Identification of Rhodamine-B and Characteristics of Bulk Strawberry Jam in Yogyakarta City Market

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Abstract

Food safety is a crucial aspect in ensuring health, especially by ensuring that food products are free from hazardous substances. Rhodamine-B is a hazardous synthetic dye used in non-food industries such as paper, ink, and textiles, but its use in food products is prohibited because it is toxic and potentially triggers health issues. Nevertheless, its use is still often found in food as a red dye, including bulk jams sold without trademarks or BPOM distribution permits. Bulk jam, especially strawberry jam, is often given additional coloring to enhance its visual appeal. Thus, this study aims to detect the presence of Rhodamine-B qualitatively and quantitatively, as well as to determine the characteristics of bulk strawberry jam circulating in the Yogyakarta City Market. Ten of the bulk strawberry jams that are available come in plastic bags, while the remaining two are packaged in plastic jars. The research was conducted using both qualitative and quantitative approaches. Qualitative tests were conducted using a rhodamine-B test kit, while quantitative tests were performed using UV-Vis Spectrophotometry. Market sample collection was carried out using random sampling techniques at 12 traditional markets. Sample collection was done directly at the designated markets. The research results show that no Rhodamine-B content was found in all samples of bulk strawberry jam in Yogyakarta City, both qualitatively and quantitatively, and this is further supported by color testing which did not show any color indicating the presence of Rhodamine-B. The results of the pH test indicate that every sample has a pH that satisfies the requirements of SNI 01-3746-2008. Nevertheless, the sugar levels in just three of the twelve samples satisfy SNI 01-3746-2008 requirements. This research is expected to contribute to supporting stricter food safety monitoring and raising consumer awareness of the dangers of illegal synthetic dyes in food products.

Keyword: jam, rhodamine-B, test Kit, UV-Vis spectrophotometry

1. INTRODUCTION

Food safety is a crucial aspect of ensuring health, especially in ensuring that food and beverage products are free from hazardous materials. Government Regulation No. 86/2019 emphasizes that food safety includes the prevention of biological, chemical or physical contamination that can endanger human health. Inadequate implementation of food safety can cause various diseases, including poisoning and even outbreaks case (KLB) (Lestari, 2020).

Based on data from the Ministry of Health (Kemenkes) in 2023, there were 4,792 cases of food poisoning with a total of 96 outbreak cases and a Case Fatality Rate (CFR) of 0.31%. The Special Region of Yogyakarta (DIY) ranked first with 19 cases of food poisoning outbreaks. One of the causes of food poisoning is the use of Food Additives (BTP) that are not

in accordance with regulations, such as hazardous food coloring which is often misused to enhance the color of food or drinks being sold (Asworo, 2019).

Rhodamine-B is a hazardous synthetic dye commonly used in the paper, ink, and textile industries, and is prohibited for use in food due to its harmful health effects (Anggrahini, 2015) Rhodamine-B contains alkylating compounds ($CH\text{-}CH_3$) which are radical and can bind to proteins that can cause liver damage, and cannot be metabolized in the liver so that these substances will accumulate in fat and will continue to grow (Prastiwi, 2024). Consumption of Rhodamine-B can cause inflammation of the gastrointestinal lining, eye irritation, skin irritation, and airway inflammation, nausea, vomiting, stomach twisting, liver cancer and even death if swallowed. Although it has been banned, its use is still often found in red-colored foods such as crackers, shrimp paste, ground red chili, and drinks (Azmalina Adriani, 2024). Rhodamine-B is still often used as BTP because it can produce striking colors, has a cheaper price than dyes for food, and has a better level of color stability than natural dyes (Pramesthi & Widwiastuti, 2022).

Research in 2019 found that 17% of 205 food samples in traditional markets in Yogyakarta contained harmful additives including Rhodamine-B by the Food and Drug Administration (BPOM), Salamah & Kurniaty, 2022 research found 3 samples (42.8%) of sausages in Yogyakarta markets were positive for Rhodamine-B. Similarly, 15.38% of ku cake samples from Sleman market were found to contain rhodamine-B (Fatimah et al., 2016). In addition, Rahman's research (2023) found that 2 samples of shrimp crackers sold in Godean Market contained Rhodamine-B at 16.67%. These cases prove the rampant use of Rhodamine-B in the culinary world in Yogyakarta City. Based on these previous studies, there has been no research on rhodamine-B content in jam in Yogyakarta City.

