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DETERMINATION OF THE CONTENT OF AMINO ACIDS IN SOLANUM LYCOPERSICUM SEEDS

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Abstract
This article discusses information about the Solanum lycopersicum plant, its chemical composition, its importance in medicine, and the determination of the amino acid content of Solanum lycopersicum extract by high-performance liquid chromatography, as well as its physicochemical properties and spectral characteristics.

Keywords: Solanum lycopersicum, amino acid, Leucine, Isoleucine, Valine, Phenylalanine, Tryptophan, Threonine, Methionine, Histidine, Alanine, Aspartic acid, Glutamic acid, Glycine, Proline, Serine, Tyrosine, Arginine.

Introduction

Today, it is difficult to imagine our people's table without vegetables and melons. That is why in recent years, great attention has been paid to the cultivation of vegetables and melons in the republic. Based on this, the population's interest in vegetable crops and their cultivation is growing. This, in turn, improves the material well-being, lifestyle and healthy nutrition of families, ensures that their free time is occupied with useful work, and is also an important source of filling our markets with various vegetable products. As is known, each country depends on its agriculture and the level of food security. Due to the planned expansion of the area of vegetable crops in our country from year to year, more and more vegetable products are being grown. Today, while there is a threat of food shortages in the markets of some countries, our President Sh. The instructions of M. Mirziyoyev and the government of the republic on the further development of the industry make the issue of increasing and exporting

vegetable and melon products a key task. The Resolution of the President of the Republic of Uzbekistan No. PQ-3978 dated October 17, 2018 “On additional measures to increase the efficiency of exporting fruit and vegetable products to foreign markets” and the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 935 dated November 20, 2018 “On additional measures to increase the volume of fruit and vegetable processing in the republic in 2019-2020” are also devoted to this area. It states, among other things: "Great attention is being paid to increasing the production of fruits, grapes, vegetables, melons, legumes and increasing export volumes based on the effective use of household and personal plots of land. At the same time, an analysis of the commissioning of new capacities for the processing (drying) of fruit and vegetable products grown in household and personal plots of land shows the need to further develop activities in this area in some districts of the republic and take measures to implement new projects."

THEORETICAL PART

Tomato (Solanum lycopersicum) is an annual, perennial herbaceous plant in tropical climates. It is widely cultivated as a vegetable crop. Although the scientific terminology uses the name tomato, in Uzbekistan both the plant and the fruit are called pomodoro or "pamildori" (among the people). Tomato is derived from the Italian word pomo d'oro, which means "golden apple". In English, Japanese, and Korean it is called tomato, in Chinese it is called shu fan qie, in French it is called arbe a tomates, tomate arbustive, in German it is called tomatobaum, zbaumtomate, baumtomatenstrauch, and in Spanish it is called tomate. It first originated from the American continent. Later, after the Spanish began to establish colonies in America, it spread throughout the world. Nowadays, many varieties of tomatoes are grown in different countries of the world. Tomatoes are consumed both raw and as an ingredient in various dishes and sauces or drinks. The tomato plant usually grows to a height of 1-3 meters. The stem is loose, often spreading along the ground and not entangling other plants. The root system of the tomato is highly branched, penetrating deep (up to 150 centimeters) layers of the soil and can grow up to 1.5-2.5 meters in diameter. When there is sufficient moisture, roots easily appear from all parts of the stem, so tomatoes can be propagated not only by seeds, but also vegetatively. The stem of the tomato is herbaceous, erect or prostrate, strongly or weakly branched, and grows from 30 centimeters to 2-3 meters, depending on the type of stem. Depending on the structure of the stem and leaves, tomatoes are divided into 3 types: a thick stem with a stem, less branched, erect even with fruits; The stem is thin, strongly branched, and droops under the weight of the fruit; large potato-like leaves. Tomato stems are

also divided into determinant (the main stem and side branches grow moderately, ending with the formation of a flower head) and indeterminate (the main stem is distinguished by strong growth, and when the side branches are removed, it can grow up to 2-3 meters). Determinant tomato varieties are planted in the open field, while indeterminate varieties are grown mainly in greenhouses. The flowers are bisexual, small, yellow, usually with 5-7 petals. The stamens are 5-6, arranged in a cone shape. In most varieties, the flower's ovule is located inside a cone of stamens, which requires the tomato crop to be self-pollinating in 95% of cases. In some varieties or in adverse weather conditions (hot temperatures), the pollinator beak is located higher than the pollinators, in which case tomato flowers can be pollinated from the outside with the help of insects or wind. The fruit is a two-, three- and multi-chambered, watery, berry. The weight of the fruit is from 50 to 1000 grams; the color can be red, pink, yellow, purple, white and even black; the shape can be round, round-flat, pear-shaped, plum-shaped. The seeds are small, flat, pointed, hairy, yellow-gray in color, 1000 seeds weigh 2.5-4.0 grams, and remain viable for up to 4-6 years. Tomato is a thermophilic plant. For its normal growth and development, the optimal temperature is 20-25 ° C and the relative humidity of the air is 40-65%. When the temperature drops below 15°C, growth slows down, and at 0-1°C it stops growing altogether, and at 1-2°C the plant dies. Extremely high temperatures (35 °C<t) also have a negative effect on the growth and development of tomato plants. In addition, tomatoes are light-loving plants, and when grown in the shade, their stems grow thin and long, and they do not produce fruit. Solanum lycopersicum seed and finished product Figure 1. [1-7]

