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Analysis of Sodium Benzoate Contents in Beverages Non-BPOM Packaged Fruit Juice Using UV-Vis Spectrophotometry Method

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ABSTRACT

Background & Objective: The rapid growth of the beverage industry in Indonesia has led to an increasing circulation of various soft drink products in society, including packaged fruit juice beverages produced by Micro, Small, and Medium Enterprises (MSMEs). These products often contain additional ingredients, particularly preservatives such as sodium benzoate. However, some manufacturers do not provide clear information regarding the concentration of these additives on product labels. The uncontrolled and unmonitored use of food additives may pose potential health risks, especially if the preservatives exhibit carcinogenic properties. This study aims to analyze the levels of sodium benzoate in packaged fruit juice drinks available on the market. The absence of sodium benzoate in the tested samples would indicate that the products are free from synthetic preservatives and therefore safe for consumption.
Method: This study employed a descriptive-analytical design to determine the concentration of sodium benzoate in non-BPOM registered packaged fruit juice beverages. Quantitative analysis of sodium benzoate was performed using UV-Vis spectrophotometry. The population consisted of non-BPOM packaged fruit juice beverages available in local markets and retail outlets. Samples were collected using purposive sampling, based on product availability and labeling that did not specify preservative content.
Result: The qualitative analysis using 5% $FeCl_3$ reagent indicated positive results for the presence of sodium benzoate in both sample A and sample B. Furthermore, quantitative analysis revealed that the sodium benzoate concentrations in sample A and sample B were each 40 mg/kg (0.004%).
Conclusion: The findings of this study confirmed the presence of sodium benzoate in both non-BPOM packaged fruit juice samples. These levels were relatively low and remained within acceptable safety limits established by international food safety standards, indicating that the analyzed products are safe for consumption with respect to sodium benzoate content.

Keywords: Sodium Benzoate, UV-Vis Spectrophotometry, fruit Juice Beverages, Food Safety.

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INTRODUCTION

The beverage industry in Indonesia has experienced rapid growth in recent years, leading to a wide variety of soft drinks and fruit juice products circulating in the market. Among these, packaged fruit juice beverages produced by Micro, Small, and Medium Enterprises (MSMEs) are increasingly popular due to their affordability and accessibility (Pradana et al., 2021). However, such products are often formulated with food additives, including preservatives such as sodium benzoate, to prolong shelf life and maintain product stability. Sodium benzoate (SB), a derivative of benzoic acid, is extensively utilized as a food preservative. It is often employed in combination with other preservatives to enhance antimicrobial effectiveness (Lennerz et al., 2015). Sodium benzoate (SB) is a salt derivative of benzoic acid with high water solubility. Due to its antifungal and antibacterial properties, it is utilized as a food preservative in strictly regulated amounts (Albuquerque et al., 2022).

Sodium benzoate is one of the most commonly used preservatives in the food and beverage industry due to its antimicrobial activity, particularly against yeast, mold, and some bacteria (Ali et al., 2019). Despite its widespread application, concerns have arisen regarding its potential health risks. High levels of sodium benzoate intake have been associated with adverse effects, including hyperactivity in children, oxidative stress, and potential carcinogenicity when it reacts with ascorbic acid to form benzene (Mpountoukas et al., 2022). Consequently, international regulations such as those set by the Codex Alimentarius Commission and national authorities have established maximum allowable limits for sodium benzoate in beverages.

In Indonesia, the Food and Drug Monitoring Agency (BPOM) plays a critical role in regulating the use of food additives, including preservatives. However, several fruit juice products circulating in local markets, particularly those not registered with BPOM, often fail to provide transparent labeling regarding additive content (Hidayat et al., 2020). This lack of information raises concerns about the safety of such products, as unregulated and unmonitored consumption of preservatives could pose health risks to consumers.

Given these circumstances, it is necessary to evaluate the presence and concentration of sodium benzoate in non-BPOM packaged fruit juice beverages available in the market. UV-Vis spectrophotometry is widely recognized as a reliable and cost-effective analytical method for determining sodium benzoate content in food and beverage matrices (Nagaraj et al., 2018). This study aims to analyze the qualitative and quantitative presence of sodium benzoate in non-BPOM packaged fruit juice products to assess their safety for consumption.

