IDENTIFICATION OF FORMALIN LEVELS IN RAW TOFU SOLD AT THE TRADITIONAL MARKET OF PURUK CAHU CITY

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Abstract

Consuming tofu that using formalin continuously will cause long and short term bad effect to human body. Long term effect can cause cancer. Beside, short term effect is skin irritation, nausea, vomiting, diarrhea and shortness breath. To know the content of formalin levels in raw tofu on Puruk Cahu Traditional Market with quantitative analysis method using Spectrophotometry UV-Vis and to compare formalin levels in some raw tofu samples.This research uses Cross Sectional method. Sample research is raw tofu that was found in Puruk Cahu Traditional Markets. In this research, using a piece of raw tofu from different markets. Data was collected by using Purposive Sampling. Analysis formalin levels was using Spectrophotometry UV-Vis to determine the formalin levels in raw tofu. In qualitative analysis with KMnO4 and fehling test, all samples shown positive results. In quantitative analysis of formalin levels on Market Sample B is 10.72 mg/L, Market Sample H is 11.24 mg/L, and Market Sample Hi is 8.450 mg/L. The difference of sampling location has no effect to the formalin levels ($p = 0.07$). The result of analysis formalin levels in raw tofu from Hungan Market higher than Bahitom Market and Puruk Cahu Hilir Market. This case is absolutely does not fit the regulation of Health Ministry of Indonesia No. 722/Menkes/Per/IX/1988 that states no formalin is allowed in food product. The result of analysis formalin levels in raw tofu from Hungan Market higher than Bahitom Market and Puruk Cahu Hilir Market. This case is absolutely does not fit the regulation of Health Ministry of Indonesia No. 722/Menkes/Per/IX/1988 that states no formalin is allowed in food product. The result of analysis formalin levels in raw tofu from Hungan Market higher than Bahitom Market and Puruk Cahu Hilir Market. This case is absolutely does not fit the regulation of Health Ministry of Indonesia No. 722/Menkes/Per/IX/1988 that states no formalin is allowed in food product.

Keywords: Raw Tofu, Formalin, Traditional Market, Spectrophotometry UV-Vis

Introduction

Soybean is a food ingredient that has a fairly high nutritional value. Soybeans have a high protein content of 35%, even superior soybean varieties have a protein content of 40% compared to other foodstuffs such as rice (6.30%), corn (9.20%), cassava flour (1.10%).), green beans (22.0%), meat (19.0%), fresh fish (17.0%), and chicken eggs (13.0%) (Agung 2010). The health benefits of soybeans are being able to controldiseasedegenerative diseases such as diabetes mellitus, hypertension, hypercholesterolemia and cancer because soybeans have nutritional components, namely protein, essential amino acids, vegetable fats, vitamins and minerals, as well as non-nutritive components such as dietary fiber and bioactive components. (Triandita & Putri, 2019), so the use of soybeans as a food ingredient is one of the right choices for the community. One of the food ingredients made from soybeans is tofu

Tofu is a food that is often consumed by the public because of its delicious taste, affordable price, high nutritional value and easy to find in traditional markets. Although this food ingredient is affordable and has a simple shape, it turns out that tofu has a special quality in terms of nutrition. Tofu is rich in high-quality protein, high in protein complementation properties, ideal for diet foods, low in saturated fat and cholesterol free, and rich in minerals and vitamins. Most of the tofu factories in Indonesia still use traditional methods in their production, but this traditional method requires every worker to work optimally in making tofu. However,

Formalin is very dangerous for health and can threaten health because it will cause effects in the short and long term. The short-term effects are nausea, vomiting, and diarrhea, while the long-term effects are injuries to the kidneys, lungs, and cancer. The body can be exposed to formaldehyde through the digestive tract (ingestion), skin contact or inhalation. Formalin exposure can cause health problems, both acute symptoms and chronic symptoms.Iftriani et al, 2016). Formalin (CHOH) is a colorless, pungent-smelling solution containing less than 37% formaldehyde in water and usually added methanol as a preservative. Based on the Regulation of the Ministry of Health of the Republic of Indonesia Number 722/MenKes/Per/IX/1988 (Depkes, 2011) it is explained that the content of formalin in the product is not permitted to be used. According to the International Program on Chemical Safety (IPCS), formalin in the form of food that can be consumed by adult humans if accidentally only 14 mg per day.