Figure 1. Solanum lycopersicum seed and finished product

Solanum lycopersicum is currently one of the most widely cultivated vegetable crops in the world due to its valuable and dietary properties. To date, more than 1,000 different varieties of tomatoes have been created, which are grown in open and protected areas (for example, in greenhouses). Currently, about 4.4 million hectares (2009) of the world are planted with tomatoes, producing a total crop of 153 million tons.

The main tomato-growing countries are China (45.4 million tons), the USA (14.14 million tons), India (11.15 million tons), Turkey (10.7 million tons), Egypt (10.0 million tons). In Uzbekistan, tomatoes are one of the main vegetable crops, accounting for 40-45% of the total area of vegetable crops. In 2010, tomatoes were grown on 75,000 hectares in Uzbekistan. 70% of the total yield is processed, 10-15% is sold on the local market, and 15-20% is exported. Tomatoes are a popular vegetable grown and consumed worldwide due to their nutritional benefits. The aim of the study was to determine the chemical composition (dry matter, soluble solids, titratable acidity, vitamin C, lycopene), taste. The results of the analysis showed that during ripening, the content of soluble solids increases by an average of two times in all analyzed varieties; the highest content of vitamin C and lycopene was determined in tomatoes of the Sunstream variety at the red stage, and the highest total acidity, expressed as citric acid g 100 g -1, was observed at the pink stage (varieties Sakura) or the breaking stage (varieties Sunstream and Mathew). has a significant effect on tomatoes.[3-4]

Vegetables are one of the main types of food due to their palatability, nutritional value and medicinal properties. The nutritional value of vegetables is determined by the amount of carbohydrates, proteins, fats and other substances they contain. The biochemical composition of vegetables consists mainly of water (60-90%), and dry matter in cucumbers, tomatoes -4-7%, in root vegetables - 11-17%, in green peas - 24%, in garlic - up to -35%. Therefore, the nutritional value of vegetables is not high. One kg of the most consumed vegetables has an energy content of 150-400 kcal or 600-1700 kJ. Vegetables as food cannot satisfy the energy needs of the body. However, they serve as a source of biologically active substances, vitamins, enzymes, proteins, oils, carbohydrates, mineral salts, etc. necessary for the human body. The role of vitamins in human life and healthy nutrition is great. [7-10]

Regarding the essential classification of amino acids, according to the synthesis method and metabolic requirements of amino acids in the body, amino acids can be divided into essential amino acids and non-essential amino acids. Essential amino acids are amino acids that the human body cannot synthesize on its own and must be obtained from food. There are 9 essential amino acids for adults and 10 essential amino acids for infants. Common essential amino acids include: Leucine, Isoleucine, Valine, Phenylalanine, Tryptophan, Threonine, Methionine, Histidine, Alanine, Aspartic acid, Glutamic acid, Glycine, Proline, Serine, Tyrosine, Arginine. (essential for infants). Non-essential amino acids are amino acids that the human body can synthesize on its own. Their synthesis in the body usually depends on other amino acids or metabolites. Common non-essential amino acids include: Alanine, Aspartic acid, Glutamic acid, Glycine, Proline, Serine, Tyrosine, Arginine. (essential for

children). Conditionally essential amino acids are amino acids that, although they can normally be synthesized in the body, under certain conditions (illness, physical stress, etc.), are insufficient in the body and must be obtained from exogenous sources. These amino acids include: Cysteine, Glutamine. Tyrosine, Arginine.

