ESTONIAN AGRICULTURAL ACADEMY

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Эстонская сельскохозяйственная академия
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О СОДЕРЖАНИИ АМИНОКИСЛОТ В НЕКОТОРЫХ КОРМОВЫХ РАСТЕНИЯХ, ВЫРАЩИВАЕМЫХ В ЭСТОНСКОЙ ССР

На английском языке

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Hinnata

In connection with the realization of the Seven-Year Plan (1959-1965) for the development of the national economy of the U. S. S. R. which envisages a large-scale increase in livestock production throughout the country, including the Estonian S. S. R., the solution of the problem of increasing the protein and especially the amino acid content of forage has acquired a particular importance.

The amino acid composition of fodder plants grown in the Estonian S. S. R. had not been investigated before the authors of this paper undertook their researches. Some of the results of this work are presented below.

Methods

The amino acid composition was investigated of the herbage of white melilot ("Raadi 1"), red clover (local variety), alfalfa ("Ascania Nova") and of the herbage and tubers of four varieties of Jerusalem artichoke ("Beloklubnevy", "Lilovoklubnevy", "Zeltoklubnevy" and "Kavkaski rosovy").

The air-dry plant material (1.0 g.) was hydrolysed for 24 hours with 6 N HCl in a boiling water bath. The hydrolyzate was freed of excess hydrochloric acid by repeated evaporation. The residue was dissolved in 10% isopropanol. The amino acid composition was determined in the hydrochloric acid hydrolyzates of the plant material by tne paper partition chromatography method.

The hydrolyzates of white melilot, red clover and alfalfa were chromatographed according to the two-dimensional ascending method involving solvents that we have described in an earlier paper (A. S i i m & V. T a l i, 1959): (1) n-butanol, ethanol, ammonium hydroxide and water

(20:60:7:13) and (2) n-butanol, acetic acid and water (25:6:25). Rapid-filtering chromatographic paper of Leningrad Paper Mill No. 2 was used.

In order to determine the localization of amino acids the chromatograms were developed with a 0.5% solution of ninhydrine in ethanol. The amino acids were identified by comparing their location on the chromatogram with the location of standard amino acids on a control chromatogram obtained simultaneously and under identical conditions with the one being investigated.

For the quantitative determination of amino acids their spots were cut out and eluted with 5 ml of 75% ethanol. The solutions obtained were colorimetrized against standard ones in a ФЭК-М photoelectric colorimeter.

The quantitative determination of amino acids in the herbage and tubers of different varieties of Jerusalem artichoke was effected according to another method - that of circular paper chromatography as employed by K r i s h n a - m u r t h y and S w a m i n a t h a n (1955).

Polychromatic development with an isatine reagent according to B o y a r k i n (Бояркин, А. Н., 1956) was resorted to in order to ensure better identification when there was partial overlapping of amino acid spots in the chromatograms.

Results

The presence of the following amino acids has been determined in the herbage of all the plants investigated: cystine, cysteine, lysine, histidine, arginine, aspartic and glutamic acids, glycine, serine, threonine, alanine, proline, tyrosine, valine, methionine, phenylalanine, leucine and isoleucine (see Figure).

No varietal differences were discovered in the qualitative amino acid composition of the Jerusalem artichoke.

Quantitative determinations (the results of which are given in Table 1) showed that there are differences in the quantitative amino acid composition of individual varieties of the Jerusalem artichoke (see Table 1).

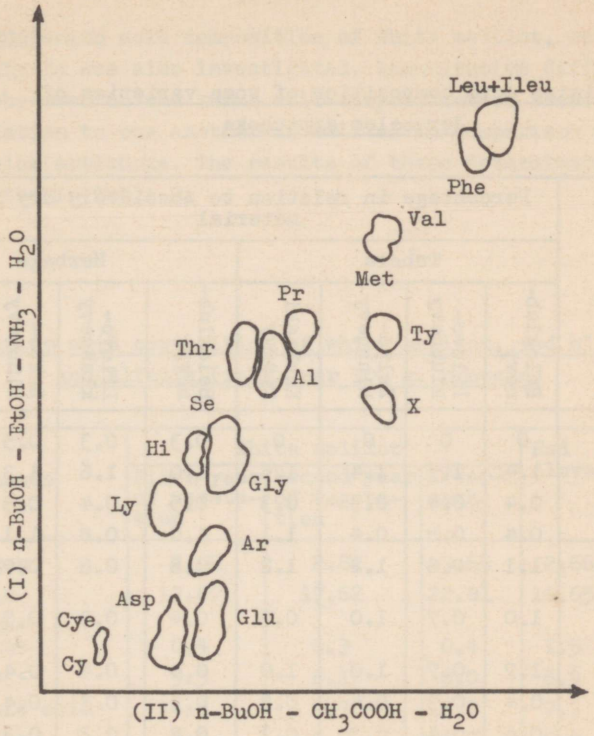

Figure. Scheme of chromatogram of acid hydrolyzate of white melilot.

Solvents: (I) n-butanol - ethanol- ammonium hydroxide - water (20:60:7:13); n-butanol - acetic acid - water (25: 6:25). Glu - glutamic acid, Asp - aspartic acid, Cy - cystine, Cye - cysteine, Ly - lysine, Ar - arginine, Hi - histidine, Gly - glycine, Se - serine, Thr - threonine, Al - alanine, Pr - proline, Ty - tyrosine, Val - valine, Met - methionine, Phe - phenylalanine, Leu - leucine, Ileu - isoleucine, X - unidentified substance coloured by ninhydrine.

