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Determination of Vitamin C (Ascorbic Acid) Contents in Two Varieties of Melon Fruits (*Cucumis melo* L.) by Iodometric Titration

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ABSTRACT

Vitamin C, also known as ascorbic acid, is a water-soluble vitamin that is regarded as one of the safest and most effective nutrients. Vitamin C can be found in most fruits, and one of the fruits that contain vitamin C is melon fruit. The objective of the study is to determine vitamin C content in two varieties of melon fruits (Sky Rocket and Rock Melon) through the iodometric titration method. The method of determination was cheap, accurate, and can be used for routine analysis. The samples were collected from different markets in Yogyakarta. The results recorded the concentrations of ascorbic acids in Sky Rocket melon (30.84±0.3066 mg/100 g), and Rock Melon (33.77±0.2237 mg/100 g). The color of the fruit flesh affects the difference in vitamin C content between two varieties of melon fruit. The vitamin C content of orange-colored flesh (Rock Melon) is greater than that of greenish-yellow flesh (Sky Rocket).

Introduction

Vitamins are organic chemical substances that are required by all organisms due to their critical function in metabolism. Vitamin C is one of the most vital vitamins for human health. Vitamin C, commonly known as ascorbic acid, is a water-soluble vitamin with a monosaccharide structure [1].

Vitamin C cannot be produced by the body and must therefore be acquired from dietary sources such as vegetables or fruits, particularly in fresh conditions. Ascorbic acid, in addition to functioning as an antioxidant [2], plays a key role in wound healing and osteogenesis, as well as iron absorption, immune response activation [3], and collagen production [1]. Collagen is a protein that is found in the skin, connective tissue, bones, and teeth. A lack of ascorbic acid in the body might cause collagen production to be disrupted. This potentially fatal disease can be avoided with as little as 10 mg of vitamin C per day, which is easily obtained from fresh fruits and vegetables [4].

The majority of fruits and vegetables, particularly those with a green leafy appearance, are high in ascorbic acid [5]. Fruits are high in vitamin C, according to several studies. Citrus, tomatoes, strawberries, peppers, grapefruit, guava, and other fruits have been reported to have significantly high levels of vitamin C [3]. Fruit vitamin C levels vary greatly depending on factors such as species, maturity, climate, temperature, and soil nutrient [3,4].

Melon (*Cucumis melo* L.) is a fruit that belongs to the *Cucurbitaceae* family and has the potential to be developed through plant breeding [6]. Many Asian countries, including India, Japan, Korea, China, and Thailand, have developed melon plant breeding applications to produce superior varieties [6].

High-quality and high-phytonutrient melon fruits have strong market opportunities besides their health-related benefits. Hence, information about the content of vitamin C in melon fruits is expected to be able to maximize

by the community as important information in community business development.

Many analytical techniques, such as titrimetric [7], fluorimetric [5], spectrophotometric [7,8], high-performance liquid chromatography [9], and enzymatic [10], are mentioned in the literature for determining vitamin C in various matrices. In this study, vitamin C was determined by the iodometric titration method. The method of determination was cheap, accurate, and can be used for routine analysis.

Studies that systematically compare ascorbic acid contents of melons, especially the differences among varieties, are limited. In this study, we examined ascorbic acid contents in the two varieties Sky Rocket (greenish-yellow colored flesh) and Rock Melon (orange-colored flesh).

Methods

Preparation of Samples

Fresh samples of two melon varieties (Sky Rocket and Rock Melon) were obtained from different markets in Yogyakarta city. The samples were washed with water, peeled, sliced into smaller portions, weighed, squeezed in a juicer machine, and centrifuged. Then the volume and weight of the supernatant liquid were taken.

