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DETERMINATION OF CHEMICAL COMPOUNDS OF VEGETABLE PLANTS OF THE SOLANACEAE FAMILY

Gas chromatography – mass spectrometry method was used to determine the most valuable extractive compounds of Solanaceae family vegetable plants. Samples of Potato grass, Tomato grass and Eggplant grass were harvested, dried and prepared for GC-mass spectrometry analysis after extraction by dichloromethane. As a result 20, 14 and 13 compounds were identified, accordingly, including hydrocarbons, alcohols, carbon acids, fatty acids and phytosterols. Results of research have shown that these grasses can be promising for production terpens, fatty acids, phytosterols in future and for usage of this compounds for development and manufacture of original herbal remedies.

Key words: Solanaceae family; gas chromatography – mass spectrometry; Potato; Tomato; Eggplant.

FORMULATION OF THE PROBLEM

One of the most beneficial ways of saving material resources and increase effectiveness of enterprises is a complex processing of raw materials. Therefore, urgency of the problem of rational application of plant resources is undeniable. Problem of recycling of large agricultural waste can be avoided by exploring the chemical composition of agricultural raw materials and its further application.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Solanaceae family is one of the largest families of herbs: it contains about 90 genera and 2500 species that are found almost worldwide. This family includes a number of important agriculture herbs, decorative and toxic herbs, although some toxic members of Solanaceae family are used in pharmaceutical industry [1]. Fruits of vegetable plants of Solanaceae family (e.g. Potato, Tomato, Eggplant, Pepper, Physalis) are widely used in agriculture industry, as well as in pharmaceutical industry, but aerial parts of these plants are not used because of the lack of information about their chemical compounds [2-5]. Different methods of analysis can be used for definition of chemical compound of herbs (e.g. NMR, FTIR, NIR spectroscopy, HPLC, GC-mass Spectrometry, XRF analysis, etc) [6-8]. These data provide a great deal of very useful information for the identification of herbal material and exact quantification of valuable compounds.

Regarding the aspects of quality control and “Good Manufacturing Practice”, gas chromatography is time-consuming, comparatively expensive, and requires highly qualified technicians. The coupling of GC with mass spectrometry is a powerful tool for the identification and assay of substances in herbal samples [8].

FORMULATION OF PURPOSES OF THE ARTICLE

The scope of our study was to analyze the composition of extractive substances of Potato, Tomato and Eggplant herbs using gas chromatography-mass spectrometry method as well as rapid evaluation of the most important substances directly in the herb as a useful alternative for usually applied chromatography techniques.

PRESENTATION OF THE MAIN MATERIAL

The analyzed samples of Potato, Tomato, Eggplant grasses were collected in different regions of Ukraine.

The Agilent Technologies gas chromatograph 6890 series with mass spectroscopy detector 5973 series was used; fitted with a column (30 m × 0.25 mm i. d.). The following oven temperature program was used: 50 °C for 1 min then 4 °C/ min up to 320 °C: this final temperature was held for 9 min.

Carrier gas was helium with a constant flow rate of 1.2 mL/min. Samples were starting to put into column when temperature of detector reached 250 °C.

The other compounds were approximately identified by using the Nist 05 and Wiley 138 library databases of the GC-MS system. The percentage composition was computed from the GC peak areas according to the 100 % method without using any correction factors.

The air-dried and crushed grasses were exposed to the extraction by dichloromethane in the ratio 1:20. Interior standard tridecane was added in the calculation 50 μg of the substance to a certain amount of herbal sample. Further assay of interior standard was determined and used for settlements.

After 24h extraction samples were moved to vials and then were evaporated to 50 μl volume. 1 μl of samples were put into chromatography column without any separation of stream, because this approach increases greatly the sensitivity of analysis.

The values obtained for the main components (>0.1 % of total GC peak area percentages) occurring in the analyzed Potato, Tomato and Eggplant grasses samples are presented in table 1. Gas chromatograms obtained from the Potato, Tomato and Eggplant Grasses Samples are presented on Figures 1-3, respectively.

Chemical composition of Potato, Tomato and Eggplant grasses was composed of 20, 14 and 13 identified components, accordingly, including hydrocarbons, alcohols, carbon acids, fatty acids and phytosterols. Amounts of chemical components are not equal. It can be seen that each sample shows different amounts of chemical components.

Fatty acids. In Table 1 differences in chemical compound of grasses has shown. The most various fatty acid composition is in Potato grass, some fatty acids were identified in Potato grass sample only (e.g. Decanoic acid, Lauric acid, Myristic acid and Eicosanoic acid). Tetradecanoic acid was found in Eggplant grass sample only.

Hydrocarbons. Hydrocarbon composition of Potato, Tomato and Eggplant grasses is very similar, apart from triacontane content. Some hydrocarbons were identified in Potato and Eggplant grasses in similar concentrations, but in Tomato grass hydrocarbons were found in higher concentration.

