

Food Chemical Quality Assessment : Food and Beverages Products Case Study in Malang City

Mika Vernicia Humairo^{1)*}, Alfian Ihza Mahendra¹⁾, Caroline Renee Lesmana P¹⁾, Jihan Alfin Salsabilla¹⁾, Nadya Nurhikmah¹⁾, Yudha Eka Pratama¹⁾

¹⁾Universitas Negeri Malang

*Corresponding Author: vernicia.humairo.fik@um.ac.id

ABSTRACT

Food safety is the urgency behind testing preservatives, colorants, and sweeteners in snacks and measuring heavy metal levels in marine animals in maintaining public health and ensuring the quality of food consumed. The purpose of conducting food quality testing practicum is to determine the presence or absence of harmful additives that have an impact on health. This research is a descriptive study using a qualitative method using a reagent test kit for the substances to be tested. The results obtained were 5 food samples containing formalin and 1 beverage sample containing cyclamate. In addition to the hazardous food additives test, heavy metal content tests were also conducted on marine animals. The results showed that 6 samples contained lead and 2 food samples contained mercury. All ingredients or substances tested in this study, namely Borax, Formalin, Arsenic (As), Rodhamin B, Methyl Yellow, Saccharin, Cyclamate, Aspartame, Lead (Pb), and Mercury (Hg) are substances that are harmful to health especially if consumed in excessive amounts. Findings from the study indicate that there are still food producers who use hazardous food additives such as preservatives, dyes, and sweeteners in snacks. In addition to food additives, food safety can also be affected by the environment, such as the heavy metal content in seafood

Keywords: Food safety; Preservatives; Colorants; Sweeteners; Heavy metal

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INTRODUCTION

Food safety is the driving force behind testing preservatives, dyes, and sweeteners in snacks, as well as measuring mercury and lead levels in seafood to protect public health and ensure the quality of food consumed. Snacks are an integral part of people's diets, especially for children who tend to consume more light meals (Amir et al., 2021). However, negative consequences arise when these snacks contain harmful additives such as formalin, borax, synthetic dyes, and artificial sweeteners, which can lead to serious health problems, ranging from poisoning to cancer risk (Herdyastuti et al., 2023).

In the context of seafood, fish, shrimp, and shellfish are important sources of protein for human health. However, a threat arises when these marine animals are contaminated by heavy metals such as mercury and lead. Mercury and lead can accumulate in the human body and cause various serious health problems, especially in the nervous and renal systems (Maharani et al., 2023). As industrial activity and pollution increase, the risk of mercury and lead contamination in seafood also increases, making regular monitoring of the levels of these two metals crucial for maintaining the quality of seafood consumed by the public.

To address these concerns, regular and accurate testing of additives in snacks and measuring mercury and lead levels in seafood is essential. This includes testing for preservatives (Formalin, Borax), dyes (Methyl Yellow, Rhodamin B), and sweeteners (Saccharin, Cyclamate, Aspartame). Laboratories serve as the primary venues for conducting these tests, taking samples from markets or snack producers for analysis (Werdiningsih, 2023). Analytical methods with testing standards are employed to ensure the accuracy of test results, enabling appropriate measures to be taken to maintain food quality and safety. In addition to testing additives and heavy metals in food, public education plays a vital role in raising awareness about the potential hazards in everyday

food. With a better understanding of the risks associated with additives and contaminants in food, the public can take more effective preventive measures, such as choosing safe snacks or limiting the consumption of certain seafood that may be contaminated (Haryani et al., 2022). This research aims to identify and measure the content of preservatives, dyes, and sweeteners in various types of food and beverages, as well as to measure mercury and lead levels in seafood samples commonly consumed by the public. By conducting this identification, the research can assess whether the content of these substances complies with the food safety standards established by applicable regulations.

