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Amino- and fatty acid composition of roots of the Haloxylon species from Kazakhstan

Қазақстанда өсетін Haloxylon тамырының май және амин қышқылды құрамы

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Қазақстандық Haloxylon түрлерінің тамырларының амин- және майқышқылды құрамдары, сәйкесінше аминқышқылды талдағыш пен газ хроматограф көмегімен анықталды. Зерттеліп отырған Haloxylon түрлерінің тамырларында сандық мөлшерлері бойынша ерекшеленетін 18 амин- және 8 май қышқылдары табылған. Амин- және май қышқылдарының ең көп мөлшері *H. aphyllum* тамырында анықталған. Барлық түрлерде глутамин, аспарагин, олеин, линоль, пальмитин қышқылдары басым мөлшерде кездескен.

Определены амино- и жирнокислотные составы корней казахстанских видов Haloxylon с помощью аминокислотного анализатора и газового хроматографа, соответственно. Корни исследуемых видов Haloxylon содержат по 18 амино- и 8 жирных кислот, различающихся между собой по их количественному содержанию. Наибольшее содержание амино-, жирных кислот отмечено в корнях *H. aphyllum.* Во всех видах доминируют глутаминовая, аспарагиновая, олеиновая, линолевая, пальмитиновая кислоты.

Only three species of genus Haloxylon are found in Kazakhstan: *H. aphyllum Bge.* (black saxaul), *H. persicum Bge*. (white saxaul) and *H. ammodendron Bge*. (zaisanii saxaul) [1]. The genus Haloxylon is traditionally reported for its toxically and applied externally on scorpion and snake stings. The ash is used for internal ulcers [2, 3]. Mongolian medicine uses the aerial part of *H. ammodendron Bge.* to cure cardiovascular diseases, hypertension and blood diseases [4].

H. ammodendron Bge. very few researches were done on its phytochemical content. Alkaloid ammodendrine was found in it [5]. The qualitative and quntative content of the biological active compounds of aerial part of H. ammodendrone Bge. were found to be: flavonoids (0.60 %), phenolic acids (1.49 %), carbohydrates (1.56 %), amino-acids (1.18 %) and tannins (3.64 %). In the mineral composition of the ashy residue of the plant material 42 elements were found with strontium, iron, phosphorus and manganese as major constituents [6]. Extracts from the aerial part of *H. ammodendrone Bge.* show high antioxidant activity [7]. In the aerial part of *H. persicum Bge.* alkoloids and other nitrogen compounds (anabasine, nicotin, betainchlorid), organic acids (oxalic, citric) are found. These very acids are found in the aerial part of *H. aphyllum Bge.* In addition, fruits of this plant contain vitamin P, hesperidin, and lipochromes (carotin, lutein, neoksatin, violaxanthin) [4].

The aim of this work comprises the investigation of amino- and fatty acid composition of roots of Haloxylon species.

α-Amino acids are the structural units of protein molecules. Totally, there are about 300 amino acids, however, the proteins comprise only 20 of them, named the albuminous or proteinogenic, amino acids. Proteinogenic amino acids are the α-amino acids with a common structural feature: the presence of carboxylic and amino groups. On the biological value amino acids are divided into replaceable and irreplaceable amino acids. Irreplaceable amino acids are: valine, leucine, methionine, phenil alaline, threonine, triptophane, ly-

sine. Threonine plays an essential role in the processes of synthesis of fatty acids, lipids, carbohydrates. Cysteine, cystine and methionine are the sources of organic sulphur in the contextures and organs. Lack of triptophan slows the function of genital glands [8].

Fatty acids are divided into five main groups: saturated and unsaturated, branched-chain, oxy- and cyclic acid. Qualities of fatty acids depend on the length of the chain of carbon atoms in the molecule and the level of saturation. At room temperature unsaturated fatty acids constitute oil liquid. They have a large number of non-polar C–C bonds, C–H chains, which impart a non-polar character of the whole molecule in the presence of a polar group COO. The presence of a long hydrophobic tail of the hydrophilic head attaches peculiar qualities to fatty acids and lipids, which may be simultaneously be both hydrophobious and hygrophilous compounds. Such qualities permit lipids to form a suspension and are ideal components that help to stabilize the membranes of plant cells.