Alcohols. With regards to alcohols: content of this group of compounds in Potato, Tomato and Eggplant grasses was present by phytol mostly. Results about determination of ***terpens*** were obtained: the highest amount of these compounds is in Potato grass, composition of terpens of Eggplant grass is very poor.

Phytosterols. Phytosterols (γ-sitosterole, squalene, stigmasterole, etc.) were present in Tomato and Eggplant grasses in similar proportions, unlike Potato grass.

Table 1

GC-MS DETERMINATION OF THE MOST VALUABLE SUBSTANCES IN POTATO, TOMATO AND EGGPLANT GRASSES SAMPLES.

Sample component	RT	Content of components mg/kg		
		Potato	Tomato	Egg-plant
Fatty acids				
Decanoic acid	19,29	74,1	—	—
Lauric acid	23,09	23,8	—	—
Tetradecanoic acid	26,07	—	—	44,4
Myristic acid	26,12	25.2	—	—
Hexadecanoic acid	29,07	1709.4	2229,4	984,6
Octadecanoic acid	31,2	223,9	922,2	191,5
Linoleic acid	31,58	1623,8	1220,4	310,7
—Linolenic acid	31,92	1434,2	791,5	519,8
Eicosanoic acid	33,16	62,2	—	—
Hydrocarbons				
Heptacosane	506.3	71.5	187.6	53.3
Nonacosane	36.66	238.2	506.3	71.5
Triacontane	37.45	38.6	203.0	—
Untriacontane	38.34	417.9	2154.4	365.3
Alcohols				
Phytol	30.16	80.5	213.9	138.2
Terpens				
Loliolide	29.94	61.6	66.7	—
Dihydroactinid-iolide	25.54	32.9	—	—
Phytosterols				
Squalene	37.31	25.2	88.1	262.7
γ—sitosterole	42.9	53.3	218.6	111.2
Stigmasterole	42.49	155.6	258.0	193.4
Tocopherole	44.23	24.5	228.1	129.5

Conclusion. A good opportunity exists to very easily determine the major compounds of vegetable plants of the Solanaceae family using presented GC-mass spectrometry method established for air-dried herbs for routine analysis. Possibilities of recycling of raw materials after harvesting of fruits were proved. Results of research have shown that Potato, Tomato and Eggplant are promising plants for fatty acids, phytosterols and terpens production and developing original remedies with directed actions on its basis.

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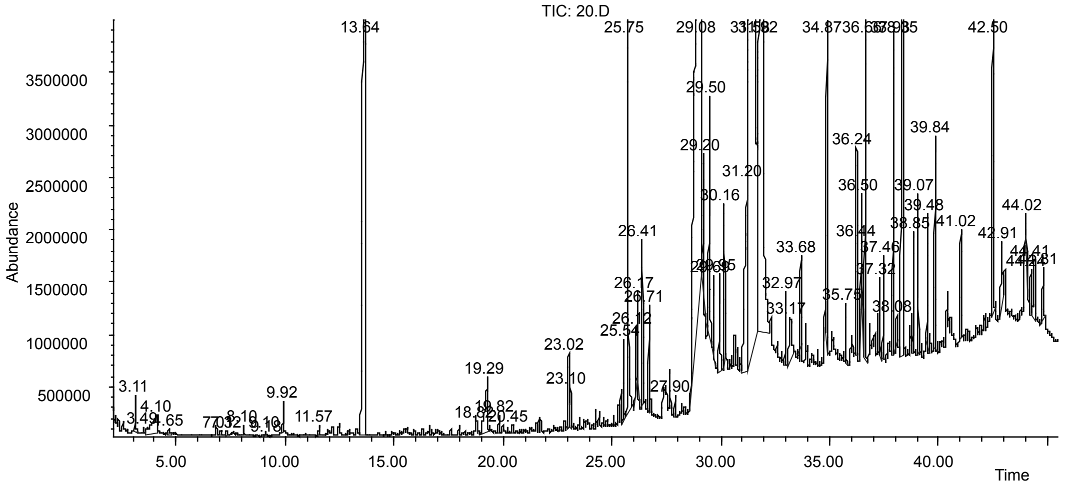