MATERIALS AND METHODS

This study adopted a descriptive research design with a qualitative case study approach to assess the chemical quality of food and beverage products in Malang City (Creswell and Poth, 2018). Food and beverages from Malang city with randomly. The research utilized a variety of food and beverage samples suspected to contain preservatives, dyes, sweeteners, or heavy metals. The selected food items were those readily available, both labelled and unlabelled. A total of 18 food samples and 3 beverage samples were tested in the study. Samples for preservative testing: fish balls, fish sticks, tofu, tofu crackers, salted fish, and millet crackers. Samples for dye and sweetener testing: beverage X with chocolate flavour, beverage X Mango flavour, beverage Y, Jelly Gum, candy, beverage Z with orange flavour, traditional cake, tomato sauce. Samples for heavy metal testing: Raw shrimp, cooked shrimp, raw squid, cooked squid, raw blood clams, cooked blood clams, raw mackerel, and cooked mackerel.

The reagents used in the study were categorized into four groups based on the type of test: (1) Preservative test: Reagent Test Kit Borax/Boraks and Reagent Test Kit Formalin; (2) Dye test: Reagent Test Kit Rhodamin B and Reagent Test Kit Methil Yellow; (3) Sweetener test: Reagent Test Kit Siklamat, Reagent Test Kit Sakarin, and Reagent Test Kit Aspartam; (4) Heavy metal test: Reagent Test Kit Timbal (Lead) and Reagent Test Kit Merkuri (Mercury).

RESULTS AND DISCUSSION

Food testing is a crucial step in ensuring the safety and quality of the food we consume. Food quality is a critical factor in maintaining public health. Food testing is a fundamental pillar in safeguarding public health by ensuring the safety and quality of consumed products (WHO, 2022). Food safety and quality are critical in ensuring public health, particularly in urban areas like Malang City, where processed food and beverage consumption is high. Chemical analysis helps detect contaminants from heavy metals or additive food by seller. Which is essential for consumer protection and regulatory adherence (Cortés-Herrera et al., 2019). Consuming unsafe food can lead to various illnesses, including food poisoning, digestive problems, and even death (Fung et al., 2018). Therefore, safeguarding food quality is a shared responsibility involving various parties, from producers and distributors to consumers. Food testing plays a pivotal role in ensuring food safety, quality, regulatory compliance, and consumer protection. This study conducted four types of food tests: preservative testing, sweetener testing, dye testing, and heavy metal testing. Food testing involved dripping reagents onto samples and observing for color changes that indicate positive test results for the presence of specific substances in the food. There are seven common public health risks related with food safety in the food market. Microbial contamination of foods, chemical contamination of foods, food adulteration, misuse of food additives, mislabelling, GM foods, and foods past their use-by dates were the identified food safety-related health risks in the food market (Gizaw, 2019).

Table 1. Preservative Test Results

No	Sample	Sample Visualization	Borax Analysis		Formalin Analysis	
			Visualization	Result	Visualization	Result
1	Fish balls	White	white	-	Pinkish spots	+
2	Fish sticks	Bright yellow	Bright yellow	-	Pinkish spots	+
3	Tofu	Orange	Orange	-	Pink	+
4	Tofu crackers	Light yellow	Light yellow	-	Pinkish spots	+
5	Salted fish	Brownish green	Brownish green	-	Dark Purple	+

6	Millet crackers	Bright yellow	Bright yellow	-	Bright yellow	-
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Table 2. Dyes Test Results

No	Sample	Sample Visualization	Rhodamin B		Metil Yellow	
			Visualization	Result	Visualization	Result
1	Beverage X with chocolate flavour	Brown	Brown	-	Brown	-
2	Beverage X Mango flavour	Orange	Orange	-	Orange	-
3	Beverage Y	Yellowish white	White	-	White	-
4	Jelly Gum	Pink	Pink	-	Pink	-
5	Candy	Pink	Pink	-	Pink	-
6	Beverage Z with orange flavour	Yellow	Yellow	-	Yellow	-
7	Traditional cake	Bright red	Bright red	-	Bright red	-
8	Tomato sauce	Red	Red	-	Red	-