Table 1

Amino acid composition of some varieties of Jerusalem artichoke

Amino acids	Percentage in relation to absolutely dry plant material							
	Tubers				Herbage			
	Beloklubnevy	Lilovo-klubnevy	Zelto-klubnevy	Kavkaski rosovy	Beloklubnevy	Lilovo-klubnevy	Zelto-klubnevy	Kavkaski rosovy
Cystine	0	0	0	0	0.3	0.3	0.5	0.4
Arginine	1.4	1.5	1.4	1.6	1.0	1.6	1.3	1.0
Alanine	0.4	0.4	0.3	0.3	0.5	0.4	0.5	0.5
Proline	0.4	0.8	0.4	1.1	1.0	0.8	1.1	1.1
Tyrosine	1.1	0.6	1.2	1.2	0.8	0.6	0.7	0.7
Aspartic acid	1.0	0.7	1.0	0.9	0.4	0.3	0.5	0.6
Glutamic acid	1.7	0.7	1.0	1.0	0.4	0.4	0.4	0.3
Serine	0.4	0.3	0.4	0.3	0.3	0.3	0.4	0.4
Glycine	0.4	0.4	0.3	0.3	0.2	0.2	0.3	0.3
Threonine	0.7	0.4	0.7	0.7	0.5	0.3	0.3	0.6

It is noteworthy that the content of arginine is conspicuously high in all the samples of Jerusalem artichoke herbage and tubers investigated (1.0 - 1.6% of absolutely dry weight) and that there is an absence of cystine + cysteine in the tubers. There is a comparatively high content of tyrosine (0.6 - 1.2%), aspartic acid (0.2 - 1.0%) and glutamic acid (0.7 - 1.7%) in the tubers of Jerusalem artichoke as compared with its herbage, where the content of tyrosine is 0.6 - 0.8%, that of aspartic acid 0.2 - 0.6%, and of glutamic acid 0.3 - 0.4%.

The amino acid composition of white melilot, red clover and alfalfa was also investigated. Quantitative differences were observed in the amino acid composition of these plants in relation to one another as well as in comparison with the Jerusalem artichoke. The results of these determinations are presented in Table 2.

Table 2

Amino acid composition of white melilot, red clover and alfalfa (in g. per 100 g. protein)

Components	White melilot			Red clover	Alfalfa
	First year of vegetation	Second year of vegetation	Aftermath		
Nitrogen	2.86	2.82	3.65	2.66	2.15
Protein	17.87	17.62	22.81	16.65	13.43
Cystine+cysteine	0.4	0.3	0.4	1.5	4.0
Lysine	9.5	8.1	8.0	6.9	6.3
Aspartic acid	14.6	9.7	12.1	7.3	15.3
Arginine	6.0	5.7	6.0	6.7	5.5
Glutamic acid	25.1	28.9	19.6	16.8	15.8
Serine+glucine+histidine	11.3	9.5	10.1	6.4	7.0
Threonine	4.5	5.2	5.4	5.0	4.7
Alanine	4.7	5.0	4.6	5.5	4.5
Proline	6.7	6.7	7.0	15.5	8.2
Tyrosine	0.3	0.3	0.3	2.0	2.3
Valine+methionine	4.2	4.4	4.2	6.6	4.4
Phenylalanine	3.2	3.8	4.3	3.5	3.1
Leucine+isoleucine	4.1	4.2	4.6	7.1	4.9
Total of amino acids	94.6	91.7	86.6	90.8	86.0

The content of cystine + cysteine, proline and tyrosine was comparatively low in the case of white melilot (0,3 - 0.4%, 6.7 - 7.0% and 0.3% of protein respectively) when compared with the content of the same amino acids in red clover (1.5%, 15.5% and 2.0% respectively) and in alfalfa (4.0%, 8.2% and 2.3% respectively). The content of glutamic acid, serine + glycine + histidine and lysine in white melilot (19.6 - 28.9%, 9.5 - 11.3% and 8.0 - 9.5% respectively), however, considerably exceeds the content of these amino acids in red clover (16.8%, 6.4% and 6.9% respectively) and in alfalfa (15.8%, 7.0% and 6.3% respectively). The aspartic acid content is low in red clover (7.3%). Differences in the content of the other amino acids are insignificant.

The Jerusalem artichoke, white melilot, red clover and alfalfa contain all the essential amino acids and constitute, biologically speaking, very valuable forage for animals.

Our further researches comprise a wider range of the most important forage plants grown in the Estonian S. S. R. Special attention is being paid to the variability of amino acid composition in its dependence on growth conditions and the vegetation period.

LITERATURE

Б о я р к и н, А. Н. Разноцветное проявление аминокислот на бумажных хроматограммах. Физиология растений, вып. 4, 1956.

S i i m, A. ja T a l i, V. Lõssi amiinohappelisest koostisest. Eesti Põllumajanduse Akadeemia teaduslike tööde kogumik 9, Tartu, 1959.

K r i s h n a m u r t h y, K. and S w a m i n a t h a n, M. Quantitative determination of amino acids by circular paper chromatography. Analytical Chemistry, 27, 1396 - 1399, 1955.

GRATIS