Jam is one type of food that is widely consumed by the public, especially among children, teenagers and families. Good jam according to Indonesian National Standard (SNI) 01-3746-2008 has a pH level of 3.5-4.5, maximum water content of 35%, sugar content of at least 55%, ideal pectin content of 0.75%-1.5%, total soluble solids of at least 65%, soft texture, consistent, possess the taste, aroma, and color of natural fruit. One of the most popular type of jams by consumers is strawberry jam (Widya Fatmawati, 2020). The product is often used as a complement to everyday foods, such as bread and other snacks. Jams circulated in the community are often found sold in bulk or commonly referred to as bulk jams. Bulk jam is jam that is sold without a trademark and BPOM number listed on the packaging. In the jam production process, strawberry jam is identical to the color red, the addition of coloring ingredients is often used to increase the color intensity and visual appeal of the product.

Strawberry jam that does not contain rhodamine-B has a characteristic red color following the original fruit and tends not to have uneven color clumps, while jam containing rhodamine-B has a lighter color and usually there are uneven red color clumps (Tias & Rusmalina, 2023). Agustina et al., 2014 research in Medan City showed that there were 2 positive samples of rhodamine-B in jam contained in traded bread.

The Special Region of Yogyakarta, as one of the areas with significant tourism, trade and culinary activities, has become a point of concern to ensure that products circulating in the Yogyakarta City area are safe for consumption. This becomes important to be a concern because of the possibility of using rhodamine-B which can harm consumers. The easy access to the use of rhodamine-B is an opportunity for some producers to use it in jam. Therefore, this study aims to determine whether bulk jam available in the market of Yogyakarta City contains rhodamine-B. The purpose of this identification is to provide both a qualitative and quantitative overview of whether foods that are often consumed by the public contain this hazardous coloring agent.

Rhodamine-B testing generally uses rhodamine-B test kit as a tool for quick identification. However, the rhodamine-B test kit has a weakness in low sensitivity and has the potential to produce false positive or negative results (Chikmah & Maulida, 2019). Meanwhile, there is a rhodamine-B test that can determine rhodamine-B levels to relatively small levels, namely the Ultraviolet-Visible (UV-Vis) spectrophotometry test (Rahmah, 2019). Therefore, in this study, reconfirmation will be carried out using the UV-Vis spectrophotometric test to improve the accuracy of the results.

Based on this background, this study aims to identify rhodamine-B and determine the characteristics of bulk strawberry jam in Yogyakarta City Market. This research is expected to be the first step in the effort to protect consumers from various groups. This protection aims to reduce the health risks caused by the consumption of rhodamine-B. In addition, the results of this study are also expected to provide information to relevant parties for further supervisory action.

2. METHOD

This study was conducted using an observational approach to test the presence and levels of rhodamine-B. Qualitative testing aimed to identify the presence of rhodamine-B through color change reaction, while quantitative testing was conducted to determine the level of rhodamine-B based on the level of light absorption by the sample. In addition to testing rhodamine-B, this study also included analysis of sample characteristics, which included color, pH, and sugar content. These tests aimed to assess the suitability of the samples with the quality

standards set by the Indonesian National Standard (SNI) 01-3746-2008.

Sampling was located in traditional markets in Yogyakarta City. The selection of these markets was due to the large number of red bulk jam traders and their strategic location because they are located in the city center, in tourist areas, and culinary centers. Rhodamine-B content analysis was conducted at the Research Laboratory of the Faculty of Health Sciences, University of 'Aisyiyah Yogyakarta. This research was conducted from April - June 2025, including sampling to the preparation of the research report. This research has received a statement of ethical feasibility from the Health Research Ethics Commission of 'Aisyiyah University Yogyakarta with number No.4560/KEP-UNISA/VI/2025.