Amino acids are the building blocks of proteins, and almost all life processes are inseparable from proteins. Proteins are involved in various functions in the body, including enzyme catalysis, hormone synthesis, immune response, cell repair, etc. Amino acids can be used as a source of energy. When carbohydrates and fats are not enough to provide energy, amino acids can be converted into glucose or fatty acids by removing amino acids (deamination) to provide energy. Amino acids are involved in various metabolic processes in the body. For example, glutamate and aspartic acid are important metabolic intermediates and are involved in nitrogen metabolism and waste elimination. Some amino acids, such as tryptophan and tyrosine, are precursors of neurotransmitters (e.g. serotonin, dopamine, norepinephrine) that affect mood, cognition, and behavior. Amino acids also play an important role in the immune system. Glutamine is one of the main energy sources for immune cells, helps boost immunity, and helps repair cells. Amino acids, especially branched-chain amino acids (such as leucine, isoleucine, and valine), are essential for muscle repair and growth. Supplementing with amino acids after exercise can help speed up muscle recovery and reduce muscle damage.

Amino acids can be obtained through food or through synthesis in the body. Common sources of amino acids include: Animal protein: contains all the essential amino acids, such as meat, fish, eggs, dairy products, etc., and is usually considered a high-quality protein. Plant protein: such as soy, beans, nuts, whole grains, etc. Although some plant proteins lack certain essential amino acids, a complete spectrum of amino acids can be obtained through a rational combination. Amino acid supplements: used by athletes, the elderly, or people with specific health conditions. Common ones include branched-chain amino acids and single amino acid supplements. Amino acid metabolism involves the metabolic process of amino acids, including synthesis and degradation. Amino acids in the body participate in metabolism in the following ways: Deamination: Removal of amino acids to produce ammonia, which is excreted from the body via the urea cycle. This process releases the energy of the amino acid. Amino acid transamination: Amino acids can transfer their amino acids to synthesize other amino acids or metabolites through transaminases. Amino acid synthesis: Non-essential amino acids are synthesized in the body through metabolic pathways.

Amino acid deficiency: Long-term deficiency of essential amino acids can lead to malnutrition, decreased immune function, muscle atrophy, growth and development

problems. For example, lysine and tryptophan deficiency can lead to growth retardation, decreased immunity, etc. Excessive consumption of amino acids: Although amino acids are essential for the body, excessive consumption of some amino acids can increase the burden on the kidneys and even lead to metabolic diseases. Excessive branched-chain amino acids can affect the synthesis of neurotransmitters, and excess methionine can cause problems such as vascular sclerosis. In summary, amino acids are not only the basic units of protein, but they also play an important role in various physiological functions in the body. Adequate intake of amino acids, especially essential amino acids, is essential for maintaining health, promoting growth and development, strengthening immunity, and supporting recovery from exercise. [11].

DISCUSSION OF RESULTS

The content of amino acids in Solanum lycopersicum seeds was determined qualitatively and quantitatively using standard samples from Sigma Aldrich (Germany) using a fluorescence (FLD) detector on a high-performance liquid chromatography (HPLC) Agilent 1260 II Infiniti device manufactured by Agilent Technologies, USA (Agilent). The stationary phase was a Poroshel 120 EC-C-18 (150 mm × 4.6 mm × 4 µm) USA column. Pre-column derivatization was performed in an automatically programmed mode. For this, the following substances were initially derivatized: a) O-phthalaldehyde and 3-mercaptopropionic acid solution. b) 9-methylchloroformate fluorene solution.

The analysis of aminooxylates was carried out using mobile phase A - sodium dihydrogen phosphate solution (40 mM) pH 7.8 and mobile phase B - acetonitrile: methanol: water (45:45:10) in a variable mode. The values given in Table 1 are: **Table 1**

Time	Phase A % sodium dihydrogen phosphate solution (40 mM) pH 7.8	Phase B % Acetonitrile: methanol: water (45:45:10)
0.0	98	2
16	70	30
23	57	43
26	0	100
28	98	2
30	98	2

The flow rate was 1 ml/min, the thermostat temperature was 400C, the injected sample volume was 2 µl, the analysis time was 30 min, and the chromatography of the working standard solution was shown in Figure 2.

