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Д.В.Сокольский атындағы «Жанармай, катализ және электрохимия институты» АҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК РЕСПУБЛИКИ КАЗАХСТАН
АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского»

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СОДЕРЖАНИЕ

CONTENTS

N E W S
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DETERMINATION OF BAS ABOVE-GROUND PART OF PLANTS OF CIRSIUM ARVENSE L.

Abstract: The results of the study of the chemical composition of aerial parts of *Cirsium arvense L.* collected during the fruiting period in the Shamalgan village of Kazakhstan are presented in the article. The quantitative and qualitative composition of biologically active substances was determined. Samples of *Cirsium arvense L.* contain 3.2% of alkaloids, 2.08% of flavonoids, 4.08% of phenolic acids, 4.5% of hydrocarbons, 1.16% of polysaccharides, 3.8% of terpenoids, 1.2% of organic acids, 3.12% of tannins, 0.78% of coumarins, 14.85% of protein and 1.67% of fat. The variety of biologically active compounds have a biological activity according to our results. A comparative analysis of the mineral, amino and fatty acid composition of *Cirsium arvense L.* plant was carried out. The analysis of the mineral composition showed the presence of 11 mineral elements: K, Na, Mg, Ca, Cu, Zn, Cd, Pb, Fe, Ni, Mn, which allows us to recommend the studied plants as raw materials rich in macro- and microelements.

Keywords: biologically active substances; flavonoids; alkaloids; tannins; mineral composition; fatty and amino acid composition.

Introduction

All regions of Kazakhstan are rich in plant resources. These resources play a vital role in dynamic growth of economy of our country. Because of its economic, agricultural and pharmaceutical importance plant resources are still under study. The healing properties of plants are studied in botanical gardens, large research institutes, and special laboratories. However, there are a number of wild-growing plants that have not yet been fully explored. One of the plants with such healing properties is Cirsium arvense. L. (beetle) plant.

Nevertheless, Cirsium arvense. L. is outside the range of vision of the scientists, it is well known from the literature that it is used in traditional medicine in addition to some dishes [1].

Cirsium arvense. L. is not fully discovered. Only the presence of vitamins, carotene, microelements and phytoncides in the plant parts indicates its significance for humanity. Moreover, the roots of this herb contain natural insulin, so it is a real food for people with diabetes. Chemical composition is not fully studied too. The constituent of the plant varies depending on its location. It is known that the leaves contain vitamin C, hydrocarbons, and proteins.

As the research object it was chosen Cirsium arvense. L., which grows in the Chamalgan region of Almaty district. The shoot system of plant was harvested in August, 2016.

The aim of the research is to identify biologically active compounds from Cirsium arvense L.

The practical significance of the work is the phytochemical analysis of the shoot system of Cirsium arvense L. plant. The results obtained Cirsium arvense L. allows to expand the scope of the plant application.

Methods

As the research object it was chosen the shoot system of Cirsium arvense. L., which grows in the Chamalgan region of Almaty district.

General method of research: According to the first edition of the State Pharmacopoeia of the Republic of Kazakhstan it is required to follow the rules for phytochemical examination during the preparation and separation of the sample.

The second strictly followed rule is crushing the raw materials into the same amount. Otherwise it would result in damage of details ratio of raw material. In accordance with GOST 24027. 1-80; 24027. 2-80; 2237-75 the phytochemical analysis of the shoot system of Cirsium arvense L. was done, quantitative and qualitative analysis were carried out [2].

Methods of investigation: The composition on micro- and macro- elements of the shoot system of Cirsium arvense L. was determined by atomic-emission spectral analysis, flavonoids and coumarin by spectrophotometric method, tannins by permanganometric method, amount of oil by Gerber method, amino acids and carbohydrates by paper chromatography, fat and amino acids were determined by gas chromatography [3].

The chemical composition of the butanol extraction of the shoot system of Cirsium arvense L. was investigated by the mass spectrometer detector Clarus-600 (Perkin Elmer) gas chromatography [4].

A certain amount of the shoot system of Cirsium arvense L. was removed and treated with 70% alcohol solutions and distilled water. In the homogeneous chromatography qualitative analysis was carried out and it was found that biologically active substances pass through 70% alcohol solutions. The phytochemical analysis of the shoot system part of Cirsium arvense L. plant was processed. In order to obtain a scheme of the analysis the crushed raw material (shoot system) was treated with 70% alcohol solutions at room temperature for 72 hours. Individual extractions with solvents as chloroform and butanol were done [5].

The investigation on fatty acids constituents of the shoot system of Cirsium arvense L. was done by Italian "Carlo Erba 4200" device for gas chromatography.

Results

Amount of biologically active substances and quality of shoot system of *Cirsium arvense L.* are shown in table 1.