It is a well-known fact that fatty acids are part of the polar and nonpolar lipids, which include svingolipids, glycerids, triacilglycerids. Probably, the appearance of fatty acids in plant extracts are due to hydrolysis of lipids in plants. Glycerids of fatty acids are physiologically active, especially glycerids of some fatty unsaturated acids. These include linoleic, linolenic and arachidonic acids, which are necessary for the vital avtivity of living organisms (a factor of vitamin F).

These acids are not synthesized in human and animals and are irreplaceable. There is an assumption that linolenic and arachidonic acid can be formed from linoleic acid at a sufficient concentration of the latter in the contexture. Polyunsaturated acids are part of the structural components of cell membranes (flexible role). Irreplaceable fatty acids are predecessors of prostaglandins — hormones of local action (prostaglandins possess regulatory properties of many biochemical reactions, are involved in the activity of the nervous system, plain muscle contraction, etc.). The most active of these acids is arachidonic acid, the biological activity of which is 10 times higher than those of linolenic and linoleic acids [9].

Roots of Haloxylon species being under investigation contain 18 amino- and 8 fatty acids, but differ by qualitative content (table 1, 2).

Table 1

Chemical composition and content of amino acids in roots of Haloxylon, %

Amino-acid	*H. persicum*	*H. aphyllum*	*H. ammodendron*
Val*	4.80	4.88	4.74
Ile*	4.29	4.33	4.21
Leu*	9.09	9.23	8.91
Lys*	3.15	3.18	3.10
Met*	1.86	1.87	1.84
Thr*	4.41	4.47	4.32
Trp*	1.21	1.22	1.22
Phe*	3.64	3.71	3.63
Ala	6.56	6.54	6.65
Arg	8.19	8.13	8.25
His	2.83	2.79	2.82
Asp	10.58	10.50	10.68
Gly	7.05	7.00	7.09
Glu	16.79	16.67	16.92
Pro	5.38	5.34	5.40
Ser	6.08	6.04	6.13
Tyr	2.60	2.60	2.63
Cys	1.48	1.50	1.50
Summation of amino-acids	4.311	5.658	5.320
Summation of irreplaceable amino- acids	1.399	1.861	1.701
Content of irreplaceable amino-acids from the total sum of amino-acids, %	32.45	32.89	31.97
Total protein, %	4.52	6.00	5.41

*Irreplaceable amino-acids.

Table 2

Chemical composition and content of fatty acids in roots of Haloxylon, %

Acid	*H. persicum*	*H. aphyllum*	*H. ammodendron*
Myristinic	0.99	1.10	1.15
Palmic	31.15	25.74	21.15
Stearinic	2.06	2.06	1.77
Myristoleic	0.45	0.35	0.42
Palmitoleic	0.84	0.50	0.63
Oleinic	27.72	23.09	24.79
Linolic	36.10	46.76	49.58
Linolenic	0.68	0.40	0.52
Summation of fatty acids	1.31	1.99	0.96
Content of saturated fatty acids from the total sum of fatty acids, %	34.20	28.90	24.06
Content of unsaturated fatty acids from the total sum of fatty acids, %	65.80	71.10	75.94

The lowest amino acid content is in roots of *H. persicum.* In all species glutamic and aspartic acids dominate. The irreplaceable amino acid content of species of Haloxylon (from the total summation of amino-acids) is approximately the same.

Fatty acids prevail in *H. aphyllum* roots. Fatty unsatured (oleinic and linolic) and satured palmic acids dominate in the content of all investigated species.

Thus, the study of fatty, amino acid composition of the genus Haloxylon, Chenopodiaceae family is of great scientific and practical interest.

Experimental

Compound of bound amino-acids was obtained with the help of amino-acid analysator branded AAA-881 (Czech Republic). Hydrolysis of samples was carried out 5,7 n. HCl during 24 h., in soldered ampoules with the temperature of 110 ºC [10].

Fatty acids analysis was carried out on gas chromatograph «Chrome 42» (Czech Republic), and adsorbent — celit on chromosorb WAW. Gas vehicle — helium, detector — flamingly-ionization, speed of gas vehicle is 30 ml/min, detector's temperature 188 ºC, stove's temperature 230 ºC. Lipoid methylation was made by sodium methylate at temperature of 60–70 ºC [11].

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