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Research on Nutritional Composition of Tomatoes Fruit (*Solanum Lycopersicum* L.) Grown in Vietnam

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Abstract: Tomatoes are consumed worldwide as fresh vegetables because of their high content of essential nutrients. Some physiological and biochemical indicators of ripe tomatoes grown in Vietnam were analyzed to determine the nutritional components. Research results show that tomatoes should be harvested 46 days after anthesis (DAA) to ensure the yield and nutritional value of the fruit during storage. At this time, the fruit contains many main nutrients such as reducing sugars, vitamin C, amino acids, organic acids, mineral elements.

Keywords: Nutritional Components, Tomatoes.

Research Paper

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1. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) belong to the Solanaceae family originating from South America, this is a widely grown plant that varies in tropical and subtropical climates (Bhatia *et al.*, 2004; Morton, 1982). With the advantage of being an easy-to-grow, nutritious and high-yield fruit, tomatoes have become a potential crop in the world, contributing to economic development and improving the lives of farmers (Sulunke *et al.*, 1974; Erba *et al.*, 2013).

Studies have shown that tomatoes contain many nutrients that are beneficial to human health. Tomatoes have many vitamins, minerals and trace minerals that are easily absorbed, helping the body strengthen immunity and prevent infections (Ali *et al.*, 2021). Tomatoes are also an excellent source of nutrients and bioactive compounds, commonly known as secondary metabolites, the concentrations of which are correlated with the prevention of human chronic degenerative diseases, such as cardiovascular disease, cancer, and neurodegenerative diseases (Agarwal and Rao, 2000; Cheng, 2019; Willcox *et al.*, 2003).

Although scattered data are available, there is a lack of updated compiled information on the nutrient composition and the health benefits of tomatoes. Determining the nutritional content of fruit at the time of ripeness is very important to help consumers evaluate the nutritional, medicinal and economic value of the fruit for the most effective use. Therefore, we collected samples and analyzed physiological and biochemical indicators to determine the nutritional composition of tomatoes to help consumers use and preserve the fruit better.

2. MATERIALS AND METHODS

2.1. Research Materials

Tomatoes fruit were harvested in Thanhhoa Province, Vietnam. Physiological and biochemical indicators were analyzed at the Biology Laboratory, Hongduc University and the National Institute for Food Control.

2.2. Research Methods

The length and diameter of the fruit were measured by a Panme caliper and accurate to mm. Determining the fruit volume by measuring the volume of water occupying the fruit in the measuring tubes (Minh and Khanh, 1982). Determining water content, and dry matter content in fruit by electronic scales and desiccators. The electronic balance was used to determine the fresh fruit weight with a precision of 10^{-4}. Quantification of reducing sugar and starch by the Bertrand method (Mui, 2001; Chau *et al.*, 1998). Quantification of total acid by Ermacov (Ecmacov, 1972). Quantification of vitamin C by titration method (Arya *et al.*, 200). The content of total amino acids was analyzed at the National Institute for Food Control. Quantification of mineral elements (Ca, Mg, K, Fe, Na, P, Zn, Cu, Mn) by ICP - OES atomic emission spectroscopy (Mui, 2001). The content of vitamins B1, B6, E, A, and amino acids was determined at the National Institute for Food Control.

3. RESULTS AND DISCUSSION

To evaluate the quality of tomato at the time of physiological maturity, we carried out analyzes of some morphological and anatomical characteristics of fruit (Table 1), some nutritional components of fruit (Table 2), amino acid composition (Table 3) and the content of some mineral elements (Table 4).

At 46DAA, the tomato had a spherical shape with a length of 5.87 mm, a diameter of 6.19 mm. The fruit had a volume of 126.05 cm^3 and a weight of 104.55 g. At 46 DAA, tomato fruit has its characteristic colors (Figure 1), when the fruit is ripe, it has red color and the fruit almost reaches maximum size. This result is consistent with the physiological characteristics of ripe fruit (Charoenchongsuk *et al.*, 2015).

Figure 1: Tomato fruit at 46 DAA

Table 1: Some morphological and anatomical characteristics of tomato

Physiological criteria	Value	Unit
Length of fruit	5.87 ± 0.12	mm
Diameter of fruit	6.19 ± 0.15	mm
Volume of fruit	126.05 ± 0.24	cm^3
Weight of fruit	104.55 ± 0.17	gam
Color, shape of fruit	The fruit is spherical, the fruit skin is bright red (Fig. 1).	

Carbohydrate analysis yields nutritional information, standard of identity, water holding capacity, flavors, desirable textures, and stability of food products (BeMiller, 2010). We discovered that at 46DAA, tomatoes have a reducing sugar content equal to 3.47% of fresh fruit, then the reducing sugar content gradually decreases. Meanwhile, the amount of starch is low and gradually decreases after 46 days, reaching 0.54% of fresh fruit. At the time of physiological maturity, tomato fruit contains large amounts of sugars such as sucrose, fructose and glucose (Ali *et al.*, 2021). These research results are consistent with the research on total sugar, which increases rapidly in the later stages of fruit development (Patel *et al.*, 2013).

