IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 7, Issue 6 (Nov. – Dec. 2021), PP 16-19
www.iosrjournals.org

Analysis of Formalin Content by Some Types of Food Materials Using UV-Vis Spectrophotometry Method

Efbertias Sitorus[1], Lince Romauli Panataria[2]
[1](Department of Agriculture, Universitas Methodist Indonesia, Indonesia)
[2](Department of Agriculture, Universitas Methodist Indonesia, Indonesia)

Abstract:
Spectrophotometry is a measurement of an interaction between electromagnetic radiation and molecules or atoms of a chemical substance. Visible Spectrophotometry method can be used to determine the levels of formalin preservatives in food. Formalin in the presence of Cromatropat acid in sulfuric acid accompanied by heating for a few minutes will result in violet staining. When the compound is heated with Cromatropat acid in a concentrated sulfuric acid solution, it will form a violet color. This reaction occurs based on the condensation of formaldehyde with the aromatic system of Cromatropat acid, forming a colored compound (3,4,5,6-dibenzoxanthylium). The staining is due to the formation of carbenium - oxonium ions which are stable due to mesometry. Formalin absorbance can be measured at a wavelength of 568.54 nm. Optimizations carried out in this study include determining the maximum wavelength, determining the effect of acid in formalin analysis, formalin analysis and determining the linearity of formalin concentration. The optimum experimental condition is a solution of H_2SO_4 pH 3 to obtain a calibration curve linear regression equation $y = 0.209x + 0.060$ at a price of $R^2 = 0.991$. In the development of spectrophotometric detection, formalin in an acid environment is better seen from the color stability, maximum wavelength, and the resulting linearity.

Key Word: *Formalin, Food, Presevative, UV-Vis Spectrophotometry*

Date of Submission: 15-12-2021 Date of Acceptance: 31-12-2021

I. Introduction

Increasing the quality of human resources is determined by the quality of the food consumed. Law No. 7 of 1996 states that the quality of food consumed must meet several criteria, including being safe, nutritious, of good quality, and affordable by the people's purchasing power. Safe as meant here includes being free from biological, microbiological, chemical and heavy metal pollution.[7]

Preservatives are one of the most commonly used food additives. Food additives (additives) are intended for several functions for example, preservatives used to increase the shelf life of food products and antioxidants used to protect food against oxidation which can cause food to go rancid. According to the Regulation of the Minister of Health of the Republic of Indonesia Number: 033 of 2012 concerning Food Additives, preservatives are food additives to prevent or inhibit fermentation, acidification or other decomposition of food caused by microorganisms. Preservatives permitted for food include benzoic acid, Na-benzoate, K-benzoate, propionic acid, sorbic acid and their salts. The allowable dosage for these preservatives varies depending on the nature of the product. Preservatives that are not allowed to be added to food products include formalin, borax, boric acid and salicylic acid.[5]

One of the dangerous chemicals that is often used in the preservation of processed food is formalin. Today, we find many processed foods in the community, such as noodles, meatballs, porridge, pudding, nuggets, milk, corned beef, fish, and others. We should pay attention here, these foods definitely need preservatives, because to produce these food products in large quantities, it is impossible without using preservatives. A product is potentially free from preservatives, if its shelf life is relatively short, which ranges from three to four days. Worryingly, in some foodstuffs, formalin is still found which is used as a preservative.[4]

Formalin abuse is due to economic motives. The use of formalin hazardous materials in food products will cause these products to last a long time. Another factor of using this material is to increase the durability of the product, where fresh food at room temperature can only last 1-2 days, but by adding formalin it can last a long time and is very profitable for the seller. The purpose of formalin abuse is, among others, for efficiency because this hazardous material is cheap, easy to obtain and only by adding a little to food products can get good and maximum results.[1]

II. Material And Methods

The tools that will be used in this research are UV-Visible spectrophotometer, cuvette, analytical balance, *hot plate, thermometer*, and glassware commonly found in chemistry laboratories. The materials used in this study were all pro-analytical (PA) and dissolved directly without purification, namely, solution formaldehyde, H_2SO_4, Cromatropat acid, and aquades.