OBJECTIVE

The objective of this study is to identify and quantify the presence of sodium benzoate in non-BPOM packaged fruit juice beverages available in local markets. Specifically, the study aims to conduct qualitative analysis to confirm the presence of sodium benzoate in the samples, determine the concentration of sodium benzoate using the UV-Vis spectrophotometry method, compare the detected levels with internationally accepted food safety standards to evaluate the safety of the products for consumption.

METHOD

This study employed an experimental laboratory method to analyze sodium benzoate levels in packaged fruit juice drinks produced by MSMEs that do not possess a BPOM permit. The analysis was conducted using UV–Vis spectrophotometry.

The tools used included beakers, analytical balances, pipettes, test tubes, separatory funnels, filter paper, hotplates, and a UV–Vis spectrophotometer. The materials consisted of packaged fruit juice drink samples, sodium benzoate standard, 96% ethanol, $FeCl_3$ 5%, HCl, saturated NaCl, NaOH 10%, and ether.

Samples were selected based on inclusion criteria: packaged fruit juice drinks without BPOM authorization, without labeling of added ingredients and their concentrations, and produced by MSMEs. Samples with a BPOM permit were excluded.

Sample preparation was performed by weighing 10 g of sample, adding saturated NaCl and NaOH 10%, followed by filtration, acidification with HCl, and extraction using ether. The ether extract was evaporated to obtain the residue. Qualitative analysis was conducted using $FeCl_3$ 5%, indicated by the formation of a brownish precipitate. Quantitative determination of sodium benzoate was carried out using UV–Vis spectrophotometry at a maximum wavelength of 282 nm. Sodium benzoate standard solutions were prepared to generate a calibration curve, and sample absorbance was measured to determine sodium benzoate concentration.

RESULTS

1. Qualitative Analysis

Qualitative analysis was conducted to determine the presence of sodium benzoate in packaged fruit juice drink samples collected from local markets in the Ciamis area. This sampling location was chosen based on accessibility, proximity to the researchers' residence, and economic considerations. The qualitative identification of sodium benzoate was performed using a 5% $FeCl_3$ reagent, which reacts with benzoic acid derivatives to form a colored complex (Purwaningsih et al., 2016).

Upon the addition of 5% $FeCl_3$ to both fruit juice samples, a brownish precipitate was formed, indicating a positive reaction for sodium benzoate. This color change occurs due to the reaction between ferric ions and benzoate anions, resulting in the formation of ferric benzoate complexes (Apriliant, 2019). The reaction that occurs is:

$$3\ C_6H_5COOH + FeCl3 \longrightarrow Fe(C_6H_5COO)3 \downarrow + 3\ HCl$$

The qualitative test results are summarized in Table 1.

TABLE 1. The result of qualitative test

Sample	Colour	Result
A	Brownish precipitate	Positive
B	Brownish precipitate	Positive

The detection of sodium benzoate in both samples suggests that the beverages contained benzoate-based preservatives. This preservative is commonly used in acidic beverages such as fruit juices to inhibit the growth of yeast, molds, and certain bacteria (Ali et al., 2019).

2. Quantitative Analysis

Quantitative determination of sodium benzoate was carried out using the UV–Visible spectrophotometric method at a maximum wavelength of 282 nm, as previously described by Larasati (2021). Standard solutions of sodium benzoate ranging from 100 to 500 ppm were prepared to construct a calibration curve. The absorbance values of these standards are presented in Table 2.

TABLE 2. Absorbance of standard solution

Sample	Concentration (ppm)	Absorbance
	100	0,230
	200	0,335
	300	0,402
	400	0,429
	500	0,494

The standard calibration curve showed a strong linear correlation (R^2 > 0.99) between concentration and absorbance, confirming the reliability and accuracy of the analytical method used (Nagaraj et al., 2018). This linear relationship was used to determine the sodium benzoate content in the fruit juice samples.

