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B. M. IZTELEU[1], G. E. AZIMBAYEVA[1], A. A. BAKIBAEV[2], B. ZH. DZHIEMBAEV[1]

[1]Kazakh State Women's Teacher Training University, Almaty, Kazakhstan,
[2]National research Tomsk State University, Tomsk.
E-mail: bakshat_83@mail.ru

STUDY OF EXTRACTIVE SUBSTANCES OF HELIANTHUS TUBEROSUSE TUBERS

Abstract. The article examines the extractive properties of tubers of helianthus tuberosuse from two regions of Almaty. The object of the study is the extracts obtained from the tuber Helianthus tuberosuse. The extraction of tubers from helianthus tuberosuse was carried out by various organic solvents. It was found that the extraction of extractive substances by a group of solvents with increasing polarity. The greatest yield of extractive substances comes from the extraction of benzene and ethyl acetate. The main extractive substances belong to coumarin compounds (umbellioron $C_9H_6O_3$, isoscapolin $C_{10}H_8O_4$, escuftine $C_9H_6O_4$, herniarin $C_{10}H_8O_3$, umbelliferone $C_9H_6O_3$, coumarin $C_9H_6O_2$) and flavonoid.

Key words: helianthus tuberosuse, organic solvents, coumarin compounds, flavonoid compounds.

Introduction. In recent years researchers have become increasingly interested in preparations of plant litter. Plants are sources of obtaining biologically active substances (BAS), while the qualitative and quantitative composition of substances contained in medicinal plants depends on the conditions of plant growth, the phase of development, the time of collection, the method of drying and storage of raw materials and other factors [1].

Among the variety of non-traditional plant species Helianthus tuberosus is one of the most promising for economic and medical uses, thanks to high content of flavonoids, coumarins, pectins and other valuable substances [2]. Helianthus tuberosus or earth pear – a perennial herbaceous plant of the family of Compositae (Acteraceae) from 40 cm to 4 m in height with erect branching, pubescent stalks and underground shoots on which tubers develop [3].

The high content of various biological active substances in Helianthus tuberosus testifies to the prospects of using this culture in dietary nutrition and in medicinal phytopreparations [4]. In folk medicine Helianthus tuberosus is widely used in the treatment of diabetes, atherosclerosis, diseases of the cardiovascular system and the gastrointestinal tract, as well as to eliminate cosmic defects (acne, skin flabbiness, wrinkles) [5-7].

The purpose of the study is determination the extractives from plants Helianthus tuberosuse by organic solvents.

EXPERIMENTAL PART

In this work used the tubers of Helianthus tuberosus from the Almaty region of the Karasai district and the city of Almaty in the Turksib district.

The raw material was dried in the shade until it was air-dry and crushed to a particle size of 1-2 mm.

The sequential extraction was carried out in a round-bottomed flask with constant shaking, the resulting solutions were concentrated in a rotary evaporator in a round-bottomed flask using a rotary evaporator. To carry out the extraction, a sample of ground raw material about 10-20 g was used. The extracts were dried in air stream and stored in a refrigerator in a sealed container. The extractive substances were determined by chromotography methods with organic solvents [8].

In order to determine the composition of the main classes of extractive substances, sequential extraction of tubers Helianthus tuberosus with the following group of solvents was carried out: carbon tetrachloride, petroleum ether, n-hexane, acetone, chloroform, toluene, methanol, ethyl acetate, benzene, diethyl ether, distilled water, ethyl alcohol [10].

Qualitative determination the composition of extracts were carried out using spectrophotometry in the ultraviolet and visible regions using a Uviline 9100-9400 spectrophotometer (USA).

RESULTS AND DISCUSSION

The chemical composition of plants Helianthus tuberosus collected in the Almaty region was studied in [9]. It has been established that the main components of the aerial part of Helianthus tuberosus are polysaccharides, ascarbic acids, carotene, protein and polyphenolic compounds.

The results of extracting with various organic solvents such as: carbon tetrachloride, petroleum ether, n-hexane, acetone, chloroform, toluene, methanol, ethyl acetate, benzene, diethyl ether, distilled water, ethyl alcohol in concentrations (5, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 96%) (is represented in table 1).

