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COMPARISON OF VITAMIN C EXTRACTION FROM YELLOW AND ORANGE PAPRICA USING ETHANOL AND METANOL SOLVENTS

Perbandingan Ekstraksi Vitamin C dari Buah Paprika Berwarna Kuning dan Oranye menggunakan Pelarut Etanol dan Metanol

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ABSTRAK

Paprika mengandung jumlah vitamin C yang signifikan, paprika dikenal karena khasiatnya yang sangat bermanfaat bagi kesehatan, termasuk kemampuannya untuk menangkal radikal bebas dan bertindak sebagai antioksidan bagi tubuh. Studi ini menggunakan pelarut etanol dan metanol untuk mengukur kandungan vitamin C pada paprika oranye dan kuning. Penelitian ini dilakukan di Laboratorium Kimia Universitas Trunojoyo Madura pada Januari 2025. Menggunakan etanol dan metanol sebagai pelarut, prosedur maserasi digunakan untuk mengekstrak paprika. Panjang gelombang maksimum juga ditentukan. Pemeriksaan sampel ini menunjukkan ymax sebesar 373,5 nm. Persamaan y = 0,0006 x + 0,019 menunjukkan linearitas. Analisis kuantitatif dilakukan pada rentang panjang gelombang 250–400 nm menggunakan spektrofotometri UV-Vis. Pelarut etanol menghasilkan 340 mg/100 g vitamin C pada paprika kuning, sedangkan pelarut metanol menghasilkan 562,5 mg/100 g. Pelarut etanol menghasilkan 215 mg/100 g vitamin C dari paprika oranye, sedangkan pelarut metanol menghasilkan 562,5 mg/100 g. Hasil uji desain blok kelompok acak lengkap dengan y = 0,05 menunjukkan perbedaan yang signifikan dalam jumlah vitamin C yang terdapat pada setiap sampel.

***Kata kunci**: etanol, metanol, paprika, perbandingan ekstraksi, vitamin C*

ABSTRACT

Paprica it contains a significant amount of vitamin C, paprica offers several great health benefits, including its ability to ward off free radicals and defend against free radicals. This study used ethanol and metanol solvents to measure the amounts of vitamin C in orange and yellow paprika. The study was conducted at Trunojoyo University of Madura's Chemistry Laboratory in January 2025. Using ethanol and methanol as solvents, maceration procedures were used to extract the paprika. The maximum wavelength was also ascertained. The examination of this sample revealed a ymax of 373.5 nm. The equation y = 0.0006 x + 0.019 illustrates linearity. Quantitative analysis in the 250–400 nm wavelength region using UV-Vis spectrophotometry. Ethanol solvents yielded 340 mg/100 g of vitamin C in yellow peppers, while methanol solvents yielded 562.5 mg/100 g. Ethanol solvents yielded 215 mg/100 g of vitamin C from orange peppers, while methanol solvents yielded 562.5 mg/100 g. The findings of the randomized complete group block design test with y = 0.05 show a significant difference in the amount of vitamin C present in each sample.

Keywords: ethanol, extraction comparison, methanol, paprika, vitamin C

INTRODUCTION

Vegetables have an important role in improving the nutritional status of the community, as they are rich in vitamins, minerals, and carbohydrates that are important for health. With the increasing awareness of the importance of nutrition, the need for vegetables is increasing, so various types of vegetables have begun to be developed.[1] One of the

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horticultural crops, namely peppers, is a vegetable commodity whose fruit is used as a salad dish, but peppers can also be used as a side dish because peppers contain quite high nutrients. Based on research conducted by Febrianti (2022), the results of the analysis using UV-Vis spectrophotometry show that red pepper samples contain vitamin C (13.206 mg/g), green peppers (4.422 mg/g), and yellow peppers (11.164 mg/g).[2]

Bell peppers are known to be a powerful source of antioxidants and rich in vitamin C, so they are very beneficial for health. Benefits include protection from free radical damage, reduced risk of cardiovascular disease, and maintenance of optimal health.[1]

Ascorbic acid, another name for vitamin C, has powerful antioxidant properties and can help prevent degenerative diseases in the body. The body also needs vitamin C to maintain general health and strengthen the immune system.[3] In addition, Vitamin C has an important role in maintaining the structural integrity of collagen, a protein that serves as a link between various body tissues, such as skin, cartilage, veins, and other tissues.[4] Vitamin C can naturally be found in many different types of plants, especially vegetables and fruits, making it easy to meet the needs of vitamin C through the consumption of a balanced diet.[5] Perbedaan warna juga memungkinkan adanya perbedaan kandungan vitamin C. Oleh karena itu, sesuai dengan penelitian Nerdy (2018), paprika dengan konsentrasi vitamin C yang tinggi dipilih sebagai sampel dalam penelitian ini.[6]