When they are 46 days, the water content in the fruit is large and accounts for 93.09%, because tomatoes are succulent fruits. As the fruit develops, the total organic acid content in the fruit gradually increases and reaches a relatively high rate, when the fruit is 46DAA, this index reaches 44.14 mg/100g of fresh fruit. Meanwhile, the pectin and tannin content at 46DAA reached 0.89 mg/100g of fresh fruit and 1.22 mg/100g of fresh fruit, respectively.

The precise analysis of vitamin content is important for a standard balanced diet. Tomatoes are one of the most versatile and widely consumed vegetables in many countries and are a rich source of vitamins (Beecher, 1998); Borguini, 2009). Vitamins C, B-complex, A and E are the main types of vitamins present in tomatoes. According to the data in Table 2, at 46DAA, the fruit also contains a large amount of vitamin C (up to 33.68mg/100g of fresh fruit), then the vitamin B_1 content is 0.47 *mg/100g*, the vitamin B_6 content is 1.35 *mg/100g*. Besides that, the fruits contain large amounts of vitamin A (538.26 *IU/100g*) and vitamin E (12.44 *µg/100g*).

Proteins, which are macromolecules found in food, are important for biological functions. Protein analysis is important in characterizing the functional properties of food products (Phizicky *et al*., 2003). The results of the data in Table 2 show that the content of protein in tomato fruit was relatively high. At 46 DAA, the index reached 12.36%. Changes in the protein content indicate a change in metabolic activities during the development of the fruit. The protein in fruit mainly acted as enzymes rather than reserves (Wills *et al*., 1998).

Lipids are another group of macromolecules that are generally insoluble in water but are soluble in organic solvents. The precise and accurate analysis of lipid content in food is important in ensuring manufacturing specification (Christie, 1997). The lipid content of tomato fruit was relatively high; at 46DAA, the lipid content reached 2.15%. The decrease in lipids is due to the strong metabolism in the fruit. Under the action of the lipase enzyme, lipids are hydrolyzed to provide material and energy for respiration. This is the physiological process that takes place mainly when the fruit enters the ripening stage (Wills *et al.*, 1998).

Table 2: Some nutritional ingredients in tomato

No.	Ingredient nutrition	Value	Unit
1	Water content	93.09 ± 1.39	%
2	Dry matter	6.91 ± 0.25	%
3	Reducing sugar	3.47 ± 0.18	%
4	Starch	0.54 ± 0.07	%
5	Organic acids	44.14 ± 0.75	mg/100g fresh fruit
6	Vitamin C	33.68 ± 0.28	mg/100g fresh fruit
7	Vitamin A	538.26 ± 3.51	IU/100g fresh fruit
8	Vitamin E	12.44 ± 0.34	µg/100g fresh fruit
9	Vitamin B_1	0.47 ± 0.06	mg/100g fresh fruit
10	Vitamin B_6	1.35 ± 0.14	mg/100g fresh fruit
11	Pectin	0.89 ± 0.11	mg/100g fresh fruit
12	Tanin	1.22 ± 0.09	mg/100g fresh fruit
13	Protein	12.36 ± 1.26	%
14	Lipid	2.15 ± 0.04	%
15	β-caroten	6325.37 ± 201.18	µg/100g fresh fruit
16	Lycopen	4076.54 ± 136.42	µg/100g fresh fruit

Amino acids are proteins that perform important functions in the body, including maintaining cell structure, transporting and storing nutrients, and repairing damaged tissues (Elango and Laviano, 2017). A total of 16 amino acids have been identified in tomato (Table 3, Fig. 2). The amino acid content in tomato at physiological maturity (46 DAA) was relatively high, with histidine for 19.23 *mg/100g*, followed by acids such as glutamic acid (12.04 *mg/100g*), alanine (9.68 *mg/100g*), arginine (5.93 *mg/100g*), aspartic acid (5.52 *mg/100g*), serine (4.91 *mg/100g*). The lowest concentration of amino acids is lysin (1.22 *mg/100g*), followed by methionine (1.31 *mg/100g*) and valine (1.62 *mg/100g*). Thus, in the tomato at the time of physiological maturity, there is a full range of amino acids in a large proportion, which contains adequate amino acids that are not replaced.

