural Characteristics of Salted Fish and the Presence of Formalin in Salted Fish

Based on the research results, it was found that almost all samples had a hard texture, namely 17 samples (94.4%). Of these, 11 samples (61.1%) tested negative for formalin and 6 samples (33.3%) tested positive for formalin. Meanwhile, only one sample (5.6%) had a brittle texture and laboratory test results showed negative for formalin. These results indicate that a hard texture is the most common characteristic found in salted fish sold at Kuala Simpang City Market.

The hard texture of salted fish does not always indicate the presence of formalin. In this study, most of the hard-textured samples did not contain formalin. This suggests that the texture of salted fish is also influenced by the processing process, particularly the salt content used, drying time, fish species, and remaining water content in the fish. The longer the drying process, the more water content in the fish will decrease, resulting in a denser and harder texture, even without the addition of formalin.

The results of this study are in line with Aditiya's (2024) study, which stated that salted fish that tested positive for formalin tended to have a harder texture because formalin can maintain the texture of the fish during storage. However, texture alone is not sufficient to confirm the presence of formalin, so laboratory testing is still required (36). This finding is also supported by research by Ratulangi and Widyan (2024) on 15 dried seafood samples, which showed that 7 samples (46.7%) tested positive for formalin and 8 samples (53.3%) tested negative for formalin. Samples that tested positive for formalin generally had a harder, denser, and less easily disintegrated texture than samples that tested negative for formalin. However, texture can only be used as an initial indicator and must be confirmed through laboratory testing to confirm the presence of formalin (38).

According to Imam Ash-Syafi'i in Al-Umm, the purpose of sharia in establishing dietary laws is to safeguard human well-being by ensuring that food consumed does not contain harmful elements. He explained that the original law of food is halal, but this status can change if there is evidence indicating the presence of substances or elements that are harmful to health. Therefore, the assessment of food safety must be based on clear evidence, not only on its physical characteristics. In line with this, Allah SWT says in QS. Al-Ma'idah verse 88: "And eat from what Allah has provided for you that is lawful and good (thayyib), and fear Allah in whom you believe." (QS. Al-Ma'idah: 88). This verse emphasizes that food consumed must not only be halal, but also thayyib, that is, safe and not harmful to health. This is in accordance with the results of research that the hard texture of salted fish can only be used as an initial indicator of the suspected presence of formalin because the texture is also affected by the salting and drying processes. Therefore, the presence of formalin cannot be determined solely based on texture, but must be confirmed through laboratory examination so that food safety truly meets the halal and thayyib principles in Islam.

5. Conclusion

The results of the study indicate that the physical characteristics of salted fish based on color, aroma, and texture cannot be used as a definitive indicator in determining the presence of formalin. The color characteristic is dominated by white, namely 17 samples (94.4%), consisting of 11 samples (61.1%) negative for formalin and 6 samples (33.3%) positive for formalin. This finding indicates that white color can only be used as an initial indicator and cannot be used as a basis for confirming the presence of formalin. In line with that, Imam Asy-Syafi'i emphasized that a decision should not be made solely based on outward appearance, but must be supported by valid evidence. Thus, the color characteristics of salted fish need to be confirmed through more accurate examination methods before drawing a conclusion.

Aroma characteristics showed that 11 samples (61.1%) had an abnormal aroma, while 7 samples (38.9%) had a normal aroma. Abnormal aromas were more common in samples positive for formalin, although some samples negative for formalin also showed the same characteristics. Meanwhile, texture characteristics showed that almost all samples had a hard texture, namely 17 samples (94.4%), consisting of 11 samples (61.1%) negative for formalin and 6 samples (33.3%) positive for formalin. These results indicate that hard texture is not always related to the use of formalin because it can be affected by the salting and drying processes. According to Imam Ash-Syafi'i, a food is still considered halal and fit for consumption as long as there is no evidence indicating the presence of harmful elements. Therefore, both aroma and texture can

only be used as initial indications, while the certainty of the presence of formalin must be proven through laboratory examination.

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