Standardization of Sodium Thiosulfate Solution

This standardization was accomplished by pipetting 10 ml of potassium iodate (KIO_3) solution 0.1 N + 10 ml of 10% potassium iodide (KI) solution + 10 ml of sulphuric acid (H_2SO_4) 2 N into a conical flask. The liberated I_2 was titrated against a burette solution of sodium thiosulphate ($Na_2S_2O_3$) until a faint yellow color was obtained. Then 4 drops of 1% starch solution were added, and the titration was continued until the starch-triiodide complex's blue-black color completely vanished. The titration was carried out in three replicates, and the normality of the sodium thiosulfate solution was calculated. The following expression is used to calculate the normality of the sodium thiosulfate solution:

$$N\ Na_2S_2O_3 = [(V \times N)\ KIO_3] / V\ Na_2S_2O_3 \quad (1)$$

Determination of The Ascorbic Acid Concentrations

10 ml of the sample solution was pipetted into a conical flask, followed by 2 ml of 2 N H_2SO_4, and 10 mL of Iodine (I_2) solution 0.1 N. The generated excess iodine was titrated against a solution of 0.1 N $Na_2S_2O_3$. The titration method determines vitamin C in the form of ascorbic acid. The following expression is used to calculate the amount of ascorbic acid:

$$\text{Level of Ascorbic acid} = (\text{mmol} \times \text{Mr})\ \text{Ascorbic acid} \quad (2)$$

$$\text{mmol of Ascorbic acid} = [\text{mmol } I_2 - 1/2(\text{mmol } Na_2S_2O_3)] \quad (3)$$

Results and Discussion

Standardization of Sodium Thiosulfate Solution

Vitamin C levels in samples were determined using an iodometric method with $Na_2S_2O_3$ as the titrant. $Na_2S_2O_3$ is a standard solution unstable secondary, it must first be standardized using a primary standard solution (KIO_3) to determine the concentration of $Na_2S_2O_3$.

The principle of $Na_2S_2O_3$ solution standardization is based on redox iodometric titration with KIO_3 as the primary standard. $Na_2S_2O_3$ is a reducing agent which can be standardized against iodine (oxidizing agent) by iodometric titration. A primary standard is a reagent that is easily weighed and is generally representative of the number of substances present. Excess potassium iodide in an acidic medium liberates iodine, which is then re-titrated with sodium thiosulphate as a strong oxidizing agent using the following equation (4) and (5). The average value of $Na_2S_2O_3$ concentration was 0.11±0.0008 N based on standardization results.

$$KIO_3 + 5KI + 3H_2SO_4 \rightarrow 3K_2SO_4 + 3I_2 + 3H_2O \quad (4)$$

$$I_2 + 2\ Na_2S_2O_3 \longrightarrow 2\ NaI + Na_2S_4O_6 \quad (5)$$

Determination of The Ascorbic Acid Concentrations

Ascorbic acid was determined in two melon varieties using the titration method described in the experimental section. The results revealed that the average ascorbic acid content of Rock Melon was higher than Sky Rocket melon (table 1).

In this work, vitamin C was determined by the iodometric titration method. The basic

principle of the iodometric method in determining vitamin C levels is an iodine solution will oxidize ascorbic acid under acidic conditions to produce dehydroascorbic acid, as shown by the equation (6) below:

$$C_6H_8O_6 + I_2 \longrightarrow C_6H_6O_6 + 2I^- + 2H^+ \quad (6)$$

The unreacted iodine solution excess is titrated with the sodium thiosulfate solution as shown by equation (5). The starch is added as the titration approaches its endpoint to avoid interfering with the I_2 and $C_6H_6O_6$ reactions. The amount of vitamin C in the sample is determined by the amount of sodium thiosulfate used in the titration.

Table 1. The ascorbic acid concentrations in two melon varieties.

Samples		V $Na_2S_2O_3$ (mL)	Concentration (mg/100 g)
A	1	11.40	30.94±0.6721
	2	11.50	
	3	11.30	
B	1	11.30	31.09±0.5081
	2	11.40	
	3	11.40	
C	1	11.60	30.50±0.5081
	2	11.40	
	3	11.40	
D	1	10.80	34.02±0.2540
	2	10.80	
	3	10.70	
E	1	10.90	33.73±0.2540
	2	10.80	
	3	10.80	
F	1	10.90	33.58±0.2540
	2	10.90	
	3	10.80	

Note: A, B, C = Sky Rocket melon; D, E, F = Rock Melon; the represented value of ascorbic acid concentrations is the mean ± standard deviation.

