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Original article

ECOLOGY AND PHYTOCHEMICAL CHARACTERIZATION OF *CENTAUREA SOLSTITIALIS* L., FAMILY ASTERACEAE DUMORT

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Abstract

Background. According to the World Health Organization, more than 80% of the world's population in developing countries primarily use herbal medicines for their health needs.

The **purpose** of the study – phytochemical study of the C. *solstitialis* L. species of the Gulavar genus of the Asteraceae Dumort family distributed in the flora of Azerbaijan.

Material and methods. Sesquiterpene lactones, coumarin derivatives and other components were obtained from the aerial parts of the plant by Gas-Chromato-Mass-Spectrometry method.

Results. Isobergapten, C12H8O4, ostol C15H16O3, C15H18O3 *α-Santonin Centaureae solstitialis L.* - 2 coumarins and 1 sesquiterpene lactone belonging to the group of natural compounds obtained from the above-ground parts of the plant were obtained. The extraction time, chemical formula and molecular weight of the components were determined by the Gas-Chromato-Mass-Spectrometry method.

Keywords: C. *solstitialis* L.; sesquiterpene lactone; coumarin; Gas-Chromato-Mass Spectrometry; isobergapten; ostol; α-Santonin

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Introduction

According to the World Health Organization, more than 80% of the world's population in developing countries primarily use herbal medicines for their

health needs. The flora of Azerbaijan has various types of plants rich in biologically active substances. Apiaceae and Asteraceae families are rich in biologically active substances within plant genera. Despite the large number of Gulavar species belonging to the Asteraceae family, their chemical composition has not been fully studied. Various biologically active substances obtained from the species of this genus are used as analgesic, anticoagulant, capillary strengthening, photosensitizing, anti-inflammatory, choleretic, and anti-malignant agents. From this group of compounds, compounds related to furocoumarins - bergapten, xanthatoxin, and ammifuran, psoralen, beroxan, meladin, and methoxaline preparations created on the basis of psoralen are successfully used in the treatment of leukoderma both in the Commonwealth of Independent States and in foreign countries [1]. The genus Centauera is a genus of Mediterranean origin, about 700 species are known in the world, 29 species are known in the flora of Azerbaijan. In modern times, the increasing demand for herbal medicinal preparations has increased the interest in the research of medicinally important species of the genus Centaurea. It is important to have species with both medicinal and useful properties in the genus. According to the latest literature information, a critical revision of the Centaurea species common in the flora of Azerbaijan was carried out, the taxonomic units were specified, 22 species were added to the composition of the species, and the number of species was increased to 49 [2; 3]. The species *Centaurea solstitialis L.* is distributed everywhere in Azerbaijan. From the lowlands to the middle mountain belt (up to 1800 m), it is found in dry clay and gravel slopes, thickets, blackthorn meadows, wormwood semi-deserts, littered places, fields, and moors. Its homeland is the Caucasus; (as a whole) Central and South-East (Crimea), North-European Mediterranean; South-West (Turkey, Lebanon, Iraq, Iran), East (Far East), Central Asia, North American countries. Comparative morphological, geographical, ecological, areological studies of all species of the Centaurea genus were carried out in detail by A. Y. Huseynova [1]. However, no research has been conducted on the chemical composition of the species of this genus.

M. Iranshahi et al. provides extensive information on the use of knitsin obtained from *Centaureae solstitialis L*. in the treatment of fungi and other diseases in medicine [4]. During the analysis of essential oils of the dried aerial parts of C. solstitialis, arglabin obtained from non-oxygenated sesquiterpene compounds - bicycloelemene, β-ylangene, α-copane, β-elemene, longifolene, β-caryophyllene, γ -elemene, kalarene, germacrene D, bicyclogermacrene is successfully used in breast cancer [5-7]. Solstitialin A and 15-dechloro-15-hydroxychloroyanerine lactone compounds were detected from the methanolic extract of the stem of C.

solstitialis. Among these compounds, substances with analgesic, antibacterial and other microorganism, cardiotonic anti-inflammatory and anti-malignant activity can be mentioned. For example, costunolide, geysedanin, eupaserin, vernolide and others can be mentioned among herbal substances (STL) with therapeutic effect against malignant tumors [8-12]. In recent years, the activity of "Arglabin" obtained from the Artemisia glabella (Asteraceae) species of the "Phytochemistry" Scientific Production Union of the Ministry of Education and Science of Kazakhstan has been determined in detail in breast cancer [13;14].

The purpose of the study is to study the phytochemical properties of the species *Centaureae soltstitialis L* of the Gulavar genus of the Asteraceae chapter, distributed in the flora of Azerbaijan.

Material and methods

The species *Centaureae solsititialis L*. used in the study is the most widespread representative of the genus Centaureae in Azerbaijan. *Centaureae solsititialis* - morphological features of the sunflower type: it is an annual, biennial, gray cobweb-like plant. The trunk is branched from the middle. The leaves around the root (they dry up during flowering) or the leaves of the lower stem are lyre-shaped, they bloom and bear fruit in June-August. Chemically, as the research object we studied, substances collected from Novkhani village, Absheron region at the beginning of the flowering phase (July 7, 2019), chopped into small pieces, and the above-ground parts (500 g) extracted with acetone (3 times for 3 days each) were used. The extractives (yield 6.4%) (14.0 g) were rechromatographed in a glass column (h=60 cm, d=3.5 cm) filled with neutral, III-IV level Al_2O_3, and 2 coumarin derivatives and a sesquiterpene lactone were obtained individually from the surface part.