The determination of the number of samples in this study was carried out using the Slovin formula. The Slovin formula is $n = N / (1 + (N \times e^2))$, where N is the market population in Yogyakarta City, which is 29 and uses an error tolerance of 10% (0.1). Therefore, $n = 29 / (1 + (29 \times 0.1^2)) = 22.4$ markets, rounded to 24 markets. Meanwhile, the number of food samples was determined using the Lemeshow formula. The Lemeshow formula is $n = (z^2 \times p \times (1-p)) / d^2$. The calculation uses a 95% confidence level (1.96), a proportion estimate of 0.025, and a precision of 10% (0.1). Therefore, $n = (1.96^2 \times 0.025 \times (1-0.025)) / 0.1^2 = 9.36$, rounded to 10 traders with a dropout rate of 10%, resulting in a total sample of 11 traders. We can infer from this computation that there are more marketplaces than traders. Thus, one dealer in each market was sampled for bulk strawberry jam. Market selection was done through simple random sampling technique with the help of randomizer application, while the selection of jam samples used purposive sampling technique. The sampling process considers inclusion and exclusion criteria. The inclusion criteria included traders who sold red-colored bulk strawberry jam in the markets of Yogyakarta City. Conversely, the exclusion criteria included bulk jam traders selling outside the Yogyakarta City market area. However, out of 24 markets, only 12 markets met the inclusion criteria. This limitation was caused by several factors, including three markets (Tunjungsari, Karangkajen, and Ngadikusuman) not providing food, two markets (Terban and Suryobrantan) were not operating, and a number of other markets only sold basic necessities, market snacks, and did not sell bulk jam. Bulk strawberry jam samples were taken within 2 days for 12 samples. The collected samples were stored at room temperature until the samples were analyzed.

The instruments used in this study consisted of qualitative, quantitative, and characteristic tests. The instrument used in qualitative testing used a rapid test kit “Labtest Reagent” with the aim of quickly detecting the presence of rhodamine-B content in bulk strawberry jam samples through a color reaction. Meanwhile, in the quantitative test, the analysis was carried out using

a UV-Vis spectrophotometer instrument that measures the absorbance of rhodamine-B accurately based on the maximum wavelength. In addition, a characteristic test was carried out on jam samples which included observations of color, pH, and sugar content. The pH measurement used a pH meter and sugar content using a refractometer. The characteristic test was conducted to obtain an overview of the overall product quality. All instruments used have been adjusted to the applicable laboratory standards.

The tools used in this study include Rhodamine-B rapid test kit (Labtest Reagent, Jakarta, Indonesia), UV-Vis spectrophotometry (Thermo Scientific, Waltham, United States), stirring rod, funnel (Herma), erlenmeyer (pyrex®), volumetric flask (pyrex®), hotplate (Thermo Scientific, Waltham, USA), glass beaker (pyrex®), filter paper, pH meter (AMTAST, USA), refractometer (AMTAST RHB-080, USA), dropper pipette (pyrex®), test tube rack, test tube (Iwaki), and analytical balance (Kern, Germany). Materials used included distilled water, Rhodamine-B, bulk strawberry jam samples, 37% HCL, and methanol.

Rhodamine-B qualitative test was conducted with reference to the research of Mustamin et al. (2022) with modifications. The modification made refers to Purniati (2015), namely the addition of positive control in qualitative testing. The test was carried out by weighing a sample of 5 grams by dissolving in 10 mL of hot distilled water. A total of 10 mL of solution was transferred into a test tube. Addition of 1 drop of reagent 1 ($SbCl_5$ in HCL 5 N) to the rapid test tool, followed by the addition of 3 drops of reagent 2 (metal benzene). The sample will change color to purplish red or purple if positive for Rhodamine-B after 15 minutes. Positive control in qualitative testing is used to ensure the accuracy of the results by dissolving 50 mg of rhodamine-B in 10 mL of methanol.

Several methods are used to do quantitative testing, including:

1. Rhodamine-B Solution Preparation at 1000 ppm (Khasna et al., 2022)
   After being weighed, 0.1 g of rhodamine-B dye was added to a 100.0 mL volumetric flask along with methanol.
2. Rhodamine-B Solution Preparation at 100 ppm (Khasna et al., 2022)
   Preparation of 100 ppm rhodamine-B solution dissolved with 10 mL of 1000 ppm Rhodamin B solution into a 100.0 mL volumetric flask with methanol as a solvent.
3. Measurement of the Maximum Wavelength (Khasna et al., 2022)
   In order to determine the maximum wavelength, 2.0 mL of a 100 ppm Rhodamine-B solution was dissolved in 50.0 ml of volumetric flask containing methanol to achieve a concentration of 2 ppm. Using methanol as a blank, a spectrophotometer was used to detect the maximum absorbance in the 400–600 nm wavelength range.