Method

The method used is UV-Vis Spectrophotometer, Color Reagent test and the sample used is raw tofu.

a. Sample preparation

A sample of raw tofu is weighed as much as 2 g, put into a mortar and then ground until smooth, take a sample of raw tofu that has been ground sufficiently and put into a cuvette, then add hot water to the mark, put the cuvette into a centrifuge for 5 minutes at a speed of 3000 rpm, take supermatant/substance from the centrifugation using a pipette.

b. Qualitative Test with Color Reagent Test method

1) KMnO4 . color reagent

Test for Formalin Content in Tofu Samples by using 0.1 N KMnO4 reagent. Take 3 drops and then put it into a test tube that already contains the supermate. A positive result if the purple color changes to brown(Kiroh et al., 2019)

2) Fehling's color reagent

Test the Formalin Content in Tofu Samples using Fehling's reagent taken as many as 3 drops and then put into a test tube that already contains the supermate. observe the changes that occur, where if there is a color change to orange and there is a brick red precipitate then the sample tested positive contains formalin.(Pratiwi et al., 2019)

c. Quantitative test using UV-Vis Spectrophotometry method

Quantitative analysis in this study using UV-Vis spectrophotometric instruments, the stages in the test are as follows:

1) Preparation of formalin standard mother liquor

To make a standard mother liquor of formalin (1000 ppm) made by weighing 100 mg of formalin, put it into a 100 ml volumetric flask that has been filled with aquadest, then add aquadest to the mark, then shake until homogeneous.

2) Preparation of formalin standard solution

A standard solution of 100 ppm formalin was made from 10 ml of 1000 ppm mother liquor, then put into a 100 ml volumetric flask, add distilled water to the mark, then shaken until homogeneous.

3) Calibration curve creation

The standard 100 ppm solution that has been prepared is taken 0.5 ml, 1 ml, 1.5 ml, and 2 ml to make standard solutions with concentrations of 5 ppm, 10 ppm, 15 ppm, and 20 ppm. Then 0.5 ml of H2SO4 P and 0.5 ml of Chromatofat Acid reagent were added, then diluted with aquadest in a 10 ml volumetric flask to the mark and homogeneous. The standard solution and the blank solution were measured for absorbance with a wavelength of 544 nm. Then the regression curve is measured from the absorption of the standard solution, a straight line is drawn connecting the concentration with the absorbance (absorption) and an equation is obtained y = bx + a(Ma'ruf et al., 2017).

4) Tofu sample making

Weigh 15 grams of the tofu sample and then grind it using a mortar until smooth and then soak it with 5 ml of distilled water, enter it into the Erlenmeyer, shake gently and let stand for 5 minutes. Filter the tofu sample with filter paper, the filtrate is put into an Erlenmeyer and covered with aluminum foil.

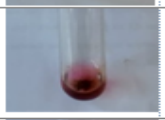
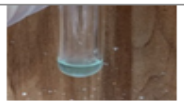
5) Testing with UV-Vis spectrophotometry

The results of the tofu sample filtrate were taken 5 ml into a 10 ml volumetric flask, then added 0.5 ml of H2SO4 P and 0.5 ml of Chromatofat Acid reagent, after that add distilled water to the mark. The absorbance was measured at a wavelength of 544 nm(Ma'ruf et al., 2017).

Results

Testing of raw tofu samples in qualitative analysis using KMnO4 reagents and Fehling results from this qualitative analysis can be seen in table 1

Table 1 Qualitative Test Results with KMnO4dan Fehling

No	Kode sampel	$KMnO_4$	Gambar	*Fehling*	Gambar
1	(B)	Cokelat (+) Terdapat kandungan formalin		Biru (-) Tidak terdapat kandungan formalin	
2	(H)	Cokelat (+) Terdapat kandungan formalin		Biru (-) Tidak terdapat kandungan formalin	
3	(Hi)	Cokelat (+) Terdapat kandungan formalin		Biru (-) Tidak terdapat kandungan formalin	

Note: B = sample from Bahitom Market; H = sample from Hungan Market; Hi= sample from Puruk Cahu Hilir Market

After testing the qualitative analysis, this study also uses quantitative analysis to determine whether there is formalin content in raw tofu. Quantitative analysis used in this research is UV-Vis Spectrophotometer. Before measuring the level of formalin in the raw tofu sample, a calibration curve was made. The calibration curve was obtained from the measurement of several concentrations of formalin standard solutions using a UV-Vis Spectrophotometer with a wavelength range of 300-800 nm and the result was a wavelength of 339 nm.