The initial stage of the study includes the process of collecting food samples at traditional markets in Medan City. There were 10 samples of food ingredients taken from traders in the traditional market of Medan City. Food samples were tested qualitatively by the Cromatropat acid method. Samples that are positive for formalin will be tested quantitatively by UV-Vis spectrophotometric method.

Samples are ground until smooth, each sample is weighed as much as 5 g and then dissolved in ± 50 mL of distilled hot water (80^o C). Then the solution was heated for 30 minutes to ensure that all formaldehyde present in the sample had dissolved in the solvent. The solution was then centrifuged at 3000 rpm for 20 minutes to separate the precipitate and the filtrate and to purify the solution, the filtrate obtained was added with reagent Cromatropat acid and H_2SO_4 at the optimum pH and reheated for 15 minutes. The sample is ready to be analyzed by using the spectrophotometric method.

After the optimum conditions for each - each parameter in advance, do determination of formaldehyde in food samples. By calculating the standard curve, the concentration of formaldehyde in food is known. After obtaining the calibration curve, the concentration of formaldehyde in the sample can be determined by converting the absorbance obtained from each sample levels Formaldehyde in samples.[5]

III. Result and Discussion

3.1 Formaldehyde optimization

The principle of analysis is based on the determination of the levels of organic compounds that have a chromophore structure or contain a chromophore group, and absorb ultraviolet radiation. Determination of levels is done by measuring the absorbance at the maximum wavelength (peak curve), in order to provide the highest absorption for each concentration. The optimized parameters were the effect of acid on the sensitivity of the formaldehyde solvent, the calibration curve of the standard solution, the effect of the disturbance on the determination of formaldehyde and the determination of formaldehyde in food samples. Determination of working time was carried out by reacting 1 mL of standard solution of formaldehyde 5 g/mL with 3 mL of Cromatropat acid then diluted using H_2SO_4 optimum pH to the limit mark of 10 mL and heating for 15 minutes, after which the absorption was measured at the maximum wavelength that previously obtained at 1-20 minute intervals. Optimum working time is obtained from the highest absorbance value.

3.2 Effect of pH on Sensitivity

The effect of acid on formaldehyde analysis was carried out using a solution of H_2SO_4 as a solvent. The effect of H_2SO_4 as a solvent is seen from the maximum wavelength given for each H_2SO_4 and the resulting calibration curve. Determination of the maximum wavelength was measured using a standard solution of formaldehyde with a concentration of 1 g/mL (V = 100 L) then reacted with 3 mL of Cromatropat acid and a color was formed which was diluted in a 10 mL volumetric flask with the solvent H_2SO_4 pH 3, 4, and 5 and then heated in a water bath temperature of 80°C for 15 minutes. After that, the absorbance was measured at a wavelength of 500-600 nm.

The effect of acid pH on sensitivity was determined by dissolving formaldehyde in various atmospheres, namely solvent H2SO4 pH 3, 4 & 5. Then the wavelength and absorbance were measured in each atmosphere, using UV-VIS spectrophotometry. The effect of pH at the maximum wavelength of each pH (pH 3, 4, and 5) on the absorbance of the solution at each concentration of formaldehyde (1, 3, 5, 8, 10 g/mL).

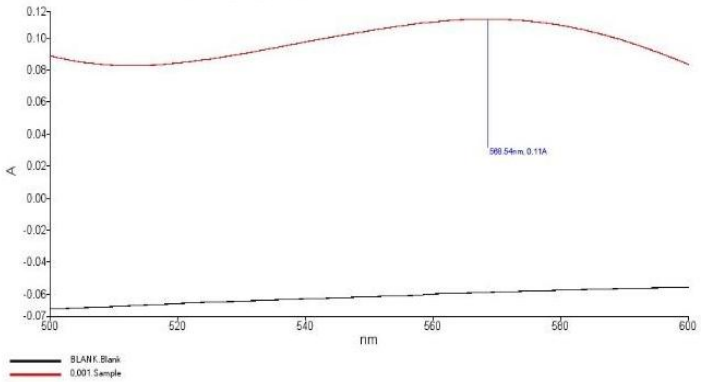

Figure 1. The value of the wavelength of formaldehyde in the solvent H_2SO_4 pH 3 using UV-Vis spectrophotometry obtained 568.54 nm