In our study, it has been found that the most extractive properties for Helianthus tuberosus are: carbon tetrachloride, petroleum ether, n-hexane, acetone, chloroform, toluene (diagram 1); in a moderate extractive properties for Helianthus tuberosus in ethyl acetate, in ethyl alcohol in a concentration of 70-96%, and the best extractive properties for Helianthus tuberosus showed benzene, ethyl alcohol at a concentration of 5 -60% and in distilled water (diagram 2). And diethyl ether did not show any result at all. At what, as can be seen from the data of the table, the above-mentioned regularity is valid for tubers of Jerusalem artichoke, which grows in the Karasai region.

As can be seen from table 1 and diagram 1, it is established that the extractivities of the tubers of the Helianthus tuberosus in the Karasai District are higher in organic solvents than in the Turksib District, petroleum ether - 4.75%, in carbon tetrachloride - 2.45% , in acetone - 16.2%, n-hexane - 7.15%.

The method of UV and visible spectrophotometry was used to determine the main classes of compounds extracted by various solvents. The results are given in tables 2-3 and figures 1.2.

Table 1 – Extractivity of Helianthus tuberosus tubers by organic solvents

#	Organic solvents	Extractivity,%	
		Tubers of Helianthus tuberosus of Turksib district	Tubers of Helianthus tuberosus of Karasai district
1	Carbon tetrachloride	2,15	2,45
2	Petroleum ether	4,30	4,75
3	N-hexane	6,45	7,15
4	Acetone	12,90	16,25
5	Chloroform	15,05	19,80
6	Toluene	21,50	33,76
7	Ethyl acetate	47,31	46,55
8	Benzene	73,11	79,56
9	Diethyl ether	-	-
10	Distilled water	64,51	75,26
11	5% ethanol	86,02	92,47
12	10% ethanol	96,67	96,77
13	20% ethanol	94,62	94,62
4	30% ethanol	92,47	90,32
15	40% ethanol	90,32	88,17
16	50% ethanol	88,17	86,02
17	60% ethanol	83,87	81,72
18	70% ethanol	58,06	64,51
19	80% ethanol	45,16	52,31
20	90% ethanol	43,01	41,61
21	96% ethanol	34,40	30,10

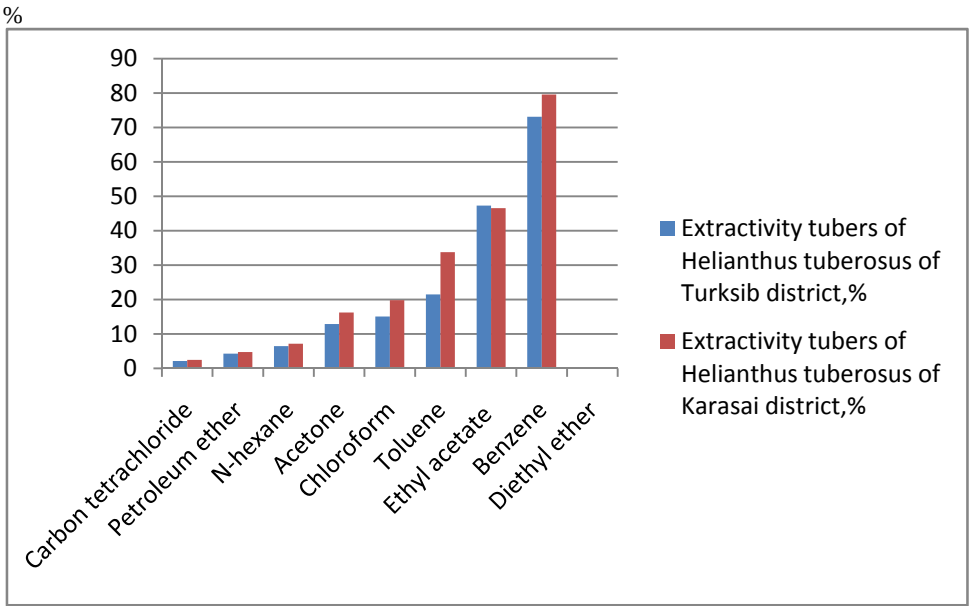

Diagram 1 – The total content of extractive substances
in the tuber of Helianthus tuberosus in organic solvents

