DETERMINATION OF VITAMIN C LEVELS IN RED APPLES (*MALUS DOMESTICA*) AND GREEN APPLES (*MALUS SILVESTRIS*) USING THE IODIMETRIC METHOD

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A B S T R A C T

Apples are one of the best types of fruit and are highly favored by people for their distinct flavor and rich content of nutrients and vitamins, particularly vitamin C. This study aims to determine the level of vitamin C in red apples (Malus domestica) and green apples (Malus silvestris). One of the chemicals that has many benefits for human health is vitamin C. This is a laboratory experiment using iodimetry, which is a direct titration process between iodine and vitamin C. The results of the I2 standardization test showed that the concentration of vitamin C in red apples were higher than green apples. The results of the I2 standardization test showed an I2 concentration of 0.0652 N. For the vitamin C content test, the average value at the end of the titration for red apples (Malus domestica) was 27.54048 mg and for green apples (Malus silvestris) was 45.9008 mg. Therefore, it can be concluded that green apple (Malus silvestris) has higher vitamin C content than red apple (Malus domestica).

INTRODUCTION

Indonesia is an agricultural country with enormous potential in the plantation and agricultural sectors, especially in the production of various varieties of fruits. Green apples, which are known for their health benefits, are one of the fruits that have enormous potential. Green apples, scientifically known as Malus sylvestris and also known as Manalagi apples or Malang apples, have been widely known as a fruit that is beneficial for those who are on a diet program and want to improve body and eye health (Nugraha et al., 2023).

In scientific terms, Malus domestica, or red apple is the most commonly consumed type of fruit. This species can be found in a variety of colors, including dark red, pink, maroon, and yellowish red, found in red apples. According to Pah et al. (2021) some of the most popular red apple cultivars are Cameo, Fuji, Royal Gala, Red Delicious, and Anna.

Apples are one of the most popular fruits because of their varied tastes and abundant nutritional content, such as healthy fats, carbohydrates, proteins, and various vitamins including vitamins C, A, B1, and B2 (Neighbors et al., 2019). With a total production reaching 84.6 million tons per year, apples are the fourth most consumed fruit in the world (Soetadipura, 2022).

Apple is a type of fruit that has red, green, and yellow skin. Malus domestica is the scientific name for apple, which is a member of the genus Malus. The genus Malus is known as one of the earliest cultivated agricultural plants, with its center of variety located in Eastern Turkey. 'Apple' comes from the Old English word aeppel. There are six known varieties of apple from the Iron Age to the first century AD, when the Romans arrived. The natural antioxidants found in apples are good for your skin and eye health.

Ripe apples produce vinegar that is good for skin rejuvenation, and apple juice has anti-wrinkle qualities similar to spinach juice. Apple skin will become shiny and smooth after reaching full ripeness. Another beverage option to overcome cellulite is apple juice. The author's interest in using apples as a raw material for soap comes from their many health benefits and easy availability (Domesticus & Soap, nd). In addition, apples contain high levels of phytochemicals, phenols, and fiber (Khurniyati & Estiasih, 2015).

Due to its function as an antioxidant and its medical benefits, vitamin C, or ascorbic acid, is an essential part of the diet. It helps in collagen synthesis, which is necessary for the formation of

collagen structures, through the activation of the enzyme prolyl hydroxylase. This process is essential for the production of hydroxyproline, the main component of collagen. If vitamin C is absent, collagen fibers in various body tissues will not be perfect. Therefore, vitamin C plays a crucial role in the growth of tissues such as subcutaneous, cartilage, bones, and teeth (Fitriana & Fitri, 2020).

In addition, vitamin C also plays an important role in various body functions, such as preventing the formation of carcinogenic compounds, stimulating collagen synthesis, slowing the aging process, functioning as an antioxidant, and increasing the immune system against serious diseases such as cancer and heart disease. However, vitamin C is easily oxidized due to exposure to high temperatures, heavy metals, and interactions with other components in food, which can reduce the effectiveness of its benefits (Hudiyanty, 2017).

This study used a laboratory experimental design that used a combination of quantitative and qualitative methods (Teheni et al., 2021). One method that can be used to measure the levels of ascorbic acid (Vitamin C) in fruit is iodimetric titration. This method was chosen because it is affordable, the process is simple, and does not require complicated laboratory equipment. Iodimetry, a titrimetric method, is used to measure vitamin C levels in various types of fruits and vegetables (Erwanto et al., 2018).