Figure 1. *Gas Chromatogram obtained from the Potato Grass Sample*

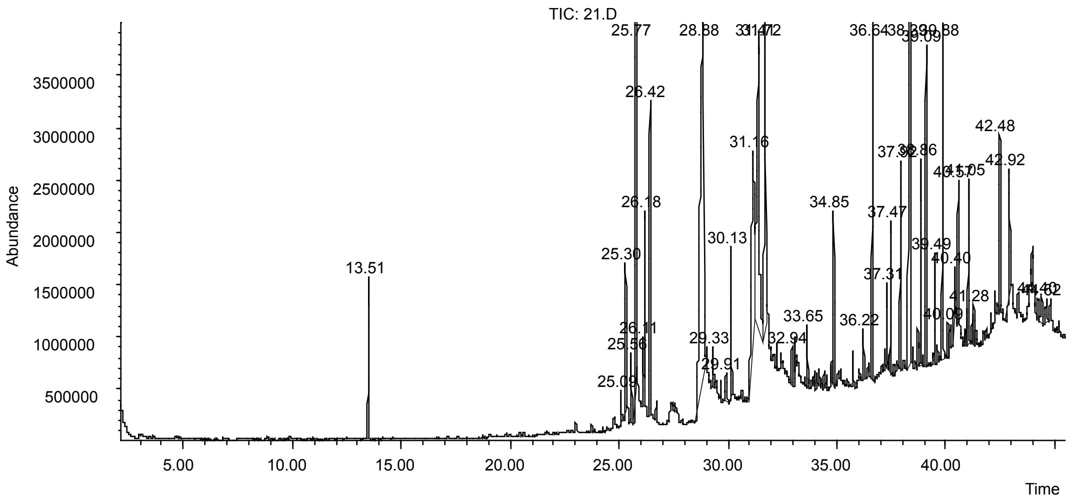

Figure 2. *Gas Chromatogram obtained from the Tomato Grass Sample*

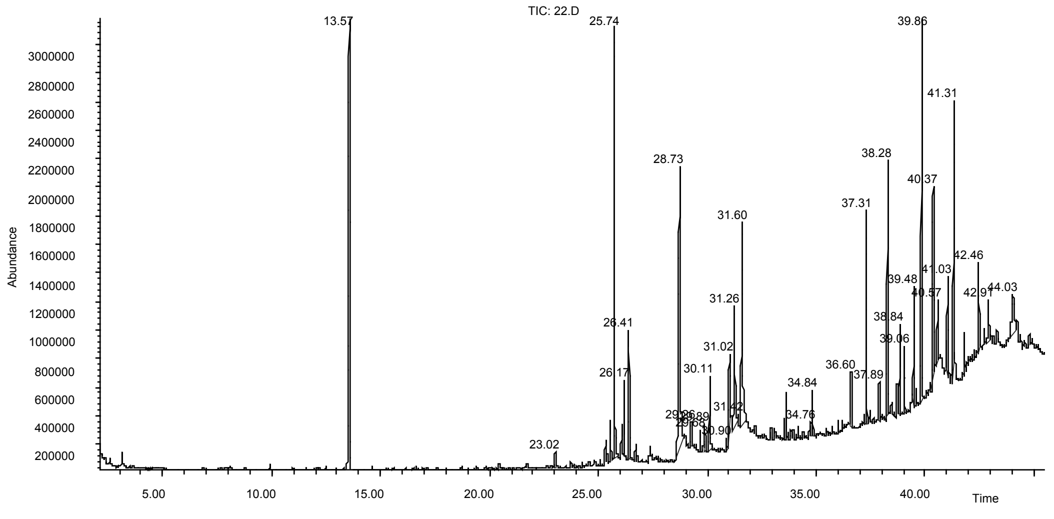

Figure 3. *Gas Chromatogram obtained from the Eggplant Grass Sample*

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ОПРЕДЕЛЕНИЕ ХИМИЧЕСКИХ СОЕДИНЕНИЙ ОВОЩНЫХ РАСТЕНИЙ СЕМЕЙСТВА ПАСЛЕНОВЫЕ

С помощью метода хромато-масс-спектрометрии были определены наиболее значимые экстрактивные соединения овощных растений семейства Пасленовые. Из заготовленных и высушенных образцов травы картофеля, помидора и баклажана экстракцией дихлорметаном были приготовлены образцы для хромато-масс-спектрометрии. В результате исследования было идентифицировано 20, 14 и 13 соединений, соответственно, включая углеводороды, спирты, карбоновые кислоты, жирные кислоты, терпеновые соединения, фитостеролы. Результаты исследования показали, что данные растения являются перспективными для получения терпеновых соединений, жирных кислот, фитостеролов в будущем, которые могут быть использованы для разработки и производства оригинальных фитотерапевтических средств.

Ключевые слова: семейство Пасленовые, хромато-масс-спектрометрия, картофель, помидор, баклажан.

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ВИЗНАЧЕННЯ ХІМІЧНИХ СПОЛУК ОВОЧЕВИХ РОСЛИН РОДИНИ ПАСЛЬОНОВІ

За допомогою методу хромато-мас-спектрометрії були визначені найбільш значущі екстрактивні речовини родини пасльонових. Зі зразків трави картоплі, томату та баклажану, які були зібрані та висушені, шляхом екстракції дихлорметаном були приготовані зразки для хромато-мас-спектрометрії. В результаті дослідження було ідентифіковано 20, 14 та 13 сполук, відповідно, включаючи вуглеводи, спирти, карбонові кислоти, терпенові сполуки, фітостероли. Результати дослідження показали, що обрані рослини є перспективними у майбутньому для отримання терпенових сполук, жирних кислот, фітостеролів, що можуть бути використані для розробки та виробництва оригінальних фітотерапевтичних засобів.

Ключові слова: родина Пасльонові, хромато-мас-спектрометрія, картопля, томат, баклажан.

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