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Identification of Formalin and Borax Content in Salted Fish Circulating in The World West Bolangitang District

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Abstract:
Salted fish is a well-known dish in Indonesia. Nationally, salted fish is one of the important fishery products, with almost 65% of fishery products being processed and preserved through salting. Formalin is a solution of 30-50% formaldehyde gas (CH_2O), commonly used for embalming, disinfecting, and as an antiseptic, as well as in plastics, antifreeze, paper, carpet, textile, construction materials, paint, and furniture industries. Borax is a chemical compound known as sodium tetraborate ($Na_2B_4O_7.10\ H_2O$). Borax or boric acid is usually used in making detergents and antiseptics. The purpose of this research is to identify the presence of formalin and borax in salted fish and to determine the levels of formalin and borax in salted fish. This research employed qualitative analysis, using the permanganate, citric acid, and chromotropic acid methods for formalin detection. Turmeric paper, flame test, and $AgNO_3$ precipitation methods were used for borax detection. Meanwhile, the quantitative analysis was conducted using the UV-Vis Spectrophotometry method. Based on the qualitative research results, all four samples tested negative for formalin, while one sample tested positive for borax. Consequently, the sample that tested positive for borax underwent quantitative analysis, revealing a borax level of 0,0975 g/kg in sample B.

Keywords: Borax, Formalin, Salted Fish, UV-Vis Spectrophotometry

1. Introduction

Indonesia, renowned for its vast maritime and agricultural resources, relies heavily on the fishing industry as one of its major economic pillars. As an archipelagic nation with extensive coastlines, the country boasts a rich diversity of marine life, providing significant livelihood opportunities to its coastal communities. However, the perishable nature of fish poses challenges, particularly for fishermen in remote areas where transportation infrastructure may be lacking. To prevent spoilage, traditional fish preservation methods such as salting, drying, and smoking have been employed for centuries. Salted fish, in particular, is a common method used to extend the shelf life of fish, a practice prevalent in Indonesia's markets and households [1].

While salting effectively inhibits bacterial growth, making it an ideal preservation technique, it has limitations in maintaining the freshness and taste of the fish over extended periods. This often leads unscrupulous vendors to turn to harmful chemicals, such as formalin (formaldehyde) and borax, to further prolong the shelf life of salted fish. These chemicals, though commonly used in non-food industries, are illegal and dangerous when applied to food. According to the Ministry of Health Regulation No. 033 of 2012, both formalin and borax are prohibited as food additives due to their severe health risks [2]. These substances can have long-term, adverse effects on human health, particularly targeting the kidneys, liver, and nervous system [3].

Formalin, typically used in the preservation of biological specimens and in construction materials, can cause immediate symptoms such as stomach pain, respiratory distress, and nausea upon ingestion. Long-term exposure is associated with more severe conditions like cancer [4]. Borax, commonly found in detergents and antiseptics, is also toxic when ingested. It accumulates in the body, leading to chronic health conditions, including organ failure [5]. Despite these dangers, studies have shown that both chemicals are still detected in food products, particularly in salted fish, in some Indonesian markets [6].

The improper use of food additives to enhance appearance, texture, and shelf life has become a pressing issue in Indonesia. In addition to formalin and borax, other additives like benzoates and synthetic dyes are sometimes misused, contributing to a broader public health concern [7]. These chemicals not only violate food safety standards but also undermine consumer trust in the food supply chain. Regular consumption of foods tainted with these harmful substances can result in long-term health complications, raising the need for stricter enforcement of food safety regulations [8].

Given the seriousness of this issue, there is an urgent need for research aimed at identifying and quantifying the presence of harmful preservatives in food products, particularly in commonly consumed items like salted fish. The present study focuses on the identification of formalin and borax in salted fish distributed in the West Bolangitang District. This research aims to provide valuable insights into the safety of fish products consumed in the region and to raise awareness about the health risks associated with the use of these prohibited substances.