This method works by calculating the amount of I2 (Iodine) produced from the reaction of the sample with iodide ions or with ascorbic acid. According to Dodi Iskandar (2017), the indicator used is a 5% starch solution. The color change from blue to clear is the equivalence point. If the compound has a lower oxidation potential than the iodine-iodide system, this iodimetric titration method can be used. This method oxidizes the reductant that can be quantitatively oxidized at its equivalence point through direct titration with iodine solution.

METHOD

Types of research

This study uses a laboratory experimental method, where research conditions are intentionally and controlled to observe certain events or incidents. The main purpose of this experimental approach is to observe changes that occur due to modifications of variables made during the study.

Time and Place of Research

This research was conducted from July to August 2024 at the Baubau Polytechnic Pharmacy Laboratory.

Tools and materials

In this study, various tools were used, including stirring rods, blenders, burettes, Erlenmeyer flasks, measuring cups, label paper, filter paper, Whatman paper, watch glasses, measuring flasks, digital scales, volumetric pipettes, dropper pipettes, clamps, and horn spoons. The materials used in the study included red apples (*Malus domestica*) and green apples (*Malus silvestris)*, distilled water , 1% starch, potassium iodide (KI), 0.01 N iodine solution (I2), $N_{a2}S_2O_3$ (sodium trosulfate).

Sampling

The apple samples used in this study were obtained from a local market in Baubau city. A total of 100 grams of red and green apples were selected in a fresh state to be used as research samples.

Work procedures

Determination of Sample Content

How the sample works

After cutting the red and green apples into small pieces, weigh 100 grams and puree them with a blender until they become pulp or juice. 10 grams of water are taken and put into a 100 milliliter beaker, then distilled water is added to the desired volume. Then the solution is filtered to distinguish the filtrate. This sample is then used as a test sample (Karmila, 2021).

Qualitative test

A dry and clean test tube is labeled according to the sample, then 5 grams of red apple (Malus domestica) and green apple (Malus silvestris) that have been dissolved in distilled water in a 100 mL measuring flask until it reaches the volume limit, are put into the test tube. Next, 1 mL of the solution is put into the test tube, then dripped with 0.1 N iodine solution. The number of iodine drops is counted until the color changes from brownish yellow to clear, which indicates the presence of vitamin C in the sample (Karmila, 2021).

Quantitative test

Making 1% starch indicator

The 1% starch indicator is made by weighing 2 grams of starch, then dissolving it in 100 mL of hot water which is put into a 100 mL beaker. This solution is used as an indicator in the experiment (Karmila, 2021).

Making 0.01 N Iodine solution

A 0.01 N iodine solution was prepared by weighing 4.5 grams of KI dissolved in distilled water, then gradually adding 3.17 grams of I2 until completely dissolved. After that, the solution was transferred into a 100 mL measuring flask and distilled water was added until it reached the desired volume (Karmila, 2021).

Preparation of standard solution of $N_{a2}S_2O_3$

The standard $N_{a2}S_2O_3$ solution was made by weighing 6.5 grams of $N_{a2}S_2O_3$, which was then dissolved in 250 mL of distilled water in a beaker (Karmila, 2021)

Standardization *of I2* solution with $N_{a2}S_2O_3$ solution

The standardization process of I2 solution is done by pipetting 25 mL of I2 solution and adding 2 mL of starch solution as an indicator. The solution is then titrated with $N_{a2}S_2O_3$ solution until the color changes to clear.

Determination Vitamin Levels C in red apple

Determination of vitamin C levels in red apples (Malus domestica) was carried out by taking 10 mL of apple filtrate, which was then put into a 125 mL Erlenmeyer flask, followed by the addition of 2 mL of 1% starch solution and 20 mL of distilled water. The solution was then titrated with 0.01 N iodine until the color changed to dark blue. The same procedure was applied to green apples (Malus silvestris) (Karmila, 2021).

Analysis of Vitamin C Level Determination using the iodimetry method

$$\text{Vitamin C content (mg/10 g)} = \frac{(V.N)iodin \times Mr\ C6H8O6}{\text{Berat Sampel(g)}} \times 10$$

Information :

V : Titration volume (mL)

N : Normalized Iodine (N)

Mr Vitmin C : Molar mass of Vitamin C (Nisa, 2020)

RESULTS & DISCUSSION

Samples of red apple (Malus domestica) and green apple (Malus silvestris) were used in this study with an initial weight of 100 grams before being crushed. 10 mL of the crushed sample was put into a 100 mL Erlenmeyer flask, then 2 mL of 1% starch solution and 20 mL of distilled water were added. 0.01 N iodine solution was then added to the mixture until the color changed to dark blue. Before testing the levels of vitamin C in green and red apples, a qualitative test was carried out to determine the content in the sample.