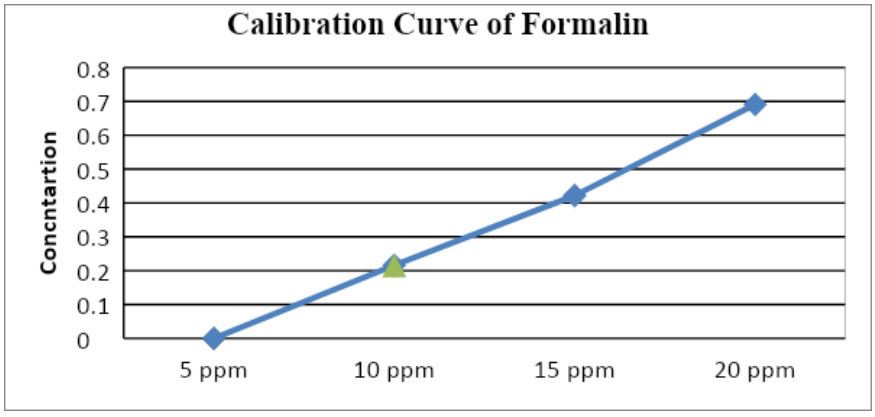


Figure 1. Location curve vs. Sample Concentration

Based on the results of measurements and calculations of the absorbance of the formalin standard solution and the calibration curve of the formalin standard solution with

measurements of 5 ppm, 10 ppm, 15 ppm, 20 ppm and the results show that the higher the concentration, the higher the absorbance of the solution so that a straight line is obtained, then the results are calculated to get the values of a, b and r. The result of the a value is 0.2105, while the b value is 0.04369 and the r value is 0.996 which will be used to calculate the formalin content in the raw tofu sample. The linear regression equation for the standard solution is:

$$y = 0.04369x - 0.2105$$

After measuring the calibration curve, the raw tofu samples sold in traditional markets were measured using a UV-Vis Spectrophotometer with a wavelength of 339 nm can be seen in table 2

Table 2 Calculation of Concentration and Formalin levels

No	Kode Pasar	Absorbansi (y)	Nilai a (a)	Nilai b (b)	Konsentrasi (mg/L)	Kadar Formalin (mg/kg)
1	B	0.261	0,2105	0,04369	10,53	21,06
2	H	0,284	0,2105	0,04369	10,23	20,46
3	Hi	0,161	0,2105	0,04369	8,26	16,52

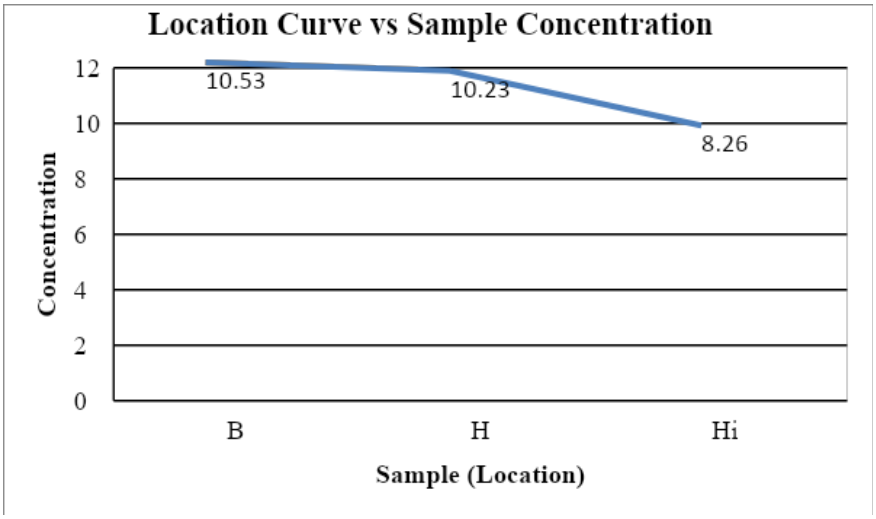


Figure 2 Curve Location vs. Sample Concentration

Based on the results of the concentration calculation above, the results of the curve that fluctuate, can be seen from the results of the calculation of samples at Bahitom Market (B) 10.53 mg/L, Hungan market (H) 10.23 mg/L and Puruk Cahu Hilir Market (Hi) 8.26 mg/L.