The results of the study by Nerdy (2018) explained that peppers of different colors have the following vitamin C content: There are 16.52 milligrams of vitamin C in 100 grams of green peppers, 159.61 milligrams in 100 grams of yellow peppers, and 121.38 milligrams in 100 grams of orange peppers. red pepper 81.19 mg vitamin C per 100 g red pepper uses the titration method with metaphosphoric acid as an oxidation inhibitor of vitamin C, and the solvent used, namely 2,6-dichlorindophenol. A procedure known as extraction can be used to separate the vitamin C component from the pepper.[6]

There are several ways to perform the extraction process, including soccultation, reflux, and maceration. To separate the necessary components, the maceration process in particular involves shaking or stirring the mixture at room temperature. This method is widely used to maintain the quality of extracts due to its simple process and does not involve heating that has the potential to damage the natural ingredients.[7] Vitamin C compounds are not heat-resistant, so this study uses the maceration method for extraction. This is based on previous research by Murti (2017) which showed that higher extraction temperatures (80°C) can lower vitamin C levels.[8] By using the maceration method, it is hoped that natural materials will not be damaged and decomposed, so that vitamin C levels can be maintained.

Selecting the right type of solvent is a factor that greatly affects the extraction rate.[9] Vitamin C compounds have polar properties, so the solvent used must also be polar to maximize the effectiveness of extraction. In accordance with the principle of "*like dissolve like*", the selection of the right solvent is essential to ensure maximum solubility and molecular extraction results, as a compound will dissolve more easily in solvents that have similar characteristics.[10]

In extraction procedures, polar solvents such as ethanol, methanol, acetone, and water are often used. Based on the results of the study, the use of methanol as a solvent in the extraction of mangosteen peel showed better results with higher extract yields compared to ethanol at the same concentration.[10] Likewise, in barley seed extract, the highest yield was obtained using methanol solvents compared to

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ethanol and acetone.[10] This is because the polarity of ethanol is affected by the length of its carbon chain, and the polar bond is in the -OH group. The longer the carbon chain, the less polarity of ethanol will be.[11] As a result, ethanol and methanol were the two types of solvents used in the study. This study was conducted to measure vitamin C levels in yellow and orange peppers using the UV-Vis spectrophotometry method with ethanol and methanol solvents.

METODE

Samples of orange and yellow peppers from the traditional market of Bangkalan City were analyzed in this study using experimental approach methods and quantitative analysis. This research was conducted at the Chemistry Laboratory of Trunojoyo University in Madura in January 2025. The research process included sample solution preparation, determination of maximum wavelength, calibration curve, and quantitative analysis using UV-Vis spectrophotometry in the wavelength range of 250–400 nm, with three measurement repeats to ensure the accuracy of the results.

The materials for this study consist of yellow and orange bell peppers, vitamin C (Merck), distilled water (Brataco), and 90% ethanol and 90% methanol solvents from Merck. The tools used in this study are analytical scales (Shimadzu), measuring flasks (Iwaki) with capacities of 25ml, 50ml, and 100ml, measuring cups (Pyrex) with capacities of 10ml, 50ml, and 100ml, test tubes (Pyrex), volume pipettes (Pyrex), dropper pipettes (Iwaki) with capacities of 5ml and 10ml, funnels, Erlenmeyer (Iwaki) with capacities of 25ml and 50ml, filter paper Whattman No.2, distillation tools, and UV-Vis spectrophotometer (Thermo Electron Sci Inst UV-VIS Spectrophotometer 335908P-000).

Preparation of Paprika Fruit Extract

Yellow and orange peppers are cleaned from the stalks and seeds are then thinly sliced then blended until smooth. The mashed yellow peppers are weighed by 100g and divided into 2 parts. Then 1 part is macerated using 150 ml of 90% ethanol and the other part is macerated using 150ml of 90% methanol. Next, it is closed and left at room temperature in a tightly closed container for 48 hours. A funnel and Whatman No. 2 filter paper are used to filter the extract to separate the filtrate from the residue. Distillation tools are then used to concentrate the maserate until the solvent evaporates. To produce a thick extract, the extract is then steamed in an oven set at 50°C.

Manufacture of Vitamin C Parent Solution 100 ppm

A vitamin C solution is made by weighing 50 milligrams of vitamin C and dissolving it in distilled water to a volume of 500 ml.