Table 3: Composition of amino acids

No.	Amino acid	Value (mg/100g)
1	Aspartic acid	5.52 ± 0.03
2	Glutamic acid	12.04 ± 0.12
3	Serine	4.91 ± 0.05
4	Histidine*	19.23 ± 0.14
5	Arginine	5.93 ± 0.05
6	Glycine	2.50 ± 0.01
7	Threonine*	2.39 ± 0.01
8	Tyrosine	1.74 ± 0.01
9	Alanine	9.68 ± 0.02
10	Valine*	1.62 ± 0.01
11	Methionine*	1.31 ± 0.01
12	Phenylalanine*	2.74 ± 0.03
13	Isoleucine*	2.41 ± 0.02
14	Leucine*	2.03 ± 0.02
15	Lysin*	1.22 ± 0.01
16	Prolin	3.44 ± 0.06

*Of which: *: are non-replaced amino acids*

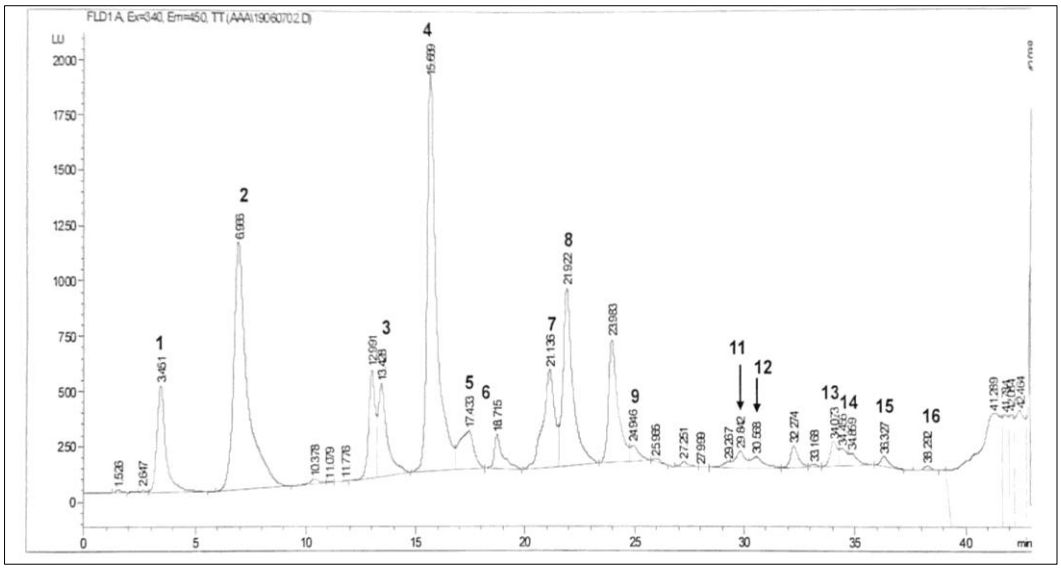

Figure 2: Amino acid composition chromatogram

Table 4: Composition of some mineral elements

No.	Mineral composition	Value (mg/100g)
1	Na	68.43 ± 0.21
2	Fe	4.50 ± 0.06
3	K	1500.0 ± 1.45
4	Mg	94.44 ± 0.25
5	Ca	137.07 ± 0.54
6	P	215.09 ± 0.67
7	Zn	2.15 ± 0.05
8	Mn	0.56 ± 0.01
9	Cu	0.49 ± 0.09

Minerals are essential for many body functions, including regulating metabolic processes, forming important organs, maintaining physiological functions, balancing blood pressure, and nerve transmission... (Baer *et al*., 1970; Gopalan *et al*., 1980). From a nutritional perspective, tomato is a good source of minerals and other elements. The highest proportion of minerals in tomatoes at physiological maturity (46 DAA) is potassium 1500.0 *mg/100g*, followed by phosphorus 215.09 *mg/100g*, calcium 137.07 *mg/100g*, magnesium 94.44 *mg/100g* and sodium 68.43 *mg/100g*. Some mineral components have lower concentrations in fresh fruit such as iron 4.50 *mg/100g*, zinc 2.15 *mg/100g*, manganese 0.56 *mg/100g* and copper 0.49 *mg/100g*. Thus, tomatoes contain many mineral elements and have high concentrations.

4. CONCLUSION

Through the research process, we found that tomatoes at 46 DAA are of good quality, containing high levels of sugar, vitamin C, vitamin B1, vitamin B6, lipids and protein... In addition, high water content helps the body hydrate easily. Lycopene and β-carotene are two main active ingredients in tomatoes with strong antioxidant properties, which are linked to many health benefits, including cancer and heart. This fruit contains a full range of amino acids, including 8 irreplaceable amino acids. In addition, tomatoes also contain many high-quality mineral elements. Therefore, tomatoes are an excellent source of nutrition and very useful in disease prevention.