Discussion

Research on formalin chemical compounds using raw tofu samples taken from three traditional markets in Puruk Cahu. The analysis used in this research is qualitative analysis and quantitative analysis. Qualittaif analysis aims to determine the content of formalin compounds using KMnO4 reagent and Fehling reagent while, for quantitative analysis using UV-Vis Spectrophotometer to determine the levels of formalin compounds contained in raw tofu samples. Based on the test results obtained, it is known that the entire sample showed positive results in the sample test using KMnO4 reagent can be seen in table 4.1, then the analysis test using KMnO4 reagent, all raw tofu samples showed positive results, this can be seen from the color change in the test tube which has been filled with 1 ml sample filtrate then added KMnO4 reagent there is a color change to brown and there is a precipitate. The addition of KMnO4 in table 4.1 the formation of a brown color and the precipitate showed a positive sample containing formalin chemical compounds this was due to a change in the color of the solution from purple to brown due to the aldehyde reducing KMnO4 so that the color of the solution was initially purple to brown, with the resulting reaction:(Avif, 2019)

$$H2CO + KMnO4 \rightarrow HCOOH + KMnO3$$

The addition of Fehling's reagent in table 4.1 formed a light blue color which indicates a negative sample. The negative result was caused by the small formalin content, so it showed a negative result and was not identified using color reagents(Avif, 2019). The results of the Fehling reaction equation with formalin compounds are:

$$CH2O(aq) + 2\ Cu2+(aq) + 5OH-(aq) \rightarrow HCOO-(aq) + 3H2O(l) + Cu2O(s)$$

In addition to knowing the presence or absence of formalin in raw tofu, this study also aims to determine how much formalin content in raw tofu samples and whether the levels exceed the provisions of the rules of the Ministry of Health of the Republic of Indonesia Number 722/Menkes/Per/IX/1988, Testing raw tofu samples by quantitative analysis using UV-Vis Spectrophotometer. The selection of the UV-Vis Spectrophotometer method was due to the formalin compound having absorption in the visible light region. The visible light region is in the wavelength of 380-780 nm. Formalin solution is a colorless solution. Terms of compounds that can be measured by means of a UV-Vis Spectrophotometer are organic compounds that can provide absorption, namely compounds that have chromophore groups. The chromophore group is an unsaturated functional group that provides absorption in the ultraviolet or visible light region, therefore in the measurement process, the sample is reacted with a reagent that can provide a colored absorption spectrum with formalin, namely Chromatofat Acid and H2SO4 reagents. The addition of reagents Chromatofatic acid is used to bind formalin compounds contained in standard standard solutions. Formaldehyde also reacts with chromatophoric acid to produce a complex compound that has a purplish red color. The addition of reagents Chromatofatic acid is used to bind formalin compounds contained in standard standard solutions. Formaldehyde also reacts with chromatophoric acid to produce a complex compound that has a purplish red color. The addition of reagents Chromatofatic acid is used to bind formalin compounds contained in standard standard solutions. Formaldehyde also reacts with chromatophoric acid to produce a complex compound that has a purplish red color.

Making a calibration curve made with a standard solution of formalin pro analysis 100 ppm and then made again with a concentration of 5 ppm, 10 ppm, 15 ppm and 20 ppm, before measuring the calibration curve, the maximum wavelength measurement is carried out which aims to provide sensitivity to samples containing compounds. formalin with a maximum, the absorbance curve is linear and produces a constant absorbance value if repeated measurements are made, after measuring the wavelength with a wavelength range of 300-800 ppm.The selection of the wavelength range is carried out in order to determine the area where formaldehyde works to provide color absorption that can be absorbed by a UV-Vis spectrophotometer so that a value in the form of absorbance can be produced. The maximum wavelength obtained for formalin levels is 339 nm. maximum formalin.

The maximum wavelength obtained is slightly different from the literature, which is 544 nm (Ma'ruf et al., 2017). This may be due to a shift in wavelength caused by several factors such as the condition of the tool and the difference in the equipment used.