%

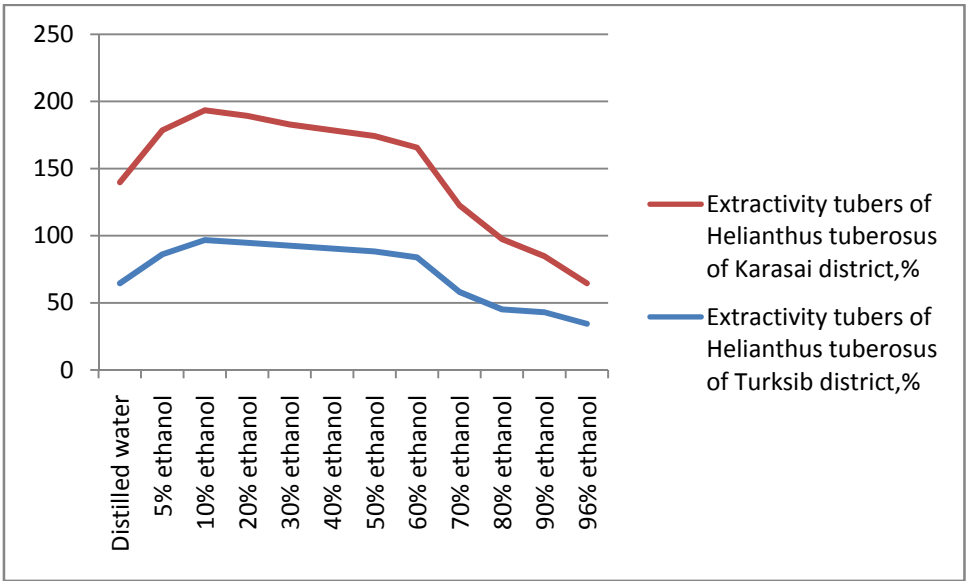

Diagram 2 – The content of extractives
in the tuber of Helianthus tuberosus choke in water-alcohol solutions

Table 2 – Results of the UV spectrum of tubers Helianthus tuberosus (in ethyl acetate solvent)

#	Ethyl acetate, nm	Coumarin compounds		Flavonoid compounds	
		Name	λ_{max}, nm	Name	λ_{max}, nm
1	220	Umbelliferone $C_9H_6O_3$	230	–	–
2	235	–	–	–	–
3	249	Isoscopeline $C_{10}H_8O_4$	254	–	–
4	260	Escouletin$C_9H_6O_4$	260	Flavonoid$C_{21}H_{20}O_{11}$	260
5	287	–	–	Flavonoid$C_{21}H_{24}O_{10}$	287

From the data in table 2, it is seen that the UV spectrum of the ethyl acetate extract has absorbance bands at 220 , 219 , 260 nm, which indicates the presence of coumarin substances (umbellioron $C_9H_6O_3$, isoscapolite

$C_{10}H_8O_4$, eskulein $C_9H_6O_4$), as well as absorption bands at 260 nm and 287 nm correspond to flavonoid compounds (flavonoid $C_{21}H_{20}O_{11}$, flavonoid $C_{21}H_{24}O_{10}$) (figure 1) [11-13].

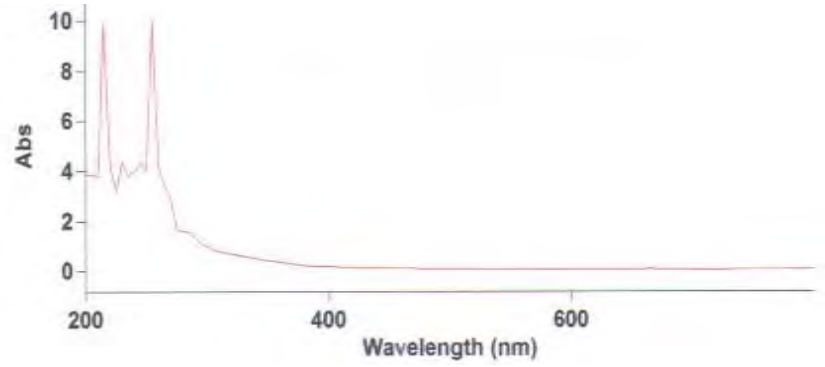

Figure 1 – UV spectrum of substances extracted
from the Helianthus tuberosus of the Turksib district with ethyl acetate

Table 3 – Results of UV spectrum of tubers Helianthus tuberosus (in benzene solvent)

№	Benzene, nm	Coumarin compounds		Flavonoid compounds	
		Name	λ_{max}, нм	Name	λ_{max}, нм
1	205	Gerniarin $C_{10}H_8O_3$	218	–	–
2	220	Umbelliferone $C_9H_6O_3$	230	–	–
3	235	–	–	–	–
4	245	–	–	–	–
5	262	Coumarin $C_9H_6O_2$	262	–	–
6	285	–	–	Flavonoid $C_{21}H_{24}O_{10}$	287

From the data in table 3, it is seen that the UV spectrum of the benzene extract has absorbance bands at 205 nm, 220 nm, 262 nm, which indicates the presence of coumarin substances (hernaryin $C_{10}H_8O_3$, umbelliferone $C_9H_6O_3$, coumarin $C_9H_6O_2$), and absorption bands at 285 nm correspond to flavonoid compounds (flavonoid $C_{21}H_{24}O_{10}$) (figure 2). The obtained values of the absorption bands in the UV spectra are consistent with the literature data [11-13].