4. Determination of Linearity of the Standard Curve (Oktaviani et al., 2022)

   Determination of the linearity of the standard curve using rhodamine-B solution with a concentration of 100 ppm in a volumetric flask with a capacity of 50 mL with consecutive volumes of 15.0 mL, 20.0 mL, 25.0 mL, 30.0 mL, 35.0 mL, and 40.0 mL resulted in concentrations of 30.0 ppm, 40.0 ppm, 50.0 ppm, 60.0 ppm, 70.0 ppm, and 80.0 ppm. Methanol was used as a solvent. Absorption measurements were taken at a wavelength of 550 nm.

5. Sample Testing (Khasna et al., 2022)

   Sample testing was conducted with 5.0 grams of bulk strawberry jam samples placed into a 100.0 mL volumetric flask. The addition of 16 drops of 4 N hydrochloric acid and 30.0 mL of methanol was carried out, followed by a homogenization process. The solution was filtered, with 2.0-5.0 mL of the first filtrate discarded, and filtering was done three times until a clear solution was obtained. The resulting filtrate was collected in a 50.0 mL volumetric flask, and the volume of the solution was adjusted by the addition of methanol, then homogenized. A total of 2.0 mL of filtrate was pipetted and placed into a 25.0 mL volumetric flask, and the volume of the solution was readjusted by adding methanol until it reached the mark line, then homogenized. Absorption measurements were taken at a wavelength of 550 nm.

In accordance with the findings of Masyin et al. (2024), the pH test was conducted using a 5.0 gram jam sample, 10.0 mL of distilled water, and stirring until the mixture was homogenous. The pH meter electrode was inserted into the sample solution, and the sample was then measured by waiting a short while for an accurate pH value reading.

Referring to Kinanti et al. (2023) study, which involved adding 5.0 grams of jam to 10.0 milliliters of distilled water, the sugar content test was carried out. Using a drop pipette, the homogenized jam sample was put on the refractometer's prism surface. Determine the sweetness level of the whole sugar in brix units.

Limit of Detection (LOD), Limit of Quantification (LOQ), and concentration must be calculated in quantitative testing in order to establish the threshold for identifying Rhodamine-B levels (Wijayanti & Rochmah, 2024). The formula (3 × Standard Deviation)/slope used to determine LOD. LOQ was calculated using the formula (10 × Standard Deviation)/slope, and concentration was calculated through (absorbance – a)/slope. The calculated concentration became the basis for determining the results of Rhodamine-B levels (Esati et al., 2023).

3. RESULTS AND DISCUSSION

A. Qualitative Analysis of Rhodamine-B Content

The samples used in this study amounted to 12 samples of bulk strawberry jam with codes S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, and S12. Identification of Rhodamine-B content in 12 samples of bulk strawberry jam qualitatively by rapid test with two repetitions. Rhodamine-B qualitative test results can be seen in Table 1.

Table 1. Qualitative Test of Samples

Sample	Color Change		Picture		Description
	P1	P2	P1	P2	Positive/Negative
Positive Standard	There is a change in color	There is a change in color			Positive
1	There is no color change	There is no color change			Negative
2	There is no color change	There is no color change			Negative
3	There is no color change	There is no color change			Negative
S4	There is no color change	There is no color change			Negative
S5	There is no color change	There is no color change			Negative
S6	There is no color change	There is no color change			Negative
S7	There is no color change	There is no color change			Negative
S8	There is no color change	There is no color change			Negative
S9	There is no color change	There is no color change			Negative
S10	There is no color change	There is no color change			Negative
S11	There is no color change	There is no color change			Negative
S12	There is no color change	There is no color change			Negative

Qualitative analysis of the presence of rhodamine-B was carried out using the rhodamine-B rapid test kit (Labtest Reagent, Jakarta, Indonesia). The rapid test kit consists of two reagents, namely reagent 1 which contains a solution of $SbCl_5$ in HCL 5 N and reagent 2 which contains toluene or more commonly known as metal benzene. The working principle of the rapid test kit is based on the red color change that occurs due to the interaction between rhodamine-B and the antimony salt contained in reagent 1 (Khasna et al., 2022) and the color change to purple after rhodamine-B also reacts with metal benzene (Hikma et al., 2021). One important aspect in testing rhodamine-B qualitatively is the sample extraction process using hot distilled water. The addition of hot distilled water serves to dissolve rhodamine-B into the water phase, making it easier to detect the compound in the next stage of analysis (Irnawati, 2016).