Making this calibration curve serves to determine the relationship between the concentration of the solution and its absorbance, so that the concentration of the sample can be known. From the test results using the standard standard solution series in table 4.2, the equation of a linear line is obtained as follows:

$$y = 0.04369x - 0.2105$$

Based on the results obtained, the correlation coefficient (r) is 0.996, a good correlation value must be close to one with the sign of a straight line forming on the calibration curve of the formalin standard solution, in accordance with Lambert-Beer law, namely y = a + bx, where y is the absorbance, a is the slope value (the point where the curve intersects the y-axis), x is the concentration and b is the intercept (the slope of the linear curve). The value of r is obtained that has met the requirements set by the provisions of the value of the correlation coefficient (r > 0.99) which indicates that the UV-Vis Spectrophotometer is in good condition. The purpose of quantitative testing is to measure the level of formalin in the raw tofu samples that have been tested qualitatively, the samples will be analyzed using a UV-Vis Spectrophotometer with a wavelength of 339 nm on three samples of raw tofu. Based on the results of quantitative analysis using the UV-Vis Spectrophotometer, the three samples showed positive results that met the requirements set by the provisions of the correlation coefficient (r> 0.99) which indicated that the UV-Vis Spectrophotometer was in good condition. The purpose of quantitative testing is to measure formalin levels in raw tofu samples that have been tested qualitatively, samples will be analyzed using a UV-Vis Spectrophotometer with a wavelength of 339 nm on three samples of raw tofu. Based on the results of quantitative analysis using UV-Vis Spectrophotometer, the three samples showed positive results. 99) which indicates that the UV-Vis Spectrophotometer is in good condition. The purpose of quantitative testing is to measure formalin levels in raw tofu samples that have been tested qualitatively, samples will be analyzed using a UV-Vis Spectrophotometer with a wavelength of 339 nm on three samples of raw tofu. Based on the results of quantitative analysis using UV-Vis Spectrophotometer, the three samples

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Based on the results of the analysis of formalin levels in raw tofu samples sold in the traditional market of Puruk Cahu City, the comparison results from the three markets, namely the Bahitom Market (B) (10.53 mg/l) there was a higher formalin content than the Hungan Market (H). (10.23 mg/l) and Pasar Puruk Cahu Hilir (Hi) (8.26 mg/l) as shown in table 4.3. Based on the regulation of the Ministry of Health of the Republic of Indonesia Number 722/Menkes/Per/IX/1988, it is stated that these 3 samples of raw tofu exceed the threshold level of formalin that have been set and are not fit for consumption. Data analysis of formalin content in raw tofu samples was processed using one sample t-test to obtain p value. The results of the analysis obtained a value ($p = 0.005$). Based on the hypothesis if $H0 < 0$,

Based on the results of the study, of course the tofu samples circulating and consumed by the people of Puruk Cahu City are not in accordance with the provisions of the rules of the Ministry of Health of the Republic of Indonesia Number 722/Menkes/Per/IX/1988 which states that formalin chemical compounds are not allowed to exist in a food product. . Formalin compounds are antiseptics used to kill bacteria and molds, in low concentrations 2-8% formalin chemical compounds are used to preserve corpses and other biological specimens. The use of formalin chemical compounds in food is very dangerous for health both in the short and long term(Goddess, 2019). Short-term effects that will occur if formalin compounds are swallowed into the mouth, throat and stomach are burning, painful swallowing, nausea, vomiting, and diarrhea, possible bleeding, severe stomach pain, headache, hypotension (low blood pressure), seizures convulsions, unconsciousness to coma. In addition, damage to the liver, heart, brain, spleen, pancreas, central nervous system and kidneys can also occur, while long-term effects can cause cancer.

To reduce the levels of formalin compounds in tofu can be done by boiling the tofu until it boils. In addition, there are other ways to preserve tofu without using chemical additives, namely by soaking in a solution of potassium sorbate, soaking in a salt solution, soaking in a mixture of turmeric and lime solution, and soaking in a mixture of lemon juice and table salt (Tahir M et al, 2019).

Conclusion

Based on the results of the research on Identification of Formalin Levels in Raw Tofu Sold in Traditional Markets in Puruk Cahu City, it can be concluded that the results of the qualitative test using KMnO4, all samples showed positive results, the test results using Fehling's reagent showed negative results. The level of formalin in raw tofu sold at Bahitom Market is 10.53 mg/L, Hungan Market is 10.23 mg/L, and Puruk Cahu Hilir Market is 8.26 mg/L. This proves the hypothesis of this research is true that H0 < 0.05 in raw tofu sold in the traditional market of Puruk Cahu City contains formaldehyde. Based on the rules of the Ministry of Health of the Republic of Indonesia Number 722/Menkes/Per/IX/1988, it is stated that formalin is not allowed in a food product.

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