Determination of the Maximum Wavelength of Vitamin C Solution

A 50 ml measuring flask is filled with a 100 ppm concentration of vitamin C solution using a pipette. After that, distilled water is added until the desired consistency is achieved. To determine the maximum wavelength associated with the highest absorption value, the maximum absorption is evaluated in the wavelength range of 250–400 nm.[12]

Calibration Curve Creation

Two milliliters, three milliliters, four milliliters, five milliliters, and six milliliters of 100 ppm vitamin C solution are dripped into a 50-milliliter measuring flask. Each volume corresponds to the following ppm concentrations: 4 ppm, 6 ppm, 8 ppm, 10 ppm, and 12 ppm. The solution is then homogenized by adding distilled water until it reaches the mark. To produce an accurate calibration curve, absorbance measurements are taken at a pre-set maximum wavelength. Measurements are made at 373.5 nm to obtain the absorption value. concentration is required to create a linear calibration curve.[13]

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Determination of Yellow and Orange Pepper Fruit Levels

A 100 ml measuring glass is filled with extracts of red and yellow pepper concentrates, weighing 1 g each. After that, the mixture is homogenized by adding distilled water until the mark is reached. The filtrate is then separated from the residue by filtering the solution using filter paper, and the filtrate results are piped as much as 2ml and put into a measuring flask. After that, distilled water is added until it reaches the mark after the filtrate is squeezed into a 50 ml measuring flask. To ensure the accuracy of the data, this procedure is repeated three times for each sample to determine the absorbance at the maximum wavelength.

Data Analysis

After the completion of data collection, quantitative analysis techniques are used to analyze the data. The Randomized Complete Block Design statistical test was applied in this study as a quantitative data analysis method. As a practical alternative, SPSS software is used for data processing.

RESULT

The purpose of this study was to measure vitamin C levels in yellow and orange peppers using UV-Vis spectrophotometry with ethanol and methanol solvents at the Trunojoyo University Chemistry Laboratory in Madura.

Table 1. Results of Extraction of Pepper Yield (Orange and Yellow) Using Ethanol and Methanol Solvents

Solvent	Yield of Paprika Fruit (%)	
	Orange	Yellow
Ethanol	2.91	2.86
Methanol	4.44	3.94

Table 1 shows the results of the extraction process, which shows that methanol solvents produce high extraction yields in orange and yellow peppers.

UV-Vis spectrophotometry was then used to determine the maximum wavelength of vitamin C, and obtained 373.5 nm. This absorption will provide maximum sensitivity for each highest unit of concentration.[14] Furthermore, the calibration curve is based on measurements of the absorbance of standard solutions with different concentrations (4, 6, 8, 10, and 12 ppm) at a wavelength of 373.5 nm. This absorption will provide maximum sensitivity for each highest unit of concentration.[14] Table 2 describes the results of the standard solution absorbance measurement.

Table 2. Vitamin C Raw Solution Absorbance Data Obtained from UV-Vis Spectrophotometry

Concentration (ppm)	Absorbansi
4	0,045
6	0,057
8	0,066
10	0,078
12	0,096

From the data in Table 2, it can be seen that the absorbance measurements of each concentration of the solution show an increasing pattern which means that the resulting calibration curve will have linear characteristics. This allows for accurate calibration curve creation and can be resumed for further analysis.

Table 3. Results of Absorbance Values for Calibration Curve Making

Concentration (ppm)	Absorbansi
4	0,045
6	0,057
8	0,066
10	0,078
12	0,096

Absorbance measurements at each concentration show an increasing pattern, as presented in Table 3, indicating that the calibration curve is likely to exhibit a linear relationship.

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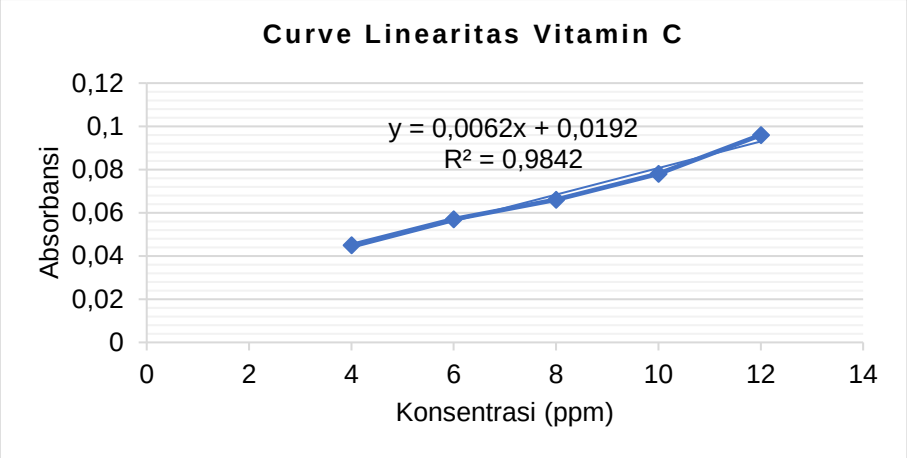

Figure 1. Vitamin C Calibration Curve at 373.5 nm Wavelength

The linearity test obtained a linear and very strong relationship between concentration and absorbance from the standard measurement of vitamin C. The results of the calculation in Figure 1 show that the regression equation formed is y = 0.0062x + 0.0192, with a value of the R2 correlation coefficient is 0.9842, which indicates a very high level of accuracy and meets the criteria of linearity. Table 4 shows the data obtained from the results of absorbance measurements.

