

The Dangerous Of Using Food Preservatives To Human Health: A Review

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Abstract

The use of formalin as a food additive remains a recurring issue in processed food products in Indonesia, particularly in perishable items such as wet noodles and tofu. This review examines ten published studies that investigated formalin detection across different regions of Indonesia using a range of analytical approaches, including the Nash reagent, UV-Vis spectrophotometry, rapid test kits, KMnO_4 , Tollens reagent, and natural indicators. The findings reveal considerable regional variation in contamination levels, with positive results most frequently reported in Palembang, Yogyakarta, Tomohon, and Pringsewu, while samples from West Jakarta and Sorong were predominantly negative. Among the methods reviewed, the Nash reagent and UV-Vis spectrophotometry demonstrated higher accuracy and sensitivity, whereas simpler techniques were more appropriate for preliminary screening and public education. Overall, this review highlights the need for strong coordination between regulatory oversight, public awareness initiatives, and the availability of reliable detection methods to improve food safety in Indonesia.

Keywords: Safety; Food; Toxicology; Health; Education

Abstrak

Penggunaan formalin sebagai bahan tambahan pangan masih menjadi permasalahan yang berulang pada produk pangan olahan di Indonesia, khususnya pada bahan pangan yang mudah rusak seperti mi basah dan tahu. Tinjauan ini mengkaji sepuluh studi yang meneliti deteksi formalin di berbagai wilayah Indonesia dengan menggunakan beragam metode analisis, antara lain pereaksi Nash, spektrofotometri UV-Vis, rapid test kit, KMnO_4 , pereaksi Tollens, serta indikator alami. Hasil kajian menunjukkan adanya variasi tingkat cemaran antarwilayah, dengan temuan positif paling banyak dilaporkan di Palembang, Yogyakarta, Tomohon, dan Pringsewu, sementara sampel dari wilayah Jakarta Barat dan Sorong umumnya menunjukkan hasil negatif. Di antara metode yang dikaji, pereaksi Nash dan spektrofotometri UV-Vis menunjukkan akurasi dan sensitivitas yang lebih tinggi, sedangkan metode yang lebih sederhana dinilai lebih sesuai untuk skrining awal dan kegiatan edukasi masyarakat. Secara keseluruhan, tinjauan ini menegaskan pentingnya koordinasi yang kuat antara pengawasan regulatori, peningkatan kesadaran masyarakat, dan ketersediaan metode deteksi yang andal dalam upaya meningkatkan keamanan pangan di Indonesia.

Kata kunci: Keamanan; Pangan; Toksikologi; Kesehatan; Edukasi

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INTRODUCTION

Food safety is a critical issue within the public health system. The consumption of food contaminated with harmful chemical substances not only poses immediate risks to individual health but also increases the likelihood of chronic diseases and long-term toxic effects.¹

Formalin, or formaldehyde, is one of the food additives most frequently misused in Indonesia. In principle, this compound is intended solely for non-food industrial

applications, including use as a disinfectant and as a preservative for biological specimens and corpses.² Nevertheless, due to its effectiveness in prolonging shelf life, formalin continues to be illegally added to food products such as wet noodles, tofu, and meatballs.³

The misuse of formalin is often associated with small-scale food producers seeking to minimize economic losses caused by rapid spoilage. However, exposure to formaldehyde poses serious health risks, including respiratory and

digestive disorders, as well as long-term carcinogenic effects.⁴

Numerous studies have reported the presence of formalin in processed foods sold at food stalls and traditional markets across various regions of Indonesia.⁵ The extent of contamination, however, varies considerably between regions and is influenced by factors such as the effectiveness of government supervision, the level of public awareness, and the commitment of food business operators to comply with existing regulations.⁶

In addition to regulatory and behavioral factors, the choice of detection method plays a crucial role in determining the accuracy of formalin identification. Analytical techniques such as the Nash reagent and UV-Vis spectrophotometry are known for their high sensitivity and ability to quantitatively determine formalin concentrations.⁷ In contrast, simpler methods—including KMnO_4 tests, rapid test kits, and natural indicators such as turmeric or bay flower—are more appropriate for preliminary screening and educational purposes, despite their lower precision.⁸

Based on this background, the present study aims to identify the presence of formaldehyde in wet noodles sold in different regions of Indonesia, to compare the effectiveness of various formalin detection methods reported in previous studies, and to provide a comparative overview of areas with high contamination levels and those free from formalin as a basis for food safety policy evaluation and recommendations.