According to table 1, it was clear that the color of the fruit flesh affects the difference in vitamin C content between two varieties of melon fruits. The flesh of the Rock Melon is orange, whereas the flesh of the Sky Rocket melon is greenish-yellow. The average ascorbic acid content of Rock Melon (33.77±0.2237 mg/100 g) is higher than Sky Rocket melon (30.84±0.3066 mg/100 g).

Melon flesh color affects the total carotenoid content, orange-fleshed melon had the highest level of carotenoid content compared to the green fleshed [6]. Other studies have reported that a catabolite of beta-carotene, is more abundant in orange netted melons like a cantaloupe than in green honeydews [11]. Watanabe and Sato also researched the carotenoid content of three watermelon cultivars with different flesh colors, watermelon with red flesh contained 35-50 μg/g lycopene, while orange flesh had a higher beta carotene content (14 μg/g) than yellow flesh (0.5 μg/g) [12]. Carotenoids are antioxidant-rich color pigments found in plants. Antioxidants are compounds that can prevent free radicals from damaging cells in the body.

According to some studies, there is a positive correlation between vitamin C and carotenoids. The chemical content of lycopene, also known as alpha-carotene, a bright red pigment carotenoid, was higher in red-fleshed pamelo oranges (32.444 mg/kg) than in white-fleshed pamelo oranges (2.801 mg/kg). The red-fleshed pamelo oranges have 0.721 mg/g of vitamin C compared to the white-fleshed pamelo oranges (0.107 mg/g) [13].

Kurniawan *et al.* (2010) carried out the same study, the content of chlorophyll, carotenoids, and vitamin C in several aquatic plants was investigated in this study [14]. According to the results of a study, the plant with the highest carotenoid content was *Nymphaea* sp., with 3.4 mg/L, and the plant with the lowest carotenoid content was *C. linum*, with 0.34 mg/L (included in the group with the dominant pigment being chlorophyll). The highest vitamin C content was found in plants with the highest carotenoids, namely *Nymphaea* sp., with a value of 14.1 mg/30 g, and the lowest vitamin C content was found in plants with the lowest carotenoid content, namely *C. linum* plant, with a value of 0.63 mg/30 g. According to this research, the higher the carotenoid content of the plants, the higher the vitamin C content of the plants.

Three melon cultivars with orange flesh (Savor, Sweetie#6, and Early Queen) had the highest antioxidant activity when compared to other cultivars. These three cultivars have high

levels of carotenoids, which may contribute to their high Trolox-equivalent antioxidant capacity. Other cultivars with greenish-white flesh, such as Swan Lake, Haogen, and Arava, have the lowest antioxidant activity [15].

According to the findings of this study, melons with orange-colored flesh had a higher vitamin C value than greenish-yellow ones. This is due to the higher carotenoid content of orange-colored flesh, which likely contributes to their Trolox-equivalent antioxidant capacity value. A high Trolox-equivalent antioxidant capacity value indicates that the compound has a high radical scavenging capacity. A high level of radical scavenging capacity is equivalent to a high level of vitamin C content.

Conclusion

There are differences in the ascorbic acid concentrations of the two melon varieties. Flesh color affects the difference in the ascorbic acid content between two varieties of melon fruit. The results recorded the concentrations of ascorbic acids in Sky Rocket melon (greenish-yellow colored flesh) were higher than Rock Melon (orange-colored flesh). Varieties with high ascorbic acid levels may provide producers with a competitive marketing and supply niche.