According to test results, every sample taken from 12 local markets in Yogyakarta City produced negative results. This is demonstrated by the sample's lack of color change following the addition of both kinds of reagents from the quick test kit. This result is consistent with the findings of Widwiastuti's research (2022), which found that bulk strawberry jam in the Magetan market area had no rhodamine-B content and had typical bright colored characteristics. This demonstrates how producers and traders adhere to food safety regulations. The unbranded bulk strawberry jam that is being sold may also be a repackaging of huge branded packaging that is already widely available on the market.

B. Quantitative Analysis of Rhodamine-B Content

The samples used in this study amounted to 12 samples of bulk strawberry jam with codes S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, and S12. Identification of Rhodamine-B content in 12 bulk strawberry jam samples quantitatively by UV-Vis spectrophotometry. The first step of quantitative testing is to determine the maximum wavelength. The results of the maximum wavelength determination can be seen in Figure 1.

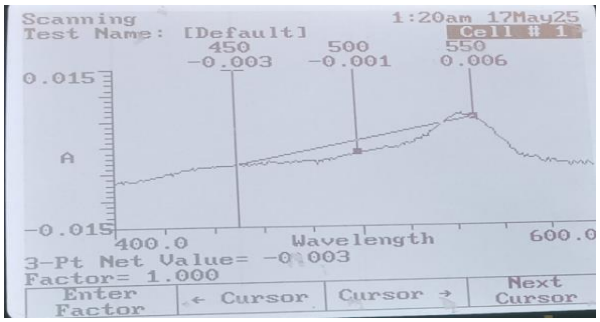

Figure 1. Maximum Wavelength

Maximum wavelength measurements were taken three times, with methanol as the solvent. The maximum wavelength was measured in the range of 400-600 nm. According to Hidayat et al. (2016) the light beam at a wavelength of 400-600 nm experienced a fairly high absorption and directly proportional to the magnitude of rhodamine-B levels. Determination of the maximum wavelength is done to obtain a wavelength with maximum measurement sensitivity to rhodamine-B compounds, so as to minimize the possibility of measurement errors (Lukitasari & Yugatama, 2017). Based on the measurement of the standard solution, the maximum wavelength of 550 nm was obtained. The maximum wavelength value of rhodamine-B is also supported by the results of research by Oktriana et al. (2022) which showed that the maximum wavelength of rhodamine-B is 550 nm.

The results of the maximum wavelength measurement were used for the preparation of a standard curve. The standard curve was obtained through the dilution process of rhodamine-B standard solution with varying concentrations with a solvent in the form of methanol. The concentration of rhodamine-B standard solution used includes 30 ppm, 40 ppm, 50 ppm, 60 ppm, 70 ppm, and 80 ppm. The absorbance value of each rhodamine-B solution can be seen in Table 2.

Table 2. The Rhodamine-B Standard Curve's Absorbance Data

Concentration	Absorbance
30	0,190
40	0,218
50	0,283
60	0,344
70	0,384
80	0,443

The rhodamine-B standard curve is then calculated using the received absorbance value data in order to ascertain the value of the correlation coefficient (R^2) and the linear regression equation y = bx + a. According to the data, concentration and absorbance have a linear relationship. According to the computation findings, y = 0,0055x + 0,0082 is the regression line

equation that was produced, and the correlation coefficient (R^2) was 0,9956. The coefficient value satisfies the predetermined threshold, which is r ≥ 0,98 or near to 1 (Kamu, 2024).

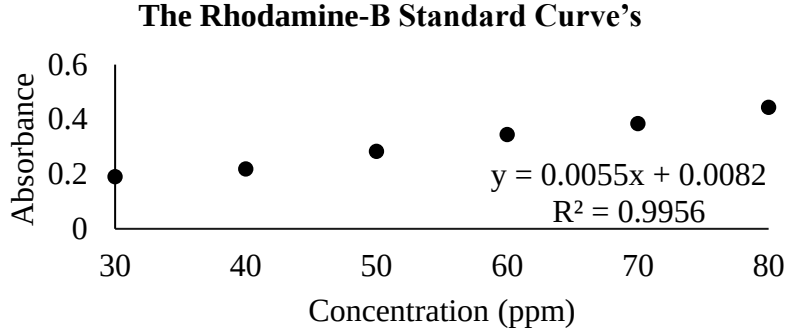

Figure 2. The Rhodamine-B Standard Curve's

The linear regression equation of the standard curve can be used to calculate the Limit of Detection (LOD) and Limit of Quantification (LOQ) values. LOD and LOQ function as the smallest concentration measurement limit of an analyte that can still be detected and quantified with an acceptable level of accuracy and accuracy at the time of measurement (Ramadhan & Musfiroh, 2021). The results of the calculation of LOD and LOQ values are presented in Table 3. The calculation results show that the LOD value is 5,6 ppm and LOQ is 18,7 ppm. Thus, samples with concentrations below these values cannot be declared to contain rhodamine-B (Esati et al., 2023).