Table 1 - Amount of BAS and quality of shoot system of *Cirsium arvense L.* samples

№	BAS in raw material	Amount in the above-ground part of *Cirsium arvense L.*, %
1	Moisture	11.10
2	Ashiness	7.98
3	Extractive substances 50% alcohol DW Acetone 70% alcohol 90% alcohol Chloroform	 30.32 38.09 2.05 32.3 25.6 3.1
4	Alkaloids	3.2
5	Flavonoids	2.8
6	Phenolic acids	4.8
7	Carbohydrates	4.5
8	Polysaccharose's	1.16
9	Terpenoids	3.8
10	Tannins	3.12
11	Organic Acids	1.2
12	Coumarins	0.78
13	Proteins	14.85
14	Lipids	1.67

In medicinal plants there should not be a lot of moisture, as this reduces their quality during storage. Usually, in the medicinal plant materials the amount of moisture should not exceed 12-15% [6].

The number of micronutrients in the shoot system of an ordinary plant Cirsium arvense. L. were determined using atomic-emisson spectral analysis at a wavelength of 750 nm using an AANALIST-400 instrument and Spekokol 11 spectrophotometer [7].

The results of the study on micro-and macronutrients are shown in Table 2 and Figure 1. As shown in Figure 1, a large amount of potassium from macronutrients and zinc from micronutrients are present in the shoot system of the plant Cirsium arvense L.

Table 2 - Micro and macronutrients found in the shoot system of the plant Cirsium arvense L. .

№	Detected Element	Elements per mass of dry substance, %
1	Potassium	67,09
2	Sodium	0,46
3	Calcium	53,39
4	Magnesium	5,47
5	Zinc	0,0875
6	Copper	0,0767
7	Cadmium	0,0012
8	Lead	0,0158
9	Iron	0,4877
10	Manganese	0,0845
11	Nickel	0,0189

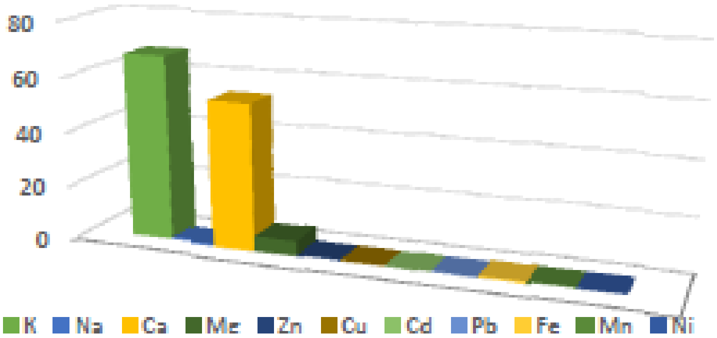

Figure 1 - Micro and macronutrients found in the shoot system of the plant Cirsium arvense L..

During the study, the amounts of vitamins A, C, and E in the shoot system of the plant Cirsium arvense L. were determined. The concentration of vitamin C was determined by the method of titrimetry, using the sodium salt of 2,6-dichlorophenolindophenol. And the concentration of vitamins A and E were determined by the method of fluorometry. As can be seen from table 3, the amount of vitamin C is high.

Table 3 - Numerical values of the amount of vitamins A, C, E in the shoot system of the plant Cirsium arvense L.

Vitamins	Amount, mg/100 g
A	0,406
C	1,9
E	0,886

Gas-liquid chromatography was used to determine the amount of amino acids. Using this method, the amounts of 20 amino acids were determined in the shoot system of the plant Cirsium arvense L. The results are shown in table 4 [8].

Table 4 - The amount of amino acids in the shoot system of the plant Cirsium arvense L.

№	Amino acid	Amount, mg / 100 g
1	Alanine	602
2	Glycine	254
3	Valine	248
4	Leucine	365
5	Isoleucine	280
6	Threonine	228
7	Serine	298
8	Proline	567
9	Methionine	96
10	Asparatat	1080
11	Cystine	42
12	Hydroxyproline	1
13	Phenylalanine	302
14	Glutamate	2116
15	Ornithine	1
16	Tyrosine	325
17	Histidine	268
18	Arginine	406
19	Lysine	194
20	Tryptophan	69

It was determined that in the shoot system of the plant Cirsium arvense L. 20 amino acids are present. Of these, glutomate and aspartate are the most abundant, while ornithine and hydroxyproline contain the least.

Gas-liquid chromatography was also used to determine the amount of fatty acids.

As can be seen from table 5, 23 species of fatty acids are present in the shoot system of the plant Cirsium arvense L. In addition, the amounts of these fatty acids have been determined. Of these, palmitic, myristic and oleic are the most abundant, undecanoic and γ-linolenic acids are the least.

Table 5 - The amount of fatty acids in the shoot system of the plant Cirsium arvense L.