Table 1 Qualitative test results on red apples and green apples

Sample	Name Test	Reagent	Observation Results	Remarks
Apple Red	Vitamin C	Iodine	Clear	+
Apple Green	Vitamin C	Iodine	Clear	+

Ket (+) positive for vitamin C
The I2 vitamin C standardization test was performed three times, or triple, to change the amount of solution used during titration to match the standard solution. The results of the test are presented in the following table:

Table 2 Results of quantitative tests on red and green apples.

Volume I_2 (mL)	Volume $N_{a2}S_2O_3$				Content I_2 (N)
	I	II	III	Average	
25	16.4	16.2	16.4	16.3	0.0652

In this study, the levels of vitamin C in red apples and green apples were measured by iodimetric titration, which was performed three times, or triple. The results are shown in the following table:

Table 3 Qualitative test results using the iodimetry method

Sample	Volume I_2 (mL)				Weight Sample (g)	Vitamin C content (mg/10g)
	I	II	II	Average		
Apple Fruit Red	2.1	1.9	3.2	2.4	10	27.54048
Apple Fruit Green	4.3	3.7	4	4	10	45.9008

In this study, the iodimetric titration method was used to measure the levels of vitamin C in red apples (Malus domestica) and green apples (Malus silvestris). This titration process is redox using a standard solution (I2) in neutral and slightly acidic conditions.
The process of determining vitamin C levels is carried out in two stages, namely qualitative and quantitative tests. The first stage carried out is a qualitative test, which aims to identify the presence of vitamin C in red apples (Malus domestica) and green apples (Malus silvestris). In this test, the color change from brownish yellow to clear is observed to confirm the presence of vitamin C. Conversely, the quantitative test aims to measure vitamin C levels by observing the color shift from brownish to dark blue. This quantitative test is carried out using the iodimetry method to determine the concentration of vitamin C in both types of apples. Before the testing process, the samples were first washed with running water, cut into small pieces, and weighed as much as 100 grams. Using a blender, the samples were crushed into juice. Then, 10 grams were taken and put into a 100 mL beaker with distilled water. Before the pulp was separated from the filtrate, filter paper and gauze were used to filter it. This filtering process was carried out twice to ensure the best results for red and green apples.

The process of making a 1% starch indicator solution begins with weighing 2 grams of starch, which is then dissolved in 100 mL of warm water in a 100 mL beaker. The next step is to make a 0.01 N iodine solution, where potassium iodide (KI) is weighed as much as 4.5 grams and dissolved in distilled water.

Then, 3.17 grams of iodine (I2) was gradually added to the KI solution until the solution was completely dissolved. After that, the solution was transferred to a 100 mL volumetric flask and distilled water was added to the specified volume . In addition, a standard solution of sodium thiosulfate (NaS2O3) was prepared by weighing 6.5 grams of $N_{a2}S_2O_3$ dissolved in 250 mL of distilled water in a beaker. For the first test, namely the qualitative test, each mashed apple sample of 5 grams was dissolved in 100 mL of distilled water.

The sample was then placed in a clean and labeled test tube, and 1 mL of the sample solution was added with 0.01 N iodine solution. The number of drops required to change the color of the solution to clear was recorded, indicating that both types of apples contain vitamin C. In the quantitative test, standardization of the I2 solution was carried out with sodium bisulfate (Na2S2O4), where 25 mL of I2 was added to 2 mL of starch solution and titrated using Na2S2O3 until the solution turned clear, resulting in a final concentration of 0.0652 N.

In the analysis of vitamin C levels in red apples (Malus domestica) and green apples (Malus silvestris) using the iodimetric titration method, 10 mL of filtrate from each sample was taken and mixed with 2 mL of 1% starch solution and 20 mL of distilled water. The mixture was then titrated using 0.01 N iodine solution until the color changed to dark blue. This titration process was carried out three times for each sample. Based on the test results, the vitamin C content in red apples was recorded at 27.54 mg, while in green apples it was 45.90 mg. Thus, it can be concluded that the vitamin C content in green apples (Malus silvestris) is higher than in red apples (Malus domestica).

CONCLUSION

The results of this study indicate that there are levels of vitamin C in red apples (Malus domestica) and green apples (Malus silvestris), with the average levels of vitamin C obtained from the final titration being 27.54048 mg for red apples and 45.9008 mg for green apples, respectively.

However, this study has limitations, where researchers do not have adequate knowledge of factors such as pH, temperature, and light exposure. These limitations can lead to the inability to maintain ideal conditions during the experiment, which has the potential to accelerate the oxidation of vitamin C and produce invalid data in the initial experiment. .

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