METHODOLOGY

This review employed a systematic literature review approach based on ten accredited national journals that examine the detection of formaldehyde in processed food products, particularly wet noodles, tofu, and meatballs.⁹ Each selected journal was critically analyzed to assess the analytical methods used for formaldehyde detection, the reported results, and the geographical distribution of the sampled products.¹⁰

Data Collection

Data were collected through a comprehensive review of ten relevant scientific journals that met the following inclusion criteria: the study focused on the detection of formaldehyde in processed foods; it employed chemical testing methods or natural indicators; it was conducted in Indonesia using real food samples; and it reported qualitative or quantitative results of formalin analysis.¹

Sample Type

The food samples evaluated in the reviewed studies consisted primarily of wet noodles, tofu, and meatballs. Sampling locations varied and included traditional markets, restaurants, school environments, and home-based food production centers.⁷

Detection Method

The formaldehyde detection methods discussed in the reviewed journals comprised several analytical approaches. The Nash reagent was used for quantitative detection based on a chemical reaction that produces a bright yellow color in the

presence of formaldehyde.² UV-Vis spectrophotometry was applied for precise measurement of formaldehyde concentration, typically at a wavelength of 413 nm.¹¹ Rapid test kits were utilized for practical and early-stage detection in field settings.⁶ Qualitative identification methods included KMnO_4 and Tollens tests, which rely on observable color reactions.³ In addition, natural indicators such as turmeric extract, bay flower, and dragon fruit peel were employed as alternative detection tools, particularly for community education purposes.⁸

Data Analysis

Data extracted from each journal were analyzed descriptively and classified according to sampling region, type of food product, detection method applied, and formaldehyde test results. The findings were subsequently presented in tabular and

narrative forms to facilitate comparison of detection effectiveness and to identify trends in formaldehyde contamination across different regions.¹²

RESULTS AND DISCUSSION

The results of the reviewed studies are summarized in Table 1, which presents a comparative overview of formaldehyde detection in processed food products across different regions in Indonesia. The table highlights the diversity of analytical methods applied, ranging from qualitative screening techniques to quantitative laboratory-based analyses, along with the corresponding detection outcomes. This comparison provides a clear depiction of regional contamination patterns and illustrates how methodological differences influence the identification and interpretation of formaldehyde presence in food samples.

Table 1. Summary of formaldehyde detection methods and results in processed foods across different regions of Indonesia

No.	Title	Test method	Result	Reference
1	Qualitative analysis of formalin compounds in wet noodles at Bakso Sorong Shop	Qualitative analysis using the Nash reagent to identify chemical compounds in the sample	No color change was observed after the addition of the Nash reagent to the wet noodle filtrate, indicating negative results for formalin	13
2	Screening of hazardous food additives in Duri Kosambi Village, West Jakarta	Descriptive study using rapid test kits to qualitatively detect hazardous food additives, including formalin, borax, and Rhodamine B	All samples tested negative; no purple color change was observed, indicating the absence of Rhodamine B and other hazardous additives	6
3	Assessment of the effects of hazardous food additives on human health	Documentation-based study and descriptive analysis using data from BPOM, the Ministry of Health, and previous academic studies	The filtrate turned bright yellow after reaction with the Nash reagent and heating, indicating the formation of 3,5-diacetyl-1,4-dihydrolutidine from formaldehyde	2

No.	Title	Test method	Result	Reference
4	Analysis of formalin content in wet noodles sold in Beringharjo and Kota Gede Markets, Yogyakarta	Experimental study employing qualitative and quantitative analytical methods	Samples A and B showed a yellow color change (positive for formalin), while samples C, D, E, and F remained colorless (negative)	7
5	Identification of natural indicators from dragon fruit peel extract and turmeric for detecting formalin and borax at UPT SD Negeri 060883 Medan	Natural indicator-based detection method	No color change was observed in turmeric; the skewer remained yellow, consistent with the negative control	8
6	Analysis of formalin content in wet noodles from Pringsewu Main Market	Qualitative analysis using the Nash reagent	The absence of any color change in all samples confirmed negative results for formalin	14
7	Determination of formalin levels in wet noodles at Piyungan Market, Yogyakarta	Combination of qualitative test kits and quantitative UV-Vis spectrophotometry	Formaldehyde concentrations varied among samples: 281.500 mg/kg (sample B), 237.810 mg/kg (sample D), and 253.197 mg/kg (sample E)	11
8	Identification of formalin in wet noodles sold at Beriman Market, Tomohon City	KMnO ₄ test combined with formalin rapid test kits	Two samples yielded positive results for formalin based on KMnO ₄ reaction	15
9	Qualitative analysis of formalin content in wet noodles from traditional markets in the Plaju region, Palembang	Test kits combined with KMnO ₄ and Tollens tests	All ten samples contained formaldehyde based on initial tests; however, only four samples were confirmed positive using the Tollens test	3
10	Identification of formaldehyde in wet noodles and tofu around the YARSI University campus, Jakarta	Quantitative analysis using a modified chromatropic acid method and UV-Vis spectrophotometry with the Nash reagent ($\lambda = 413 \text{ nm}$)	Formaldehyde was detected in all samples; levels ranged from 13.9–183.3 ppm in tofu and 13.9–408.3 ppm in wet noodles	5