Table 3. Method Validation Test

LOD	LOQ
5,6 ppm	18,7 ppm

Rhodamine-B levels in the bulk strawberry jam samples were calculated using the linear regression equation y = 0,0055x + 0,0082. However, if the sample concentration is below the LOD and LOQ values, then the sample cannot be declared positive for rhodamine-B, so no further calculation of rhodamine-B levels is required. Table 4 displays the results of the sample testing using UV-Vis spectrophotometry.

Table 4. Quantitative Test of Rhodamine-B

Sample	Weighing (g)	Concentration (ppm)
S1	5,0091	1,8
S2	5,0074	0,1
S3	5,0105	0,2
S4	5,0080	0,8
S5	5,0050	1,1
S6	5,0088	0,4
S7	5,0001	-0,9
S8	5,0098	0,4
S9	5,0111	1,8
S10	5,0043	-0,6
S11	5,0096	2,1
S12	5,0217	5,5

Quantitative testing was conducted to strengthen and confirm the results of the qualitative tests. Quantitative testing was conducted using UV-Vis spectrophotometric method. The purpose of this test was to determine the level of Rhodamine-B in the sample. According to Esati et al. (2023), if absorbance measurements are made at or above the LOD and LOQ limits, then the sample can be declared detected, and the analysis results still have an accurate level of accuracy. Conversely, if the measurement is carried out below the LOD and LOQ limits, then the presence of Rhodamine-B in the sample cannot be confirmed or is considered undetectable. If the analyte concentration is below the detection limit, the signal captured by the device is entirely noise, so the measurement accuracy becomes very low (Naschan et al., 2017). Based on this statement, it can be used as a reference that the results showed no Rhodamine-B content in all samples analyzed because the concentration was still far below the LOD and LOQ limits. The absorbance range of the samples studied ranged from 0.001 to 0.046. According to Alawiyah et al. (2022) the absorbance value that indicates the presence of Rhodamine-B content in the sample is in the range of 0.2 to 0.8. Therefore, it can be concluded that the samples tested did not contain Rhodamine-B because the absorbance values obtained were outside the range.

Based on the results of the sample concentration calculation in Table 4, there are two samples that show negative concentration values. Negative or minus concentration values indicate that Rhodamine-B is not detected in the sample. This can be caused by the low concentration of the sample extract obtained, so that the absorbance value is smaller than the constant value and can produce a concentration below zero (Khumaeni et al., 2021).

C. Characteristics of the Sample

Characteristic testing is the analysis of the properties of a sample, which includes physical, chemical, and biological properties (Muslim et al., 2023). Characteristic tests on bulk strawberry jam samples include color, pH, and sugar content with as many as two repetitions. The results of the sample characteristics test can be seen in Table 5.

Table 5. Sample Characteristic Test

Sample	Color	pH	Sugar Content (%brix)
S1	Dark red	4.05	28
S2	Light red	4.07	32
S3	Dark red	4.04	31
S4	Dark red	4.04	64
S5	Dark red	4.01	32
S6	Light red	4.04	41
S7	Translucent red	4.05	63
S8	Dark red	4.07	65
S9	Dark red	4.05	31
S10	Light red	4.06	42
S11	Light red	4.03	43
S12	Dark red	4.06	40

Based on the research results presented in Table 5, 12 samples taken from local markets in Yogyakarta City show that all samples have a pH that meets the pH range required by the Indonesian National Standard (SNI) 01-3746-2008, ranging from 3.5 to 4.5. The pH value is very influential on gel formation, a pH that is too high can cause the gel to become stiff, while a pH that is too low can result in syneresis (Natalia et al., 2022). In addition, pH measurement is also closely related to food safety aspects, because an appropriate pH can prevent the growth of harmful microorganisms, such as pathogenic bacteria that can cause food poisoning. A low pH causes jam to become a less favorable medium for the growth of potentially harmful microorganisms (Kinanti et al., 2023).