2. Materials and Methods

2.1 Tools and materials

The tools used are, Petri dishes, porcelain dishes, Erlenmeyer, measuring cups, glasses chemicals, filter cloth, filter paper, mortar and pestle, steamer, dropper pipette, tube clamp reaction, heat, tweezers, test tube rack, test tubes, and UV-Vis spectrophotometry. The ingredients used are 70% alcohol, chromatogenic acid, sulfuric acid, acetic acid, distilled water, curcumin powder, borax, formalin, H 2 O 2 , salted fish samples, KMnO 4 , methanol, and NaOH 10%.

2.2 Sampling Taking

The samples that will be used in the observations are salted fish circulating in West olangitang sub-district. Two samples were taken in each market, with Thus, the samples that will be used in this research are 4 samples.

2.3 Sample Preparation

The salted fish sample was weighed at 5 grams then added about 100 mL of distilled water then blend until smooth, then take a sufficient sample and put it in a tube centrifuge, and place the centrifuge tube into the centrifuge for 5 minutes with speed 3000 rpm. Take the supernatant and the substance resulting from centrifugation is taken Use the pipette carefully.

2.4 Preparation of 0.125% Curcumin Solution

Weighed and dissolved 125 mg of curcumin into a 100 mL ± 50 mL measuring flask acetic acid, after dissolving, add the acetic acid to the limit line.

2.5 Qualitative Test

1. Formalin
   a. Permanganate Method: The sample is put into a test tube, then add 3 $KMnO_4$ drops. Observe the color change that occurs, if the color changes from purple to purple brown to clear then the result is positive that the sample contains formaldehyde.
   b. Citric Acid Method: The sample is put into a test tube, then sulfuric acid is added and salicylic acid and heated slowly. Observe the color changes that occur if the sample If the color changes to dark red, the sample is positive for formalin.
   c. Chromatogenic Acid Method: The sample is put into a test tube, then chromatogenic acid is added and sulfuric acid. Observe the color changes that occur when the sample changes color purplish red means the sample is positive for formalin.

2. Borax
   a. Tumeric Paper Test: First, curcumin paper is made by dissolving the curcumin powder into alcohol, then paper that has been cut to size 6×1 is dipped in curcumin solution, the filter paper is dried by air-drying. Next, the curcumin paper that has been made is put into the sample solution

and you can see the color change that occurs if the curcumin paper changes color from yellow to brick red then the sample contains borax.

b. Flame Test: The sample was put into a porcelain cup and then concentrated sulfuric acid was added and methanol, then the sample is burned with fire. If the flame is green then the sample is positive contains borax.

c. AgNO 3 Deposition Test: The sample is put into a test tube, then add the silver nitrate solution. If a white precipitate forms, the sample is positive for borax.

3. Results

3.1 Qualitative Analysis

The qualitative tests for formalin and borax in salted fish samples were conducted using specific chemical reagents to observe color changes that indicate the presence of these substances. Table 1 outlines the results of the formalin qualitative test, where potassium permanganate ($KMnO_4$), citric acid, and chromatophic acid were used as indicators. Across all four samples (A, B, C, and D), no color changes were observed, indicating that none of the samples contained formalin. This suggests that formaldehyde, a commonly misused preservative, was not present in the tested salted fish.

Table 1: Results of Qualitative Analysis of Formalin

No	Sample	Parameter	Indikator	Result
1	A	$KMNO_4$	Sample reacted with $KmnO_4$,if the sample changes color from purple to color brown then the sample is positive formalin.	Negative
		Citric Acid	Samples are reacted with sulfuric acid and salicylic acid, if the sample changes color becomes dark red then formalin positive sample.	Negative
		Chromatofate Acid	The sample is reacted with chromatophic acid and acid sulfate, if the sample changes color turns red purplish then the sample is positive formalin.	Negative
2	B	$KMNO_4$	Sample reacted with $KmnO_4$,if the sample changes color from purple to color brown then the sample is positive formalin.	Negative
		Citric Acid	Samples are reacted with sulfuric acid and salicylic acid, if the sample changes color becomes dark red then formalin positive sample.	Negative
		Chromatofate Acid	The sample is reacted with chromatophic acid and acid sulfate,if the sample changes color turns red purplish then the sample is positive formalin.	Negative
3	C	$KMNO_4$	Sample reacted with $KmnO_4$,if the sample changes color from purple to color brown then the sample is positive formalin.	Negative
		Citric Acid	Samples are reacted with sulfuric acid and	Negative