Table 3. Sweetener Test Results

No	Sample	Sample Visualization	Siklamat		Sakarín		Aspartam	
			Visualization	Result	Visualization	Result	Visualisation	Result
1	Beverage X with chocolate flavour	Brown	Faded brown	+	Faded brown	-	Faded brown	-
2	Beverage X Mango flavour	Orange	Faded orange	+	Faded orange	-	Faded orange	-
3	Beverage Y	Yellowish white	White	-	White	-	White	-
4	Jelly Gum	Pink	Pink	-	Faded pink	-	Faded pink	-
5	Candy	Pink	Pink	-	Faded pink	-	Faded pink	-
6	Beverage Z with orange flavour	Yellow	Yellow	-	Faded yellow	-	Faded yellow	-
7	Traditional cake	Bright red	Bright red	-	Faded bright red	-	Faded bright red	-
8	Tomato sauce	Red	Bright red	-	Faded red	-	Faded red	-

Table 4. Heavy Metal Test Results

No	Sample	Sample Visualization	Lead		Merkuri	
			Visualization	Result	Visualization	Result
1	Raw shrimp	White	Pinkish spots	+	White	-
2	Cooked shrimp	Pink	Pinkish spots	+	Pink	-
3	Raw squid	Dark black	Pinkish spots	+	Dark black	-
4	Cooked squid	Dark black	Pinkish spots	+	Dark black	-
5	Raw blood clams	Green	Pinkish spots	+	Green	-
6	Cooked blood clams	Slightly dark green	Pinkish spots	+	Slightly dark green	-
7	Raw mackerel	White	White	-	Purplish white	+
8	Cooked mackerel	White	White	-	Purplish white	+

Preservative Testing in Food

The preservative testing involved analyzing the borax and formalin content in six different food samples. The testing utilized Reagent Test Kit Borax/Boraks and Reagent Test Kit Formalin. The borax content testing revealed that the visual appearance of all samples remained unchanged compared to their original state. This indicates a negative result for borax content in all samples. In contrast, the formalin content testing yielded varying results. Five out of the six samples exhibited visual changes. These changes included the appearance of bright pink spots, bright pink patches, or even a uniform pink color. One sample turned dark purple. These visual alterations indicate the presence of formalin in these five samples. The remaining sample, millet crackers, did not exhibit any visual changes and was the only sample that tested negative for formalin content.

Traditional food preservation methods are ineffective for reducing the spread of food-borne viruses in food and beverage, so need more preservative to keep food and beverage safety (Gemechu et al., 2015). Borax (sodium borate) and formalin (formaldehyde solution) are toxic chemicals banned as food additives in many countries, including Indonesia. Despite their prohibition, they remain misused in foods like meatballs, noodles, tofu, and salted fish due to their low cost and preservative properties (Widiati & Wahyuningsih, 2023). The preservative testing results demonstrate that formalin was present in 5 out of the 6 food samples tested. The absence of formalin in millet crackers highlights the importance of careful food selection and consumption practices to minimize exposure to potentially harmful additives. This result same with study from Humairo et al., (2023), a study conducted on street foods in Malang City used rapid test kits to detect borax and formalin. Of 15 food samples, all tested negative for borax, but 7 samples were positive for formalin, indicating ongoing misuse of formalin as a preservative in some foods. The qualitative rapid tests provided immediate results, enabling swift identification and public awareness efforts. Similar approaches in other Indonesian cities have confirmed the effectiveness of rapid test kits for these preservatives (Jamaluddin et al., 2024). Borax and formalin can give acute effects like vomiting, diarrhea, abdominal pain, and kidney failure. Another effect cause chronic effect like liver damage, infertility, hormonal disruption, and cancer (Sulistiyorini, 2024).