From the measurement results obtained, the best linearity data is the solvent pH 3 with a wavelength of 568.54 nm. So that the maximum wavelength at pH 3 is used for the analysis of formaldehyde in food samples.

3.3 Determination of Formalin using formaldehyde

Determination of the linearity of the calibration curve was carried out by reacting a standard solution of formaldehyde with concentrations of 1 g/mL, 3 g/mL, 5 g/mL, 8 g/mL, 10 g/mL and 15 g/mL, respectively. 3 mL of acid Cromatropat was then determined with H_2SO_4 optimum pH and then heated in a boiling water bath for 15 minutes, after which the absorption was measured at the maximum wavelength that had been obtained.

The purpose of the determination of formaldehyde is to know the linear regression equation of various concentrations of standard solutions measured. From the measurement results of various standard solutions, a linear regression equation will be obtained. This research was conducted by measuring various concentrations of standard solutions.

The concentrations that were varied were: 1 g/mL, 3 g/mL, 5µg/mL, 8 g/mL, and 10 g/mL, 15 g/mL. Then the results of the calibration curve measurements obtained are shown in Table 1:

Table 1. The results of the calibration curve measurements for solutions standard formaldehyde at a maximum wavelength of 568.54 nm.

Concentration (µg/mL)	Absorbance (A)
1	0.2480
3	0.3931
5	0.5114
8	0.7083
10	0.8615
15	1.0843

Based on the data obtained in table 1, a calibration curve of the formaldehyde standard solution was made as shown in Figure 2:

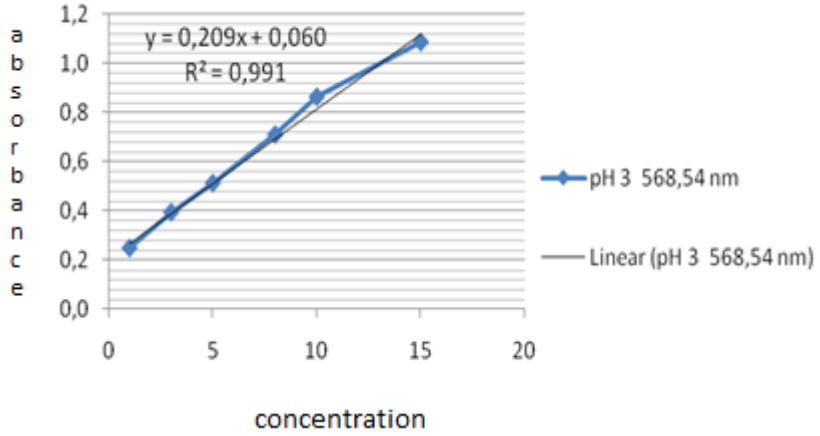

Figure 2. Calibration curve of solution standard formaldehyde at a maximum wavelength of 568.54nm

From the picture above, it can be seen that the higher the concentration of solution standard formaldehyde, the higher the absorbance obtained. From the measurement results obtained calibration curve data with the linear regression equation y = 0.209x + 0.060 at a price of R^2 = 0.991. Then the spectrophotometric instrument can be used for the determination of formaldehyde.

3.4 Application of Formaldehyde for Sample Treatment

The results of the analysis of the levels of formaldehyde in various food samples using the spectrophotometric method are shown in table 2:

Table 2. The absorbance measurement data in food samples were spectrophotometrically at a wavelength of 568.54 nm.

