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Analysis of Borax Contaminants in Sempol Snacks in Gonilan Village Kartasura

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ABSTRACT

Sempol is a snack made from processed meat and quite popular among the public. In its manufacture, there is still a lot of misuse of prohibited additives, one of which is borax, in order to obtain a more supple shape and a longer shelf life. This study aims to analyze borax qualitatively and quantitatively in sempol snacks which is circulating in Gonilan Kartasura Village. The qualitative method using turmeric paper and the quantitative method using UV-Vis spectrophotometry. The qualitative results showed that two of the seven samples were identified contaminated with borax. The quantitative results showed that the level of borax in sample were 101,55±0,75 and 166,69±0,67 mg/g.

***KEYWORDS**: Borax; Sempol; UV-Vis Spectrophotometry*

INTRODUCTION

An additive that can alter the nature or form of food is known as a food additive. Government had been regulate the use of food additive including types of materials and maximum usage level, and prohibit the use of hazardous materials. One of the dangerous ingredients that are prohibited from being used in food is borax (BPOM, 2019) (Kemenkes, 2012). The government has banned the use of borax as a food additive in Regulation of the Minister of Health Number 033 of 2012 because of it is toxic and harmful to humans.

Borax can be harmful to human health because it can be carcinogenic in human organs such as the kidneys, brain, kidneys, and testes (Damopolii, 2015). This was confirmed by the results of a literature study that reported cell damage in the kidneys and liver of white rats given borax as a toxic substance. The higher dose administered, also higher the toxicity effect (Oktavia, 2021).

Previous study on samples of meat snacks around the campus Muhammadiyah Surakarta University in Kartasura, reported that 4 of 31 positive samples contained borax, including sempol snacks (Larasati,

2019). The campus is located near Gonilan Village, Kartasura. Based on this background, the author is interested in conducting an analysis of the borax content in sempol snacks sold in Gonilan Village, Kartasura.

MATERIAL AND METHODS

Chemicals and Instrument

The materials in this study were samples of sempol snacks, borax (Merck), 5 N HCl, distilled water (Merck), 10% NaOH (Merck), 0.125% curcumin solution (Merck), sulfuric acid solution (Merck), glacial acetic acid (Merck), 96% ethanol p.a. (Merck), Whattman paper No. 1, litmus paper, and filter paper.

The sampling was conducted using the total sampling method, where the entire population was taken as the sample. From the sample collection, a total of 7 sempol snack samples were obtained, which were then labeled as A, B, C, D, E, F, and G.

The tools in this study were a UV-Vis spectrophotometer (Genesys), glassware (Pyrex), an analytical balance (AND GF-300), a water bath (Memmert), a refrigerator (LG), an electric stove (Miyako), and a centrifuge (Merck).

Qualitative Test

Turmeric Paper Preparation

Turmeric paper was made using 10 grams turmeric simplicia, sorted, macerated in 60 mL of 90% ethanol for seven days, and then filtered. Whatman No. 1 filter paper is dipped into the turmeric solution for a few moments until the solution is completely absorbed on the paper and then dried (Depkes, 1979) (Rz & Yandra, 2017).

Identify borax with turmeric paper

Positive control test: 100 mg of borax was weighed, and then 50 mL of distilled water was added. The solution was dripped onto turmeric paper and dried. Negative control test: sempol was made with commonly used ingredients but without the addition of borax.
sampel test: 10 grams of sample were added to distilled water 1:10, blended, and filtered through filter paper. Then the filtrate was acidified with 5 N HCl, dripped onto turmeric paper, and then dried. After he paper is dry, observed the color. Sample is positive borax if paper test is matched with positive control test (Fadilah, Djatmika, & Muadifah, 2019) (Harimurti & Setiyawan, 2019) (Suseno, 2019).

Verification of Quantitative Analysis

Linearity

Standard borax solutions with concentrations of 20 ppm, 25 ppm, 30 ppm, 35 ppm, and 40 ppm have been prepared. Their absorbance is measured using a spectrophotometer at the maximum wavelength for three times. The absorbance results for each concentration are averaged. A calibration curve is constructed to calculate the value of R^2 by plotting the x-axis (standard concentration) against the y-

axis (average absorbance) (Fadilah, Djatmika, & Muadifah, 2019).