№	Acids	Acid index	Number,%
1	Oil	$C_{4:0}$	1.847
2	Capron	$C_{6:0}$	1.603
3	Caprylic	$C_{8:0}$	1.230
4	Capric	$C_{10:0}$	3.026
5	Undecane	$C_{11:0}$	0.082
6	Lauric	$C_{12:0}$	3.638
7	Tridecane	$C_{13:0}$	0.145
8	Myristic	$C_{14:0}$	12.689
9	Myristolein	$C_{14:1\ (cis\text{-}9)}$	1,011
10	Pentadecane	$C_{15:0}$	1,313
11	Pentadecene	$C_{15:1}$	0.314
12	Palmitic	$C_{16:0}$	34,306
13	Palmitoleic	$C_{16:1}$	1.463
14	Margarine	$C_{17:0}$	0.652
15	Margarine olein	$C_{17:1}$	0.316
16	Stearic	$C_{18:0}$	9.929
17	Oleic	$C_{18:1\ n9c}$	22.483
18	Linoleidine	$C_{18:2\ n6t}$	0.354
19	Lynol	$C_{18:2\ n6c}$	2,506
20	γ-Linolenic	$C_{18:3\ n6}$	0.114
21	Linolenic	$C_{18:3\ n3}$	0.316
22	Arachine	$C_{20:0}$	0.302
23	Eicosenic	$C_{20:1}$	0.162

Conclusion

BAS were analyzed for the first time in the shoot system of the plant Cirsium arvense L. growing in Kazakhstan.

The study resulted in the following conclusions:

1) High-quality and quantitative analyzes were made on biologically active substances in the shoot system of the plant Cirsium arvense L.

2) As a result of a study on biologically active substances in the shoot system of the plant Cirsium arvense L., 20 amino acids and 23 fatty acids were determined using GC / MS.

Evaluation of the implementation of tasks. The tasks were fully completed. In the course of the study, large amounts of biologically active substances were found in the shoot system of the plant Cirsium arvense L. selected as the object of study. It was suggested that this garden weed, which was considered as harmful in CIS countries before that, could be used as a medicinal plant. This means that it is appropriate to continue further research on the composition of the plant, and methods for isolating biologically active substances.

Also, it can be concluded that the isolation and determination of the composition of these biologically active substances can make a huge contribution to the chemistry of natural compounds.

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CIRSIUM ARVENSE L. ӨСІМДІГІНІҢ ЖЕР ҮСТІ БӨЛІГІНДЕГІ ББЗ-ДЫ АНЫҚТАУ

Аннотация. Алғаш рет Қазақстанның Алматы облысы Шамалған аймағында өсетін Cirsium arvense L. өсімдігінің химиялық құрамы нәтижелері келтірілген. Биологиялық белсенді заттардың сапалық және сандық мөлшері көрсетілген, оның ішінде Cirsium arvense L. өсімдігінің құрамында алкалоидтар 3,2%, флавоноидтар 2,8%, фенол қышқылдар 4,8%, көмірсулар 4,5%, полисахаридтер 1,16%, терпеноидтар 3,8%, органикалық қышқылдар 1,2%, тері илегіш заттар 3,12%, кумариндер 0,78%, ақуыз 14,85%,май 1,67%. Cirsium arvense L. өсімдігінің құрамында биологиялық белсенді заттардың көп болуы олардың биологиялық белсенділік көрсетуіне негізделген. Мақалада Cirsium arvense L. өсімдігінің құрамындағы минералды заттар, май- және аминқышқылдарына салыстырмалы талдау жүргізілген. Минералдық құрамын талдау кезінде 11 минералдық элементтердің бары анықталды: K, Na, Mg, Ca, Cu, Zn, Cd, Pb, Fe, Ni, Mn.

Түйін сөздер: биологиялық белсенді заттар; флавоноидтар; алкалоидтар; тері илегіш заттар; минералдық құрам; май- және амин қышқылдың құрамы.

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ОПРЕДЕЛЕНИЕ БАВ НАДЗЕМНОЙ ЧАСТИ РАСТЕНИЙ CIRSIUM ARVENSE L.

Аннотация. В работе приведены результаты исследования химического состава надземной части Cirsium arvense L., собранных в период плодоношения в Шамалган регионе Казахстана. Исследован количественный и качественный состав биологически активных веществ. В растениях Cirsium arvense L. содержит 3,2% алкалоидов, 2,08% флавоноидов, 4,08% фенольных кислот, 4,5% углеводородов, 1,16% полисахаридов, 3,8% терпеноидов, 1,2% органических кислот, 3,12% дубильных веществ, 0,78% кумаринов, 14,85% белка и 1,67% жира. Разнообразие биологически активных соединений обусловливает широкий спектр биологической активности. Проведен сравнительный анализ минерального, жирно- и аминокислотного состава растения Cirsium arvense L. Анализ минерального состава показал наличие в образцах 11 минеральных элементов: K, Na, Mg, Ca, Cu, Zn, Cd, Pb, Fe, Ni, Mn.

Ключевые слова: биологически активные вещества; флавоноиды; алкалоиды; дубильные вещества; минеральный состав; жирно- и аминокислотный состав.

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