		Chromatofate Acid	salicylic acid, if the sample changes color becomes dark red then formalin positive sample. The sample is reacted with chromatophic acid and acid sulfate, if the sample changes	Negative
4	D	$KMNO_4$	The sample is reacted with $KmnO_4$,if the sample changes color from purple to color brown then the sample is positive formalin.	Negative
		Citric Acid	Citric Acid Samples are reacted with sulfuric acid and salicylic acid,if the sample changes color becomes dark red then formalin positive sample.	Negative
		Chromatofate Acid	The sample is reacted with chromatophic acid and acid sulfate, if the sample changes color turns red purplish then the sample is positive formalin	Negative

Formalin is a toxic substance frequently used as a preservative for biological specimens, and its ingestion can lead to serious health issues, including cancer and respiratory problems [9]. In this study, the absence of formalin is an encouraging sign of food safety compliance, as the use of formalin in food is strictly prohibited under Indonesian regulations [10].

For borax, Table 2 illustrates the qualitative analysis using turmeric paper, flame tests, and silver nitrate ($AgNO_3$). Sample B tested positive for borax based on all three indicators. When turmeric paper was dipped in sample B, it turned brick red, which is a definitive indicator of borax presence. Additionally, the flame test resulted in a green flame, further confirming the presence of borax in sample B. Other samples (A, C, and D) showed negative results for borax. This finding raises concerns, as borax, a chemical typically used in detergents and antiseptics, is harmful to human health if ingested. Continuous exposure can result in kidney and liver damage [11]. The positive result in sample B emphasizes the need for stricter monitoring of food products in local markets.

Table 2: Results of Quantitative Analysis of Borax

No	Sample	Parameter	Indikator	Result
1	A	Paper Tumeric	If the curcumin paper has been dipped into the sample changes color to red brick then the sample is positive borax	Negative
		Flame Test Fire	Samples that have been added concentrated sulfuric acid and methanol is then burned, if the flame is green then the sample is positive for borax	Negative
		$AgNO_3$	The sample is reacted with $AgNO_3$, if a precipitate forms then the sample is positive for borax The sample is reacted with AgNO 3 , if a precipitate forms then the sample is positive for borax.	Negative
2	B	Paper	If the curcumin paper has been dipped into the	Positive

		Tumeric	sample changes color to red brick then the sample is positive borax	
		Flame Test Fire	Samples that have been added concentrated sulfuric acid and methanol is then burned, if the flame is green then the sample is positive for borax. The sample is reacted with AgNO 3 , if a precipitate forms then the sample is positive for borax.	Positive
		$AgNO_3$	The sample is reacted with $AgNO_3$, if a precipitate forms then the sample is positive for borax.	Positive
3	C	Paper Tumeric	If the curcumin paper has been dipped into the sample changes color to red brick then the sample is positive Negative borax	Negative
		Flame Test Fire	Samples that have been added concentrated sulfuric acid and methanol is then burned, if the flame is green then the sample is positive for borax.	Negative
		$AgNO_3$	The sample is reacted with $AgNO_3$, if a precipitate forms then the sample is positive for borax.	Negative
4	D	Paper Tumeric	If the curcumin paper has been dipped into the sample changes color to red brick then the sample is positive borax	Negative
		Flame Test Fire	Samples that have been added concentrated sulfuric acid and methanol is then burned, if the flame is green then the sample is positive for borax The sample is reacted with	Negative
		$AgNO_3$	AgNO 3 , if a precipitate forms then the sample is positive for borax The sample is reacted with AgNO 3 , if a precipitate forms then the sample is positive for borax.	Negative