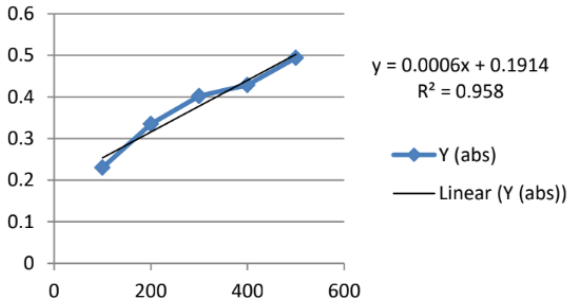

FIGURE 1. Linear standard caliration curve

The absorbance values for the fruit juice samples were measured under identical conditions as the standards. The recorded absorbance values for samples A and B ranged from 0.305 to 0.327, as shown in Table 3.

TABLE 3. The result determination of Natrium benzoat content in sample

Sample	Absorbance	Result
A	0,305	0,004%
	0,310	
	0,315	
B	0,310	0,004%
	0,318	
	0,327	

DISCUSSION

The qualitative analysis indicated that both fruit juice drink samples contained sodium benzoate, as evidenced by the formation of a brownish precipitate after the addition of 5% $FeCl_3$ reagent. This color change occurs due to the reaction between ferric ions and benzoate anions, forming ferric benzoate complexes. The presence of this brownish coloration confirms the existence of benzoate compounds, aligning with previous findings that ferric chloride can serve as a qualitative reagent for detecting benzoic acid derivatives in food matrices (Rahman et al., 2018; Singh et al., 2020).

The quantitative determination using UV–Visible spectrophotometry revealed that the absorbance values of the two samples ranged from 0.305 to 0.327, corresponding to a sodium benzoate concentration of approximately 0.004%. The standard calibration curve constructed from sodium benzoate solutions of 100–500 ppm exhibited a linear relationship between concentration and absorbance ($R^2 > 0.99$), indicating the reliability and accuracy of the analytical method.

According to the Codex Alimentarius Commission and the Indonesian National Standard (SNI), the maximum allowable concentration of sodium benzoate in non-alcoholic beverages is 0.1% (Badan Standardisasi Nasional [BSN], 2018). Therefore, the detected level of 0.004% is significantly below the permitted threshold, suggesting that the analyzed products are safe for consumption and comply with current regulatory limits. The findings also imply that manufacturers in the Ciamis area apply sodium benzoate appropriately as a preservative to maintain product stability and inhibit microbial growth in acidic fruit-based beverages.

Although sodium benzoate is widely regarded as a safe food preservative within regulated limits, its misuse or excessive application can lead to health concerns, including allergic responses and the potential formation of benzene in the presence of ascorbic acid under heat or light exposure (Yadav et al., 2021). Therefore, continuous monitoring and evaluation of food preservatives are necessary to ensure product safety and protect consumer health.

Overall, the results of this study confirm that sodium benzoate is present in commercially available packaged fruit juice drinks circulating in the Ciamis area. However, the detected concentrations remain within the acceptable limits set by regulatory authorities. These findings underscore the importance of regular quality control and monitoring in the food and beverage industry to ensure compliance with food safety standards and to maintain consumer trust.

CONCLUSION

The qualitative and quantitative analyses conducted in this study confirmed the presence of sodium benzoate in packaged fruit juice drinks circulating in the Ciamis area. The qualitative test using 5% $FeCl_3$ reagent produced a brownish precipitate in both samples, indicating a positive reaction for sodium benzoate. Quantitative determination using UV–Visible spectrophotometry revealed that the concentration of sodium benzoate in both samples was approximately 0.004%, which is significantly below the maximum limit of 0.1% set by the Codex Alimentarius and the Indonesian National Standard (SNI).

These findings suggest that the analyzed products comply with existing food safety regulations and are safe for public consumption. The presence of sodium benzoate at controlled levels

demonstrates that local beverage manufacturers apply preservative agents responsibly to maintain product quality and prevent microbial spoilage.

In conclusion, while the sodium benzoate levels detected in the examined fruit juice drinks are within safe limits, continuous surveillance and quality assurance are essential to ensure that preservative use remains within permissible standards. Further research is recommended to assess other types of preservatives and to evaluate potential synergistic effects that may occur in combination with different food additives.

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CONFLICT OF INTEREST

There is no conflict of interest in preparing this research and writing this article.

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