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STUDY OF THE COMPOSITION OF FREE AMINO ACIDS IN THE FRUITS OF FENNEL (FOENICULUM VULGARE MILL.)

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Annotation
The free amino acids of the fruit of the fennel were studied by the HPLC method. It revealed 20 amino acids with a total content of 35 mg/g. Among them, proline (4,798 mg/g) was dominant, and the amount of cysteine (0,156 mg/g) was minimal. The results obtained can be used in the study of biochemical processes in the raw material and in the development of regulatory documents for it.

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Introduction. Fennel (*Foeniculum vulgare Mill.*) is a plant of the Apiaceae or Umbelliferae family [1], growing in the Mediterranean Sea and common in almost all regions of the world [2]. Its fruits are rich in essential oil, containing up to 6%. Fennel leaf extracts contain vitamins A, C, B_1, B_2, PP, elements such as potassium, sodium, calcium, manganese [3] and fatty acids [4]. In addition, flavonoids and phenolic acids have been studied in the plant [5]. Fennel has been shown to exhibit blood-thinning, hepatoprotective, hypolipidemic and other similar pharmacological effects [6,7]. In

folk medicine, it is used as a lactogenic agent, as well as to eliminate flatulence and to treat diseases of the oral cavity [8]. It is known that various low-molecular compounds participate as starting substances in the formation of biologically active compounds in plants, and amino acids can serve as an example of this. For example, flavonoids and alkaloids are synthesized from them. They are found in plant materials in free and bound states. Their analysis allows us to understand the biochemical processes occurring in plant materials. Given the above, since there is insufficient information about the amino acids of fennel fruits, which are widely used in pharmaceuticals and in the food industry, the purpose of the study was to study them.

Research results. According to the results of the study, 20 free amino acids were found in the composition of the fruits of fennel, the total amount of which was 35 mg/g. According to the classification of functional groups, 5 of them were included in the monoaminomonocarboxylic groups, 2 each in the groups of oxymonoaminocarboxylic, monoaminodicarboxylic, amides of monoaminodicarboxylic acids, diaminomonocarboxylic, sulfur-containing, 3 in the groups of aromatic, heterocyclic, 1 in the group of imino acids. Depending on the synthesis in the human body, there were 12 replaceable amino acids, 8 essential amino acids (tables 1, 2).

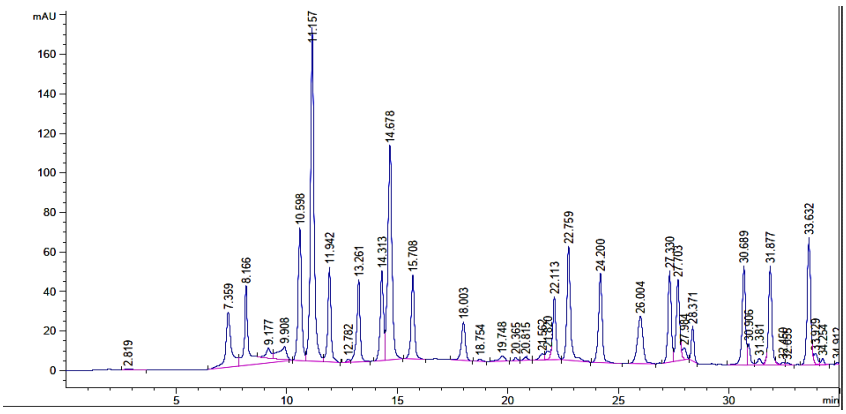


Fig. 1. Chromatogram of standard amino acid samples

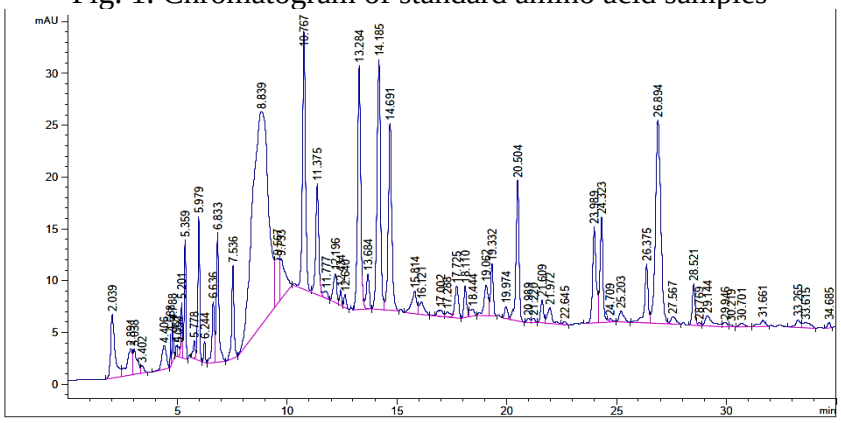


Fig. 2. Chromatogram of the test solution

Table 1. Free amino acid composition of fennel fruits

Name of amino acids	Concentration, mg/g
Aspartic acid	3,789
Glutamic acid	1,478
Serin	2,442
Glycine	0,928
Asparagine	0,952
Glutamine	0,519