Limit Of Detection (LOD) and Limit Of Quantification (LOQ)

Based on the calibration curve results, the values of LOD and LOQ can be calculated from the residuals standard deviation and the slope (b) in the equation of the line y = bx + a (Harmita, 2004).

Precision

A standard borax solution with a concentration of 30 ppm was prepared and the absorbance was measured six times. The absorbance data obtained is then used to calculate the relative standard deviation (RSD) value (Harmita, 2004) (Azas, 2013).

Accuracy

The accuracy test is using a simulation method by adding the analyte at concentrations of 20 ppm, 30 ppm, and 40 ppm to negative samples. The absorbance is measured three times for each concentration, and the % recovery value is calculated (Harmita, 2004) (Azas, 2013).

Quantitative Test

Maximum Wavelength Determination

The maximum wavelength was determined with 30 ppm borax solution. Put 1 mL of solution and 1 mL of 10% NaOH into a cup. Heat the cup on a waterbath till dried and cooled in a refrigerator. Then, 3 mL of 0,125% curcumin solution is added. Heat and stir for 5 minutes, and then cooled again in a refrigerator. 3 mL of sulfuric acid:acetic acid (1:1) mixture was added, then heated while stirring until all the sediment dissolves. It was allowed to stand at room temperature for 15 minutes. A few drops of 96% ethanol were added and the mixture was filtered using filter paper. The solution was then placed into a 100-mL volumetric flask and diluted with 96% ethanol up to the mark and measured for three times at a wavelength of 400–600 nm (Winarsih, 2018) (Fadilah, Djatmika, & Muadifah, 2019) (Sudjarwo, Poedjiarti, & Angerina, 2021).

Operating Time

The operating time was measured in a 30 ppm borax solution. Put 1 mL of solution and 1 mL of 10% NaOH into a cup. Heat the cup on a waterbath till dried and cooled in a refrigerator. Then, 3 mL of 0,125% curcumin solution is added. Heat and stir for 5 minutes, and then cooled again in a refrigerator. 3 mL of sulfuric acid:acetic acid (1:1) mixture was added, then heated while stirring until all the sediment dissolves. It was allowed to stand at room temperature for 15 minutes. A few drops of 96% ethanol were added and the mixture was filtered using filter paper. The solution was then placed into a 100-mL volumetric flask and diluted with 96% ethanol up to the mark and measured for three times at a maximum wavelength. The absorbance was measured in the time range of 25 to 90 minutes (Winarsih, 2018) (Fadilah,

Djatmika, & Muadifah, 2019) (Sudjarwo, Poedjiarti, & Angerina, 2021).

Standard Curve Preparation

The standard borax solutions was made with concentrations of 20 ppm, 40 ppm, 60 ppm, 80 ppm, and 100 ppm. Put 1 mL of each consentration and 1 mL of 10% NaOH into a cup. Heat the cup on a waterbath till dried and cooled in a refrigerator. Then, 3 mL of 0,125% curcumin solution is added. Heat and stir for 5 minutes, and then cooled again in a refrigerator. 3 mL of sulfuric acid:acetic acid (1:1) mixture was added, then heated while stirring until all the sediment dissolves. It was allowed to stand at room temperature for 15 minutes. A few drops of 96% ethanol were added and the mixture was filtered using filter paper. The solution was then placed into a 100-mL volumetric flask and diluted with 96% ethanol up to the mark. Their absorbance is measured using a spectrophotometer at the maximum wavelength for three times. The absorbance results for each concentration are averaged, and a standard curve is created by plotting the x-axis (standard concentration) against the y-axis (average absorbance). The standard curve equation y = bx+a is used to calculate the concentration of borax in the sample (Winarsih, 2018) (Fadilah, Djatmika, & Muadifah, 2019).