No.	ID Sample	Wet weight (g)	Spectrophotometry		
			Absorbance(A)	Formaldehyde content (mg/g)	Formaldehyde content (ppm)
1	Sample A	5.0034	0.1715	0.0541	54.1

2	Sample B	5.0036	0.1359	0.0362	36.2
3	Sample C	5.0031	0.0899	0.0142	14.2
4	Sample D	5.0005	0.1173	0.0273	27.3
5	Sample E	5.0061	0.1442	0.0482	48.2
6	Sample F	5.0221	0.1841	0.0513	51.3
7	Sample G	5.0026	0.1380	0.0373	37.3
8	Sample H	5.0073	0.2319	0.0841	84.1

The results of the Cromatropat acid method showed positive results if a purple color was formed according to the reaction in Figure 3 as follows .

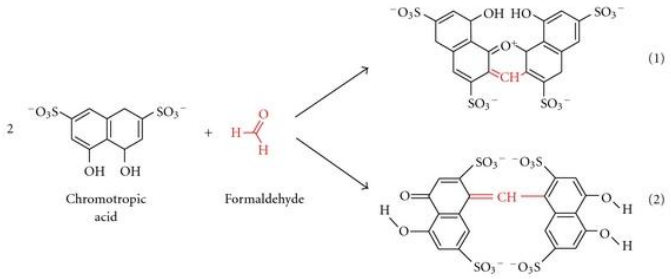

Figure 3. Reaction of Formaldehyde with Cromatropat acid.[2]

Cromatropat acid reagent with chemical formula $C_{10}H_6Na_2O_8S_2.2H_2O$ is another name for 1,8-Dihydroxynapthalene-3,6-disulfonic acid disodium salt, has a molecular weight of 400.29 g/mol. Formalin in the presence of Cromatropat acid in sulfuric acid accompanied by heating for a few minutes will result in a purple or violet coloration. This reaction occurs based on the condensation of formalin with the aromatic system of Cromatropat acid, forming a colored compound (3,4,5,6-dibenzoxanthylium). The purple or violet color formed was then measured by means of UV-Vis spectrophotometry.[3]

IV. Conclusion

Based on the results of the study, it was found that the results of the analysis of the presence of formalin content in eight samples of food ingredients in Medan, found samples containing formaldehyde, namely sample ***H*** had the highest formalin content of 84.1 ppm. the level of formaldehyde contained in the sample did not meet the requirements because there should not be formaldehyde in the food sample in accordance with the Regulation of the Minister of Health (MenKes) Number 1168/MenKes/PER/X/1999.

References

[1]. Alsuhendra, R. (2013) 'Bahan toksik dalam Makanan', *Bandung: PT. Remaja Rosdakarya*.
[2]. Georghiou, P. E. and Ho, C. K. (1989) 'The chemistry of the chromotropic acid method for the analysis of formaldehyde', *Canadian Journal of Chemistry*, 67(5), pp. 871–876.
[3]. Lubis, N. (1980) 'Analisis formalin pada usus ayam yang dijual di pasar kota garut', (11).
[4]. Male, Y. T., Letsoin, L. I. and Siahaya, N. A. (2018) 'Analisis kandungan formalin pada mie basah pada beberapa lokasi di kota ambon', (March). doi: 10.29360/mb.v13i2.3530.
[5]. Permenkes RI, 2012, Tentang Bahan Tambahan Pangan, Permenkes RI No.033 tahun 2012, Jakarta.
[6]. Simanjuntak, H. J. (2012) 'PENGEMBANGAN SENSOR OPTIK KIMIA UNTUK PENENTUAN FORMALDEHIDA DI DALAM MAKANAN'. UNIMED.
[7]. Tatuh, H. A., Rorong, J. and Sudewi, S. (2016) 'Analisis kandungan formalin pada berbagai jenis ikan di kota manado', 5(4), pp. 162–167.

Efbertias Sitorus. "Analysis of Formalin Content by Some Types of Food Materials Using UV-Vis Spectrophotometry Method." *IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)*, 7(6), (2021): pp. 16-19.