According to SNI 01-3746-2008, a good sugar content in jam products is at least 55% in Brix units. Refractometers measure total sugar content and do not measure sugar by type (Malainine Hesna et al., 2020). Based on the results of the study, of the total samples analyzed, there were 9 out of 12 jam samples that had sugar levels below the threshold, while the other 3 samples met the standard provisions. This indicates that non-compliant samples outnumber those that meet the standard. However, a low sugar content as measured by refractometer does not necessarily mean that it does not contain synthetic flavors such as artificial sweeteners. Malainine Hesna et al. (2020) stated that samples containing artificial sweeteners tend to have low Brix values. This is because synthetic sweeteners are usually used in small amounts due to their high sweetness intensity.

Sugar content affects the quality of color, spreadable texture, and taste preferred by panelists (Pistanty & Natassia, 2019). Low sugar content tends to produce a lighter jam color, while high sugar content will give a darker color (Adna Ridhani & Aini, 2021). The color is formed through the process of caramelization or browning reactions that occur due to chemical reactions between sugar and amino acids from proteins (Pistanty & Natassia, 2019). This makes the color of each sample different. In addition, sugar content also affects the shelf life of jam, considering that sugar acts as a natural preservative that can inhibit the growth of microorganisms, thus extending the shelf life of the product (Pratama, 2023). According to Pratama (2023), jam with low sugar content is more likely to be used as a medium for microorganism growth, therefore jam with low sugar content should be stored in a refrigerator with a temperature of ≤4°C to inhibit the growth of microorganisms. In contrast, jam with high sugar content has natural preservatives in the form of sugar that can inhibit the growth of microorganisms and extend the shelf life of the product even though it is stored at room temperature.

Characteristic testing in terms of color found no striking red color, color inhomogeneity, or color clumps in the product. This condition has met the quality requirements based on SNI 01-3746-2008, which states that good quality jam has a color that matches the color of the original fruit. These results are also in line with the findings of research by Widiantara & Hasnelly (2020), which states that the characteristics of food products containing Rhodamine-B include striking colors, unevenness, and the presence of color clumps in the product.

Based on the results of Rhodamine-B content research using rapid test kit and UV-Vis spectrophotometry, the same results were obtained, namely the absence of Rhodamine-B content in the bulk strawberry jam samples studied. This was further strengthened by the results of the characteristic test which showed that there was no striking color, unevenness, and color clumps such as products that were positive for Rhodamine-B. Similarly, samples S7 and S10 with negative concentration had an initial color that was not striking when compared to other samples as mentioned in Table 5. The color faded during dilution, resulting in a low absorbance value. The low absorbance value makes the sample concentration calculation results negative.

The results of the three tests showed a high level of compliance of jam producers in Yogyakarta City with the prohibition of the use of harmful synthetic dyes, which was characterized by the absence of Rhodamine-B content in all jam samples studied. Nevertheless, there are still food products that contain Rhodamine-B as in Salamah & Kurniaty (2022) found 3 samples of sausages in Yogyakarta markets positive for Rhodamine-B, Fatimah et al. (2016) found samples of ku cakes from Sleman Market proved to contain Rhodamine-B, and Rahman's

research (2023) found 2 samples of shrimp crackers sold in Godean Market contained Rhodamine-B. Therefore, continuous testing is still the right step to ensure consistency in the implementation of safe production practices and collaboration between the competent authorities and business actors is needed in carrying out regular supervision.

4. CONCLUSION

Based on the results of the study, it can be concluded that no abnormal color characteristics were found in all samples. The pH value of all samples also met the quality requirements based on SNI 01-3746-2008, which is in the range of 3.5 to 4.5. However, there were 9 samples that had sugar content below the SNI standard, which is less than or equal to 55% in Brix units. The results of Rhodamine-B content testing using rapid test kit and UV-Vis spectrophotometry showed that all bulk strawberry jam samples obtained from local markets in Yogyakarta City did not contain Rhodamine-B. Qualitative analysis using rapid test kit as well as quantitative analysis using UV-Vis spectrophotometry yielded negative results on the presence of Rhodamine-B, indicating that both test methods gave harmonized results. The results of the qualitative and quantitative tests are further strengthened by the characteristic test in terms of color, which means that the three tests prove that there is no Rhodamine-B content in the bulk strawberry jam samples circulating in local markets in Yogyakarta City.

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