Sample Absorbance Measurement

A 5 gram sample is added to 100 mL of aquadest and then homogenized. Then it is centrifuged for 2 minutes at a speed of 3000 rpm to obtain a clear sample solution. Put 1 mL of the supernatant and 1 mL of 10% NaOH into a cup. Heat the cup on a waterbath till dried and cooled in a refrigerator. Then, 3 mL of 0,125% curcumin solution is added. Heat and stir for 5 minutes, and then cooled again in a refrigerator. 3 mL of sulfuric acid:acetic acid (1:1) mixture was added, then heated while stirring until all the sediment dissolves. It was allowed to stand at room temperature for 15 minutes. A few drops of 96% ethanol were added and the mixture was filtered using filter paper. The solution was then placed into a 100-mL volumetric flask and diluted with 96% ethanol up to the mark. The prepared sample was measured at 400-600 nm using a UV-Vis spectrophotometer with 3 replicates (Winarsih, 2018) (Fadilah, Djatmika, & Muadifah, 2019) (Sudjarwo, Poedjiarti, & Angerina, 2021).

RESULTS AND DISCUSSION

Qualitative Test

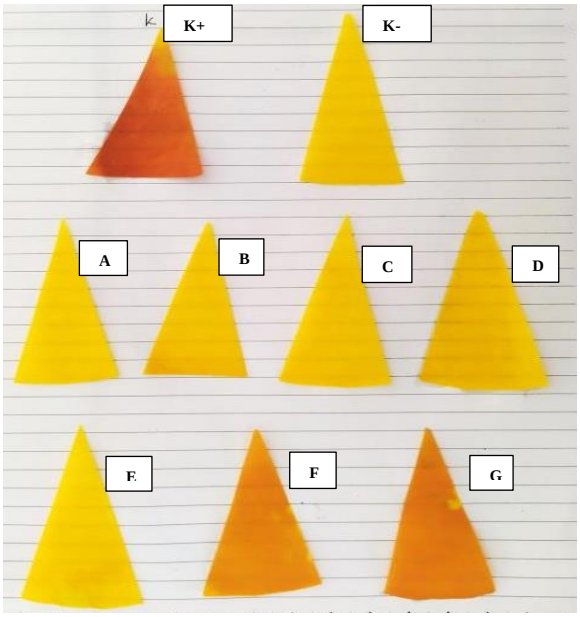

Figure 1. Results of Sample Filtrate Drops on Turmeric Paper
(K+ : positive control; K- : negative control; A-G : Sempol snack sample)

The results of qualitative test showed that samples F and G had a reddish-brown color, and difference with the negative control. The color in the positive control was darker compared to the color in samples F and G. This indicates that the borax content in the samples was lower than in the positive control. The reddish-brown color change (rosocyanin) occured due to a reaction between curcumin on turmeric paper and boric acid contained in the sample (Rusli, 2009) (Harimurti & Setiyawan, 2019) (Suseno, 2019).

Method Verification

Method verification was aimed at ensuring that the procedure to be used still met the requirements. This was expected to ensure the quality of measurement data results in research activities (Irawan, 2019). The results of the method verification which were tested on various parameters can be observed in the following table:

Table 1. Parameter of Verification Method

Parameter	Calculation Formula	Calculation Results	Acceptance Criteria
Linearity	A standard curve is made by entering the x-axis (standard concentration) and y-axis (average absorbance) and finding R^2.	y = 0,0058x+0,177 R^2 = 0,993.	$R^2 \geq 0,99$ (Riyanto, 2014; Winarsih, 2018)
Limit Of Detection **(LOD) and** ***Limit Of Quantification*** **(LOQ)**	LOD = 3.(Sy/x)*/slope(b) LOQ = 10.(Sy/x)*/slope(b)	3,27 ppm 10,90 ppm	-
Precision	% RSD = (standard deviation/average absorbance) x 100%	% RSD = 0,43%	≤ 2% (Harmita, 2004; Winarsih, 2018)
Accuracy	% Recovery = (regression concentration(x)/actual concentration) x 100%	% *recovery* = 98,79% ± 1,69.	96-105% and some argue between 80-120% (Harmita, 2004; Fadilah et al., 2019)

* Residual standard deviation

Quantitative Test

Maximum Wavelength

The maximum wavelength result in this study was 547 nm with an absorbance of 0,350. These results are same as previous studies, which also reported that the maximum wavelength of borax obtained was 547 nm (Sudjarwo, Poedjiarti, & Angerina, 2021). The other study stated that the maximum wavelength of borax obtained was 541 nm (Fadilah, Djatmika, & Muadifah, 2019).