Table 4. Vitamin C Measurement Data on Yellow and Orange Peppers Using UV-Vis Spectrophotometry with 373.5 Nm Absorption

Abs	Solvents					
	Ethanol			Methanol		
	1	2	3	1	2	3
P.K	0,0271	0,0269	0,0276	0,0327	0,0323	0,0326
	0.0271 ± 0.016a 0.0326 ± 0.019c					
P.O	0,0228	0,0261	0,0238	0,0372	0,0372	0,0372
	0.0238 ± 0.014b			0.0372 ± 0.000d		

Based on the results of the Randomized Complete Block Design (RCBD) test with y= 0.05, the superscript letters showed a significant difference (P<0.05)
Description: P.K = Yellow Paprika ; P.O = Orange Bell Pepper

Based on Table 4, it was found that the vitamin C content obtained from yellow peppers using ethanol solvent (340 mg/100 g) was greater than the vitamin C content obtained from orange peppers using ethanol solvent (215 mg/100 g). However, the vitamin C content obtained from yellow peppers using methanol solvent (562.5 mg/100 g) is smaller than the vitamin C content obtained from orange peppers using methanol solvent (757 mg/100 g).

DISCUSSION

The vitamin C content in the sample was determined using a linear equation obtained from the calibration curve. The concentration of vitamin C can be precisely determined by entering the absorbance value obtained from the absorption of the sample into the linear equation. The results of the calibration curve showed that the observed absorbance value increased with an increase in the concentration of the standard solution of vitamin C.

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Therefore, the concentration of the standard solution of vitamin C used increases along with the absorbance produced. These results are in line with previous research by Fadliya et al. (2018), which found a linear correlation between increased vitamin C concentrations and increased absorbance values determined by UV-vis spectrophotometry. Based on these results, the UV-vis spectrophotometry method was used to calculate the amount of vitamin C contained in orange and yellow peppers.[15]

Based on the results of the Complete Random Block Design Test (RAL) with y = 0.05, it showed a significant difference between the vitamin C content in yellow peppers and orange peppers extracted using ethanol and methanol solvents with vitamin C content in yellow peppers with ethanol solvent (340 mg/100 g) greater than the vitamin C content in orange peppers with ethanol solvent (215 mg/100 g). Meanwhile, the vitamin C content in yellow peppers with methanol solvent (562.5 mg/100 g) was smaller than the vitamin C content in orange peppers with methanol solvent (757 mg/100 g), from the results of this study methanol has higher polar properties than ethanol, but methanol cannot attract more vitamin C in yellow peppers. This can be influenced by several factors, including the variety, environmental conditions, planting location, fertilizer use, and the level of maturity in yellow peppers.[4] In addition, according to Khalaf's (2020) research, the various varieties of Capsicum species show variations in the content of vitamin C, phenols, and carotenoids based on their cultivation area.[16]

Overall, the solvents used for extraction show that methanol obtains higher yields than ethanol. This is because vitamin C compounds have polar properties, so the solvents used must also be polar to maximize the effectiveness of extraction. In accordance with the principle of "*like dissolve like*", the right choice of solvent is very decisive because compounds tend to be more soluble in solvents with the same properties, so that they can maximize extraction results.[10]

Based on the polarity properties of alcohol compounds, their polarity is in the –OH group. Thus, the longer the carbon chain, the lower the polarity.[11] This is in line with the results of research that has been conducted by Chos (2020) supporting this, showing that extraction with methanol solvents can produce a larger amount of olive leaf extract compared to ethanol and acetone solvents. This difference suggests that methanol has more effective extraction capabilities.[17]

The advantage of this study is that methanol and ethanol solvents can improve the quality of vitamin C extract from peppers. The limitation of this study is in the sample of orange peppers, which is difficult to find. Implications for follow-up research, because this study only tested vitamin C levels in yellow peppers and orange peppers, further research is needed to test flavonoid compounds and their biological activity.

CONCLUSION

From this study, the vitamin C content in yellow peppers with ethanol solvent yielded 340 mg/100 g, and methanol solvent yielded 562.5 mg/100 g. The vitamin C content obtained in orange peppers with ethanol solvent yields 215 mg/100 g, and methanol solvent 562.5 mg/100 g. It is suggested that further research is needed on the method of extracting peppers using other solvents.

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