REFERENCES

- Agarwal, S., & Rao, A. V. (2000). Tomato lycopene and its role in human health and chronic diseases. *Cmaj*, *163*(6), 739-744.
- Ali, M. Y., Sina, A. A. I., & Khandker, S. S. (2021). Nutritional Composition and Bioactive Compounds in Tomatoes and Their Impact on Human Health and Disease: A Review. Foods, *10*(1), 45.
- Arya, S. P., Mahajan, M., & Jain, P. (2000). Nonspectrophotometric methods for the determination of Vitamin C. *Analytica Chimica Acta*, Amsterdam, 417.
- Baer, L., Platman, S. R., & Fieve, R. R. (1970). The role of electrolytes in affective disorders: sodium, potassium, and lithium ions. *Archives of General Psychiatry*, *22*(2), 108-113.
- Beecher, G. R. (1998). Nutrient content of tomatoes and tomato products. *Proceedings of the Society for Experimental Biology and Medicine*, *218*(2), 98-100.

- BeMiller, J. N. (2010). *Food Analysis*. Springer; Boston, MA, USA: Carbohydrate Analysis, 147-177.
- Bhatia, P., Ashwath, N., Senaratna, T., & Midmore, D. (2004). Tissue culture studies of tomato (*Lycopersicon esculentum*). *Plant Cell, Tissue and Organ Culture*, *78*, 1-21.
- Borguini, R. G., & Ferraz da Silva Torres, E. A. (2009). Tomatoes and tomato products as dietary sources of antioxidants. *Food Reviews International*, *25*(4), 313-325.
- Charoenchongsuk, N., Ikeda, K., Itai, A., Oikawa, A., & Murayama, H. (2015). Comparison of the expression of chlorophyll-degradation-related genes during ripening between stay-green and yellow-pear cultivars. *Scientia Horticulturae*, *181*, 89-94.
- Chau, P. T. T., Hien, N. N., & Tuong, P. G. (1998). *Biochemistry practice*. Education Publisher, Hanoi, Vietnam.
- Cheng, H. M., Koutsidis, G., Lodge, J. K., Ashor, A. W., Siervo, M., & Lara, J. (2019). Lycopene and tomato and risk of cardiovascular diseases: A systematic review and meta-analysis of epidemiological evidence. *Critical reviews in food science and nutrition*, *59*(1), 141-158.
- Christie, W. W. (1997). *Advances in Lipid Methodology*. Volume 4 Woodhead Publishing Ltd.; Cambridge, UK: 1007.
- Ecmacov, N. A. (1972). *Metodu biochemichexki isledovania rastenii izdatelstvo "Kolos"*. Leningrad.
- Elango, R., & Laviano, A. (2017). Protein and amino acids: key players in modulating health and disease. *Current Opinion in Clinical Nutrition & Metabolic Care*, *20*(1), 69-70.
- Erba, D., Casiraghi, M. C., Ribas-Agustí, A., Cáceres, R., Marfà, O., & Castellari, M. (2013). Nutritional value of tomatoes (*Solanum lycopersicum* L.) grown in greenhouse by different agronomic techniques. *Journal of Food Composition and Analysis*, *31*(2), 245-251.
- Gierson, D., & Kader, A. A. (1986). Fruit ripening and quality. In *The tomato crop: A scientific basis for improvement* (pp. 241-280). Dordrecht: Springer Netherlands.
- Gopalan, C., Sastri, B. R., & Balasubramanian, S. (1980). *Nutrition Value of Indian Foods*. National Institute of Nutrition; Hyderabad, India.
- Minh, N. D., & Khanh, N. N. (1982). *Plant Physiology Practice*, Education Publisher, Hanoi, Vietnam.
- Morton, J. F. (1982). The tree tomato, or" tamarillo", a fast-growing, early-fruiting small tree for subtropical climates. In *Proceedings of the Florida State Horticultural Society* (Vol. 95, pp. 81-84).
- Mui, N. V. (2001). *Biochemistry Practice*, Hanoi National University Publisher, Vietnam.
- Patel, P. R., Gol, N. B., & Rao, T. V. R. (2011). Physiochemical changes in sunberry (*Physalis minima* L.) fruit during growth and ripening. *Fruits*, *66*(1), 37-46.
- Phizicky, E., Bastiaens, P. I., Zhu, H., Snyder, M., & Fields, S. (2003). Protein analysis on a proteomic scale. *Nature*, *422*(6928), 208-215.
- Salunkhe, D. K., Jadhav, S. J., & Yu, M. H. (1974). Quality and nutritional composition of tomato fruit as influenced by certain biochemical and physiological changes. *Qualitas plantarum*, *24*, 85-113.
- Willcox, J. K, Catignani, G. L., & Lazarus, S. (2003). Tomatoes and cardiovascular health. *Critical Reviews in Food Science and Nutrition, 43*, 1, 1-18.
- Wills, R. H., Mcglasson, B., Graham, D., & Joyce, D. (1998). *Postharvest: an introduction to the physiology and handling of fruit, vegetables and ornamentals.* 4thed. Wellington: CAB International. 262p.