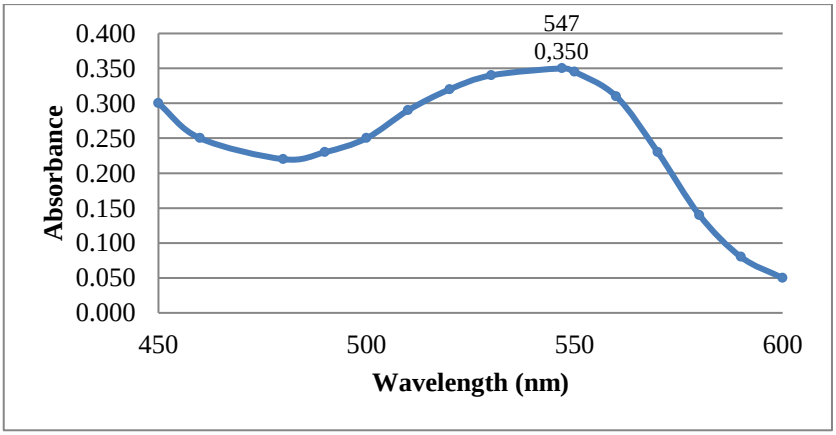

Figure 2. Graph of Absorbance vs Wavelenght

Operating Time

The operating time obtained in this study was 75 minute. Previous study stated that the optimal time for color stability in the reaction between borax and 0,125% curcumin is 70 minute (Sudjarwo, Poedjiarti, & Angerina, 2021). The stability of the color complex formed by curcumin reagent in acidic conditions can only be maintained for 2 hours (Azas, 2013). The operating time graph showed in the following figure.