Dye and Sweetener Testing in Food

The dye testing involved analyzing the Rhodamin B and Methyl Yellow content in eight different food samples. The testing utilized Reagent Test Kit Rhodamin B and Reagent Test Kit Methil Yellow. The Rhodamin B content testing revealed that the visual appearance of all samples remained unchanged compared to their original state. This indicates a negative result for Rhodamin B content in all samples. Similarly, the Methyl Yellow content testing yielded consistent results. None of the samples exhibited visual changes compared to their original state. This confirms that all samples tested negative for Methyl Yellow content. The dye testing results demonstrate that neither Rhodamin B nor Methyl Yellow was present in any of the eight food samples tested. The absence of these potentially harmful dyes highlights the importance of food safety regulations and consumer awareness. Illegal dyes such as rhodamin B and methyl yellow are sometimes used to enhance food appearance. Rapid test kits for rhodamin B are available and widely used by health authorities for qualitative detection in food and beverages, offering results within minutes (Du et al., 2024).

Studies using these kits in various Indonesian regions have shown their reliability for field inspections, though no recent Malang-specific data was found in the provided results. Rhodamin B is a synthetic dye used in textile industries, not permitted for food use. Consumption can lead to liver damage and increased cancer risk. Methyl Yellow is also an industrial dye, associated with neurotoxicity and carcinogenic effects. The Indonesian Food and Drug Authority (BPOM) strictly prohibits the use of these dyes in any food products.

Based on data, there are 2 samples that using siklamat sweetener. The sample is beverage X with different flavour. Artificial sweeteners like siklamat and sakarin are preferred for their cost and sweetness but pose health risks if misused. Rapid test kits for sakarin and siklamat have been used in studies on bubble drinks, showing negative results in all tested samples, indicating no detectable misuse in those cases. The test involves simple color changes or precipitation reactions, making them practical for routine screening (Harningsih et al., 2020).

Heavy Metal Content Testing in Food

The heavy metal testing involved analyzing the lead and mercury content in eight different food samples. The testing utilized Reagent Test Kit Timbal (Lead) and Reagent Test Kit Merkuri (Mercury). The lead content testing revealed that six samples tested positive for lead. The visual indicator of lead presence was the appearance

of pink spots on the samples. The remaining two samples did not show any signs of lead contamination. In contrast, the mercury content testing indicated that six samples did not contain mercury. However, two samples, raw and cooked mackerel, tested positive for mercury. The visual indicator of mercury presence was a white-purple color change. The heavy metal testing results highlight the potential presence of lead and mercury in certain food items. Six samples tested positive for lead, while two samples showed mercury contamination. These findings underscore the importance of food safety regulations, consumer awareness, and proper food handling practices to minimize exposure to harmful heavy metals. Heavy metals such as mercury and lead are hazardous contaminants that can enter food through environmental pollution or processing equipment. Lead in food can cause anemia and kidney problems for longterm consumption (Yang et al., 2024). Foodstuffs contaminated with Hg pose a significant health risk to consumers due to their high toxicity and ability to bioaccumulate. Sources of mercury (Hg) emissions include fuel combustion, industrial processes, incineration, residential coal burning, and volcanic activity. Mercury poisoning, adverse effects on the nervous system, insomnia, gastrointestinal tract issues, kidney and respiratory failure (Kaushik et al., 2023).

CONCLUSION

Findings from the study indicate that there are still food producers who use hazardous food additives such as preservatives, dyes, and sweeteners in snacks. In addition to food additives, food safety can also be affected by the environment, such as the heavy metal content in seafood. In this study, the preservative test yielded positive results for 5 out of 6 samples tested for formalin. The sweetener test yielded positive results for 2 out of 8 samples tested for cyclamate. The heavy metal content test found lead in 6 out of 8 samples and mercury in 2 out of 8 samples. It is hoped that food producers will be more cautious in using hazardous food additives as they can have a detrimental impact on consumer health. Consumers are also encouraged to be more careful about the food they consume and to pay more attention to the health aspects of the food. Ensuring food safety is a shared responsibility that requires collaboration among food producers, government agencies, and consumers. By prioritizing the use of safe ingredients, implementing effective regulatory measures, and making informed food choices, we can collectively safeguard public health and promote a healthier food environment.

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