3.2 Quantitative Analysis

The quantitative analysis of borax in the salted fish samples was carried out using UV-Vis spectrophotometry, a method known for its precision in detecting chemical concentrations in food. Table 3 shows the absorbance values for different concentrations of borax. In sample B, the borax concentration was found to be 0.0975 g/kg (97.60 mg/kg). Although the level detected is relatively low, it still poses significant health risks when consumed over time. According to Mudzikirah [3], even low levels of borax can lead to health deterioration, particularly affecting the human body's immune and organ systems. Long-term consumption of foods contaminated with borax can lead to reduced organ function, particularly in the liver and kidneys.

Table 3: Results of UV-Vis Spectrophotometry Analysis

Concentration (ppm)	Absorbance

5	0,041
10	0,374
15	0,574
20	0,769
30	0,961

The findings of this study are consistent with previous research that has identified the presence of borax in various food products in Indonesian markets. For instance, Muharrami [12] reported similar borax contamination in processed foods like crackers, while Wijayanti and Lukitasari [13] found formalin and borax in salted fish from other regions. These studies collectively underscore the widespread nature of this issue and highlight the urgent need for food safety interventions.

4. Discussion

The results of this study reveal a mixed picture of food safety in the salted fish market. While the absence of formalin in all samples suggests that sellers are adhering to regulations concerning this chemical, the presence of borax in one sample (B) is a cause for concern. Borax, although effective as a preservative, is banned for use in food due to its toxic effects on human health. Previous studies have also documented the misuse of borax in food products, especially in regions with less stringent regulatory enforcement [14].

The detection of borax in sample B raises questions about the effectiveness of current food safety inspections and the need for improved public awareness regarding the dangers of chemical preservatives. Vendors may be using borax to prolong the shelf life of their products, but they may not fully understand the severe health risks involved [15]. Furthermore, consumers often lack the knowledge to identify foods tainted with harmful chemicals, making them vulnerable to health risks.

In conclusion, the results of this study highlight the importance of continuous monitoring and stricter enforcement of food safety regulations. Although formalin was not detected in any of the samples, the presence of borax in one sample indicates that unsafe food preservation practices are still being employed. Public education, combined with regular inspections and sanctions for violators, will be crucial in ensuring food safety in local markets. This study emphasizes the need for future research to explore alternative, safer food preservation methods that can replace harmful chemicals like borax and formalin.

5. Conclusion

Based on the results of research regarding the identification of formalin and borax content in The conclusions obtained for salted fish circulating in West Bolangitang District are: Results qualitative formalin testing on the four samples was negative for containing formalin. Whereas, In the qualitative borax test, there was 1 sample that was positive for containing borax. Rate borax in sample B showed a concentration of 0.0975 g/kg Observations/Results of your study should be written in this section along with tables/charts/figures etc. write serial numbers and appropriate heading/title of tables and legend/caption of figures.

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Authors Profile

Ishak Isa is a distinguished professor at the Faculty of Mathematics and Natural Sciences, specializing in Analytical Chemistry. With extensive experience in his field, he has made significant contributions to the advancement of analytical techniques and is recognized for his expertise in the academic and scientific communities.

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Muhammad Taupik is a faculty member at the Faculty of Sports and Health in Universitas Negeri Gorontalo. He earned his bachelor's degree from Universitas Muslim Indonesia in 2011 and his master's degree from Universitas Gadjah Mada in 2014. His research includes the identification and study of fragmentation patterns in traditional medicine using advanced techniques such as Liquid Chromatography Mass Spectroscopy (LCMS). His published work includes studies on microcrystalline cellulose (MCC) fiber from corn cobs, and he is also involved in community service projects, such as producing mosquito repellent spray from aloe vera and lemongrass to prevent dengue fever.