Cysteine	0,156
Threonine	0,470
Arginine	1,212
Alanin	4,554
Proline	4,798
Tyrosine	0,482
Valin	2,126
Methionine	0,510
Histidine	1,462
Isoleucine	1,819
Leucine	1,978
Tryptophan	0,757
Phenylalanine	4,227
Lysine	0,335
Total	**34,994**

Table 2. Classification of identified amino acids as a result of the study

Classification of amino acids by functional groups	
Aliphatic	*Name of amino acids*
Monoaminomonocarbon	Glycine, alanin, valin, isoleucine, leucine
Oxymonoaminocarbon	Serin, threonine
Monoaminodicarbon	Aspartic acid, glutamic acid
Amides of monoaminodicarboxylic acids	Asparagine, glutamine
Diaminomonocarbon	Lysine, arginine
Sulfur-containing	Cysteine, methionine
Aromatic	Phenylalanine, tyrosine, tryptophan
Heterocyclic	Tryptophan, histidine, proline
Imino acids	Proline
Classification of amino acids by synthesis in the human body	
Replaceable	*Essential*
Glycine	Valin
Alanin	Isoleucine
Proline	Leucine
Serin	Threonine
Cysteine	Methionine
Aspartic acid	Lysine
Asparagine	Phenylalanine
Glutamic acid	Tryptophan
Glutamine	
Tyrosine	
Arginine (conditionally replaceable)	
Histidine (conditionally replaceable)	

Experimental part. The object of the study was the fruits of fennel grown in Tashkent in 2024. 1 ml (exact volume) of 20% trifluoroacetic acid was added to 1 g (exact weight) of crushed fruits of fennel and mixed. After 10 minutes, the formed precipitate was separated by centrifugation

at 8000 rpm for 15 minutes. After separating 0,1 ml of the supernatant, it was lyophilized. The hydrolyzate was evaporated, the dry residue was dissolved in a mixture of triethylamine-acetonitrile-water (1:7:1) and dried. This process was repeated twice to neutralize the acid. Determination of amino acid derivatives was carried out by HPLC (high performance liquid chromatography). Phenylthiocarbamyl derivatives of amino acids were obtained by their reaction with phenylthioisocyanate [9]. The following standards were used in the analysis: aspartic acid, glutamic acid, serine, glycine, asparagine, glutamine, cysteine, threonine, arginine, alanine, proline, tyrosine, valine, methionine, histidine, isoleucine, leucine tryptophan, phenylalanine, lysine.

Chromatography conditions:

- Equipment: Agilent Technologies 1200 chromatograph with diode array detector;
- Stationary phase: Discovery HS C18 column, 75x4.6 mm;
- Mobile phase A: 0,14 M sodium acetate + 0,05% triethylamine, pH 6,4;
- Mobile phase B: acetonitrile;
- Flow rate: 1,2 ml/min;
- Detection: 269 nm;
- Injection volume: 5 µl.

Chromatography was performed in gradient mode:

Table 3. Gradient chromatography mode program

Time, min	Mobile phase A, %	Mobile phase B, %
0	100	0
2,5	94	6
40	70	30
45	40	60
50	40	60
55	100	0

Conclusion. The composition of free amino acids of fennel fruits was studied. As a result, it was found that it contains a large amount of replaceable amino acid proline (4,798 mg/g), which simultaneously belongs to heterocyclic and imino acid groups. After proline, the following amino acids were found in similar quantities: alanine (4,554 mg/g), phenylalanine (4,227 mg/g), serine (2,442 mg/g), valine (2,126 mg/g), leucine (1,978 mg/g), isoleucine (1,819 mg/g), glutamic acid (1,478 mg/g), histidine (1,462 mg/g), arginine (1,212 mg/g), glycine (0,928 mg/g), asparagine (0,952 mg/g), glutamine (0,519 mg/g), methionine (0,510 mg/g), tyrosine (0,482 mg/g) and threonine (0,470 mg/g). Among the amino acids found, the content of cysteine (0,156 mg/g) was the lowest.

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