A review of ten journals indicates that the presence of formaldehyde as a hazardous food additive remains widespread in several regions of Indonesia, particularly in perishable food products such as wet noodles and tofu.³ Nevertheless, the distribution of contamination varies markedly across regions and is influenced by differences in

analytical methods and the effectiveness of regulatory supervision.⁶

Regions such as Sorong District and West Jakarta were identified as areas in which no formaldehyde was detected in the tested food samples.^{13,6} These findings may reflect successful regulatory enforcement and public awareness initiatives. However, an alternative explanation is that the

detection methods applied in these areas were insufficiently sensitive to identify formaldehyde at very low concentrations.⁸

In contrast, studies conducted in Palembang, Tomohon, Pringsewu, and Yogyakarta reported varying levels of formaldehyde contamination depending on sampling location and testing methodology. In Palembang, all wet noodle samples tested positive for formaldehyde using rapid test kits and KMnO_4 reactions, although confirmation with the Tollens test yielded positive results in only four samples.³ In Pringsewu, analysis using UV-Vis spectrophotometry revealed elevated formalin levels, reaching up to 0.0414%.¹⁴ In Yogyakarta, formaldehyde concentrations in wet noodles ranged from 237 to 281 mg/kg.¹¹

The detection of formalin at different concentration levels suggests that some food business operators continue to use this substance illegally to extend product shelf life, particularly in household-scale production and traditional markets.¹⁵ A similar pattern was observed in the area surrounding the YARSI University campus in Jakarta, where all sampled wet noodles and tofu were found to contain formaldehyde, in some cases at very high concentrations of up to 408.3 ppm.⁵

From a methodological perspective, the Nash reagent and UV-Vis spectrophotometry consistently demonstrated superior accuracy and sensitivity for the quantitative determination of formaldehyde.⁷ The reaction between formaldehyde and the Nash reagent produces a bright yellow

complex compound, 3,5-diacetyl-1,4-dihydrolutidine, which can be readily observed and quantitatively measured at a wavelength of 413 nm.² This analytical approach has therefore proven highly effective for precise formalin measurement.

Despite these advantages, negative results obtained in certain regions, such as Sorong and West Jakarta, warrant further critical evaluation. Such outcomes may indicate the genuine absence of formaldehyde; however, they may also arise from methodological limitations, including the low sensitivity of rapid test kits or interference from other compounds that inhibit the Nash reagent reaction.⁸ Additionally, factors such as temperature, pH variation, and incomplete extraction procedures can result in false-negative findings, even when formaldehyde is present at low levels.⁶

Several studies have explored the use of natural indicators, including turmeric extract, bay flower, and dragon fruit peel, as alternative detection tools that are environmentally friendly and suitable for community-based education.⁸ Although these approaches are simpler and more cost-effective, their analytical accuracy remains substantially lower than that of laboratory-based methods, restricting their application primarily to preliminary screening and educational activities.

Overall, the substantial variation in detection outcomes across regions underscores that food safety is determined not only by the choice of analytical methods but also by the robustness of regulatory frameworks, the level of public awareness,

and the consistency of government supervision.⁵ Regions that have successfully reduced the use of formaldehyde may therefore serve as valuable policy models for other areas. Educational strategies such as training community health cadres, demonstrating the use of natural indicators, and improving access to rapid test kits have the potential to strengthen participatory monitoring systems and more effectively prevent the circulation of illegal food additives.

CONCLUSION

Based on the review of ten journals, this study concludes that the use of formalin as a hazardous food additive remains prevalent in several processed food products in Indonesia, particularly wet noodles and tofu. While certain regions, such as Sorong and West Jakarta, reported negative findings, other areas—including Palembang, Pringsewu, Tomohon, and Yogyakarta—continued to show positive results, in some cases exceeding acceptable safety limits.

These regional differences indicate that the effectiveness of formaldehyde control is strongly influenced by the quality of regulatory supervision, the level of public awareness, and the degree of compliance among food business operators. Among the detection techniques reviewed, the Nash reagent method and UV-Vis spectrophotometry demonstrated the highest accuracy and sensitivity, whereas rapid test kits, KMnO₄-based methods, and natural indicators were more appropriate

for preliminary screening and educational applications.

Importantly, negative test results should not be interpreted as definitive evidence that a product is free from formaldehyde. Factors such as limited instrument sensitivity, suboptimal extraction procedures, and environmental conditions can compromise detection accuracy. Consequently, combining rapid screening approaches with confirmatory laboratory-based analyses is essential to ensure reliable and valid results.

Overall, effective control of formaldehyde in food products requires a synergistic approach that integrates strict regulatory enforcement, enhanced public education, and the availability of accessible detection tools. Regions that have successfully minimized formaldehyde use may serve as valuable best-practice models for strengthening a more robust and sustainable national food safety system.

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