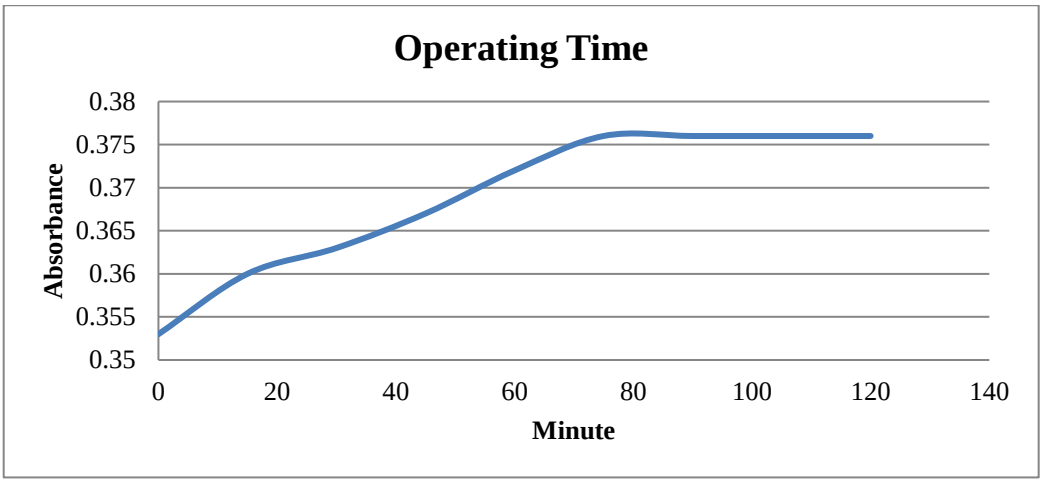

Figure 2. Operating Time of Borax Analysis

Borax standard curve

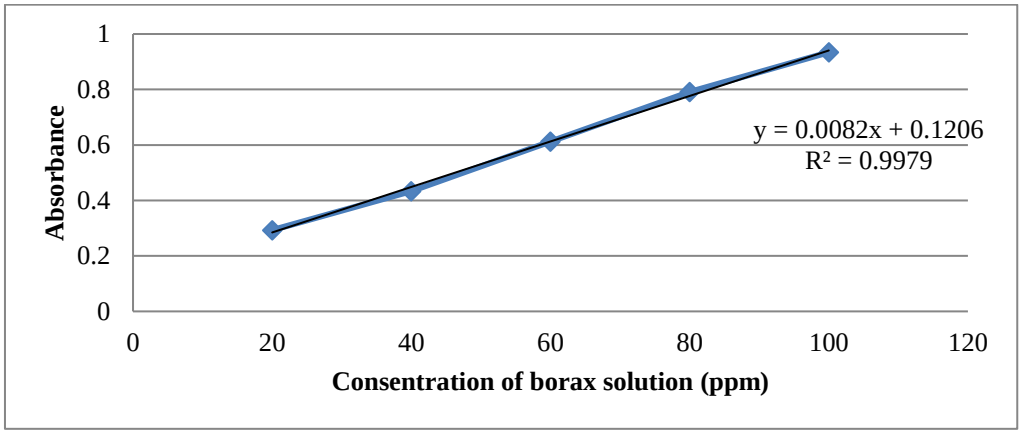

Figure 3. Sandard Curve of borax solution

The standard curve equation of borax solution is y = 0,0082x+0,1206 (R^2=0,9979). The equation is used to calculate the borax content in sempol snack samples.

Sample Absorbance Measurement

Samples that can be analyzed using UV-Vis spectroscopy are those that have chromophore and auxochrome groups. If the sample does not have chromophore groups and is colorless, it needs to be reacted with a specific reagent to form a color complex. The absorbance of this color complex could

be measured at a visible wavelength (Harmita, 2006) (Gandjar & Rohman, 2007). Borax is a compound that does not have chromophore groups, and the result of the solution is colorless. To be measurable using UV-Vis spectrophotometer, during the preparation, the borax solution is reacted with a 0,125% curcumin reagent to obtain the rosocyanin color complex (Azas, 2013).

Table 2. Borax Concentration In Sempol Samples

Sample	Average of Absorbance	Average of Borax content (mg/g sample)
F	0,537	101,55±0,75
G	0,804	166,69±0,67

From the results of this study, the concentration of borax in the sempol snack samples that is circulated in Gonilan Village, Kartasura was high. This is dangerous if consumed continuously by the public especially children, whose immune systems are lower than adults. Previous study on samples of meat snacks around Muhammadiyah Surakarta University, reported that 4 of 31 positive samples contained borax, including sempol snacks (Larasati, 2019). A similar study found that 22 of 25 samples of sempol snacks circulating in the Sukolilo District Elementary School Surabaya, were positive for borax (Hardinata et al., 2018). Another study found that 3 of 10 samples of sempol snacks in Tulungagung were positive for borax, with the highest concentration of 37,2±0,2584 ppm (Winarsih, 2018). The results of another study in Tulungagung using the UV-Vis spectrophotometric and centrifugation preparation method stated that one of the three samples of sempol snacks that positive for borax with concentration of 18,6±0,043 ppm (Fadilah, Djatmika, & Muadifah, 2019).

Borax is toxic to all living cells and affects the organs of the body depending on the concentration achieved in these organs. In the human body, the highest levels of substances are obtained during the excretion process, so the kidneys are the organs most affected compared to other organs. The highest dose that poisoned and even death in adults is 10–20 g/kgBW, and in children it is 5 g/kgBW (Saparinto & Hidayati, 2006). According to previous study, the borax solution from doses 20-600 mg/kgBW of white rats for a period of 10 days to 4 weeks, showed cell damage in the liver and kidneys. The toxic effects of borax increased with higher dose and longer duration of administration (Oktavia, 2021). If that doses are converted into human doses, borax with doses of 1,12-33,60 g/kgBW with the same administration period also has the potential to damage human liver and kidney cells.

There is still a lot of abuse of borax in food market because the lack of knowledge of manufacturer about the dangers of borax

on the human body. Furthermore, to achieved the highest profits, various efforts are made by manufacturer to make the food visually appealing, and increasing its appeal to consumers. Includes adding borax to the food, which could made it more durable and have a better texture (Larasati, 2019) (Santi, 2017).

The government has banned the use of borax as a food additive in Regulation of the Minister of Health Number 033 of 2012 without a maximum limit of usage. This means that regardless of the amount of borax added to food, it is still considered a violation of the regulation. Although the borax concentrations in this study did not reach toxic levels, consumption of borax continously remains hazardous to the human body.

CONCLUSION

Based on the results of this study, could be concluded that there are two of seven samples of sempol snacks in Gonilan village Kartasura that contain borax. The borax content in the two samples was 101,55±0,75 mg/g and 166,69±0,67 mg/g.

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