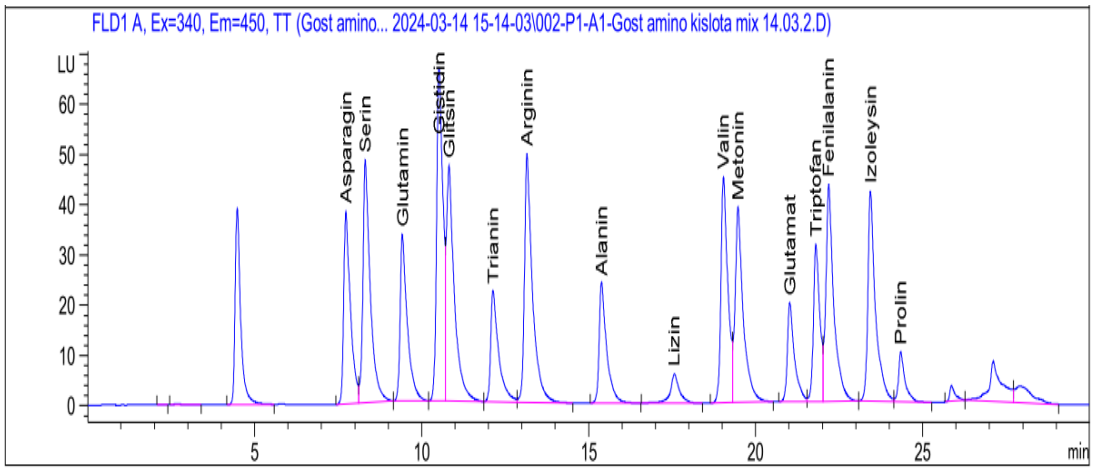

Figure 2. Chromatography of working standard solution

The chromatogram of 16 different types of amino acids taken from samples of Solanum lycopersicum seed for the determination of amino acids is shown in Figure 3.

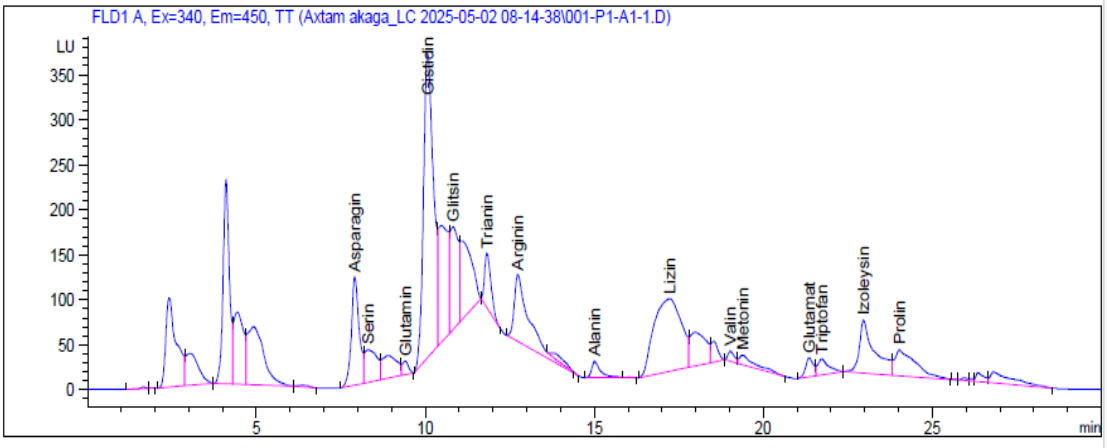

Figure 3. Chromatogram of amino acids in Solanum lycopersicum seeds

According to the above chromatogram of available amino acids, the amino acid content of Solanum lycopersicum seeds is given in Table 2.

Table 2 Amino acid content of Solanum lycopersicum seeds

№	Amino acids name	Amino acids chemical formula	Amino acids mg/gr	№	Amino acids name	Amino acids chemical formula	Amino acids mg/gr
1	Asparagine	$C_4H_8N_2O_3$	1.540	9	Lysine	$C_6H_{14}N_2O_2$	0.077
2	Serene	$C_3H_7NO_3$	0.523	10	Valine	$C_5H_{11}NO_2$	0.078
3	Glutamate k-ta	$C_5H_9NO_4$	0.155	11	Methionine	$C_5H_{11}SHO_2$	0.204
4	Histidine	$C_6H_9N_3O_2$	3.493	12	Glutamine	$C_5H_{10}N_2O_3$	0.484
5	Glycine	$C_2H_5NO_2$	1.109	13	Phenylalanine	$C_9H_{11}NO_2$	-
6	Threonine	$C_4H_9NO_3$	0.911	14	Tryptophan	$C_{11}H_{12}N_2O_2$	-
7	Arginine	$C_6H_{14}N_4O_2$	1.189	15	Isoleucine	$C_7H_{15}NO_2$	1.176
8	Alanine	$C_3H_7NO_2$	0.385	16	Proline	$C_5H_9NO_2$	3.056
	Total						14.38

The table above shows the content of 16 amino acids in 1 g of Solanum lycopersicum seeds. According to the results of the analysis, the content of amino acids was determined to be 14.38 mg/g.

The chromatographic studies show that Solanum lycopersicum contains various amino acids necessary for the human body and their content was determined.

CONCLUSION:

When the amino acid content of Solanum lycopersicum seeds was studied using high-performance liquid chromatography (HPLC), it was found that 14.38 mg of 16 amino acids were contained in a 1 g sample of Solanum lycopersicum seeds.

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