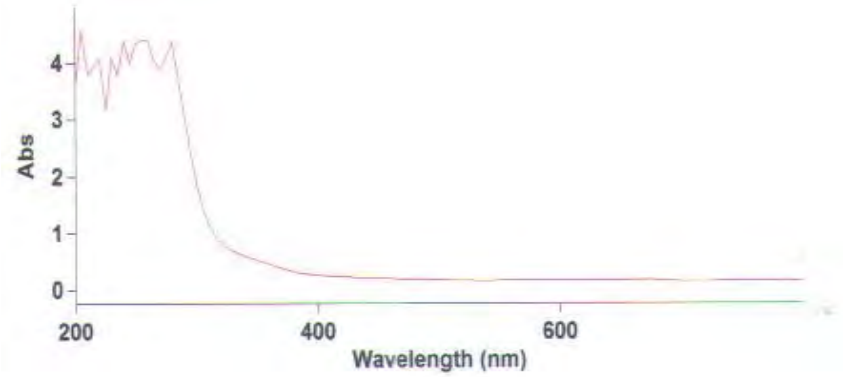

Figure 2 – UV spectrum of substances extracted
from tubers of Helianthus tuberosus from Turksib District by benzene

Conclusions. Thus, we studied the extractive properties of various organic solvents with respect to Helianthus tuberosuse and showed that the main extractive substances belong to coumarin compounds (umbellioron $C_9H_6O_3$, isoscapolin $C_{10}H_8O_4$, escuftine $C_9H_6O_4$, herniarin $C_{10}H_8O_3$, umbelliferone $C_9H_6O_3$, coumarin $C_9H_6O_2$) and flavonoid (flavonoid $C_{21}H_{20}O_{11}$, flavonoid $C_{21}H_{24}O_{10}$) of nature.

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Резюме

Б. М. Изтелеу, Г. Е. Азимбаева, А. А. Бакибаев, Б. Ж. Джиембаев

HELIANTHUS TUBEROSUSE ЖЕМІСІНІҢ
ЭКСТРАКТИВТІЛІГІН ЗЕРТТЕУ

Мақалада Алматы қаласының екі ауданының топинамбур жемісінің әртүрлі органикалық еріткіштердегі экстрактивлігі зерттелінуі қарастырылды. Зерттеу нәтижесінде көрсетілгендей, яғни негізгі экстрактивті заттарға кумаринді қосылыстар (умбеллиерон $C_9H_6O_3$, изоскополетин $C_{10}H_8O_4$, эскулетин $C_9H_6O_4$, герниарин $C_{10}H_8O_3$, умбеллиферон $C_9H_6O_3$, кумарин $C_9H_6O_2$) және табиғи флавонидты қосылыстар (флавоноид $C_{21}H_{20}O_{11}$, флавоноид $C_{21}H_{24}O_{10}$) жататындығы анықталды.

Түйін сөздер: helianthus tuberosuse, органикалық еріткіштер, кумаринді қосылыстар, флавоноидты қосылыстар.

Резюме

Б. М. Изтелеу, Г. Е. Азимбаева, А. А. Бакибаев, Б. Ж. Джиембаев

ИЗУЧЕНИЕ ЭКСТРАКТИВНЫХ ВЕЩЕСТВ
КЛУБНЕЙ HELIANTHUS TUBEROSUSE

В статье рассмотрено изучение экстрактивных свойств клубней топинамбура из двух районах Алматы в различных органических растворителях. Показано, что основные экстрактивные вещества относятся к соединениям кумариновой (умбеллиерон $C_9H_6O_3$, изоскополетин $C_{10}H_8O_4$, эскулетин $C_9H_6O_4$, герниарин $C_{10}H_8O_3$, умбеллиферон $C_9H_6O_3$, кумарин $C_9H_6O_2$) и флавоноидной (флавоноид $C_{21}H_{20}O_{11}$, флавоноид $C_{21}H_{24}O_{10}$) природы.

Ключевые слова: helianthus tuberosuse, органические растворители, кумариновые соединения, флавоноидные соединения.