References

1. Offor, C.E.; Okechukwu, P.C.U.; Esther, U.A. Determination of Ascorbic Acid Contents of Fruits and Vegetables. **2015**, *5*, 1–3, doi:10.5829/idosi.ijpms.2015.5.1.1105.
2. Padayatty, S.J.; Katz, A.; Wang, Y.; Eck, P.; Kwon, O.; Lee, J.-H.; Chen, S.; Corpe, C.; Dutta, A.; Dutta, S.K.; et al. Vitamin C as an Antioxidant: Evaluation of Its Role in Disease Prevention. *Journal of the American College of Nutrition* **2003**, *22*, 18–35, doi:10.1080/07315724.2003.10719272.
3. Dioha, I.J.; Olugbemi, O.; Onuegbu, T.U.; Shahru, Z. Determination of Ascorbic Acid Content of Some Tropical Fruits by Iodometric Titration. *International Journal of Biological and Chemical Sciences* **2011**, *5*, 2180–2184, doi:10.4314/ijbcs.v5i5.37.
4. Y. MohammedWali M. Hamad Emad K.Mohammed, Q. Spectrophotometric Determination of Total Vitamin C in Some Fruits and Vegetables at Koya Area – Kurdistan Region/ Iraq. *KUJSS* **2009**, *4*, 46–54, doi:10.32894/kujss.2009.39913.
5. Wu, X.; Diao, Y.; Sun, C.; Yang, J.; Wang, Y.; Sun, S. Fluorimetric Determination of Ascorbic Acid with O-Phenylenediamine. *Talanta* **2003**, *59*, 95–99, doi:10.1016/S0039-9140(02)00475-7.
6. Maryanto, S.D.; Ranis, R.E.; Daryono, B.S. Stability Phenotypic Characters and The Scent of Gama Melon Parfum Cultivar. *IPTEK Journal of Proceedings Series* **2015**, *1*, doi:10.12962/j23546026.y2014i1.286.
7. Majidi, M.I.H.A.; AlQubury, H.Y. Determination of Vitamin C (Ascorbic Acid) Contents in Various Fruit and Vegetable by UV-Spectrophotometry and Titration Methods. *Journal of Chemical and Pharmaceutical Sciences* **2016**, *9*, 2972–2974.
8. Rahman Khan, M.M.; Rahman, M.; M.S, I.; Ara Begum, S. A Simple UV-Spectrophotometric Method for the Determination of Vitamin C Content in Various Fruits and Vegetables at Sylhet Area in Bangladesh. *Journal of Biological Sciences* **2006**, *6*, doi:10.3923/jbs.2006.388.392.
9. Leenheer, A.P.D.; Lambert, W.E.; Bocxlaer, J.F.V. *Modern Chromatographic Analysis Of Vitamins*; 3rd ed.; University of Ghent: Ghent, 2000; ISBN 0-8247-0316-2.
10. Casella, L.; Gullotti, M.; Marchesini, A.; Petrarulo, M. Rapid Enzymatic Method for Vitamin C Assay in Fruits and Vegetables Using Peroxidase. *Journal of Food Science* **1989**, *54*, 374–375, doi:10.1111/j.1365-2621.1989.tb03084.x.
11. Saftner, R.; Abbott, J.A.; Lester, G.; Vinyard, B. Sensory and Analytical Comparison of Orange-Fleshed Honeydew to Cantaloupe and Green-Fleshed Honeydew for Fresh-Cut Chunks. *Postharvest biology and technology* **2006**, *42*, 150–160, doi:10.1016/j.postharvbio.2006.02.011.
12. Watanabe, K.; Saito, T.; Hirota, S.; Takahashi, B. Carotenoid Pigments in Red, Orange and Yellow Fleshed Fruits of Watermelon (*Citullus Vulgaris*) Cultivars. *Journal of the Japanese Society for Horticultural Science* **1987**, *56*, 45–50, doi:10.2503/jjshs.56.45.
13. Tahir, M.; Kusuma, A.T.; Ekawati, E. Analisis Kadar Likopen Dan Vitamin C Buah Jeruk Pamelo (Citrus Maxima(Burm) Merr) Varietas Daging Merah Dan Putih Asal Sulawesi Selatan. *JCPS (Journal of Current Pharmaceutical Sciences)* **2018**, *2*, 125–130.
14. Kurniawan, M.; Izzati, M.; Nurchayati, Y. Kandungan Klorofil, Karotenoid, Dan Vitamin C Pada Beberapa Spesies

Tumbuhan Akuatik. *Buletin Anatomi Dan Fisiologi dh Sellula* **2010**, *18*, doi:10.14710/baf.v18i1.2614.
15. Salandanan, K.; Bunning, M.; Stonaker, F.; Külen, O.; Kendall, P.; Stushnoff, C. Comparative Analysis of Antioxidant Properties and Fruit Quality Attributes of Organically and Conventionally Grown Melons (Cucumis Melo L.). *HortScience* **2009**, *44*, 1825–1832, doi:10.21273/HORTSCI.44.7.1825.