The individuality of the substances was determined by thin-layer chromatography on silifol UV-254 plates, and the melting point of the crystalline substances was determined on the Boyites table.

The same coumarins and sesquiterpene lactone were also obtained from the roots of the extractive substances extracted from the above-ground part of the sunflower plant with acetone, along with various components. Isoberghapten, $C_{12}H_8O_4$, ostol $C_{15}H_{16}O_3$, $C_{15}H_{18}O_3$, *α-Santonin* obtained from the aerial parts of *Centaureae solstitialis* were analyzed by gas-chromato-mass spectrometry (QXMS), and the obtained substances were identified with known substances. For analysis in the QX-MS device (Shimadzu QP-2010 Ultra GC-MS, Japan), electron impact ionization, capillary tube Rtx-5 MS with dimensions of 0.25 μm × 0.25 mm × 30 m, helium gas with a flow rate level of 1.58 ml/min was used as the carrier. The temperature of

the ionization source is 250 ºC. During the analysis, the starting temperature of the thermostat was 40 ºC for 2 min., then 9 °C/min. rapidly increased to 200 °C, then 10 °C/min. rapidly brought to 250 °C. 17 minutes for the analysis of each sample time spent. Injector temperature is 275 °C. The amount of sample taken is 0.2 μL (dilution with chloroform 1:20). The electron ionization of the mass detector is 70 eV and the mass range is 29-450 a.m.u. (atomic mass unit, DA) is chosen. After the analysis, substances were identified according to the device manual (NIST 2010), retention time - RT, characteristic molecular and fragment ions.

Results and discussion

As a result of the research, the components belonging to different groups of natural compounds were determined and identified from the aerial parts of *Centaureae solstititialis L.* plant. It is known from the literature that the quality composition of coumarin derivatives of the roots of *Centaureae solstititialis* is slightly different from the same parameters of the aerial parts [5; 11]. Isobergapten, ostol, *α-Santonin* obtained from the aerial parts of *Centaureae solstitialis L*. are 2 coumarins and 1 sesquiterpene lactone belonging to the group of new natural compounds for the plant obtained for the first time from Gulavar species (pictures 1, 2, 3). Of these substances, isobergapten, ostol, and coumarin derivatives have recently been found in the literature for conducting pharmacological studies related to heart rhythm disturbances and the effect on the tone of coronary vessels.

α-santonin sesquiterpene lactone is used not only as an anthelmintic, but also in the treatment of other diseases [8; 9].

Table.

***Centaureae solstitialis L*. aerial part (stem, leaves and flowers)**
Results of gas-chromatography-mass spectrometry research

Component	Release Time	Molecular Weight	Formula
α-Santonin	19.32	246	$C_{15}H_{18}O_3$
6-Methoxyfuro[2,3-h]chromen-2-on (isobergapten)	26.12	216	$C_{12}H_8O_4$
Ostol	27.21	244	$C_{15}H_{16}O_3$

It is known that sesquiterpene lactones from the chemical compounds contained in plants, diterpenes, triterpene coumarins and their derivatives, saponins, glycosides, flavanoids, essential oils have high biological activity among natural compounds. Scoparone coumarin derivatives of scoplet were obtained from 7 species of *Centaurea L.* genus. In general, more than 40 effective preparations

have been created among the compounds of coumarin, which are widely used in medical practice in the treatment of various diseases [3; 4].

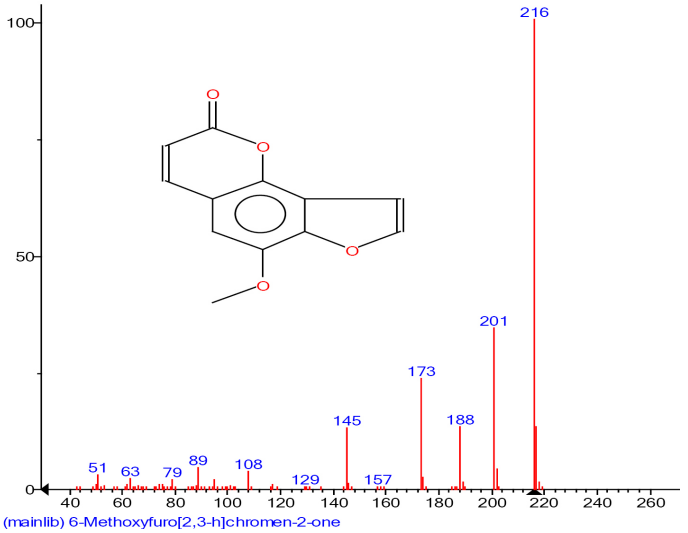

Fig. 1. Substance 1 - "ISOBERGAPTEN"

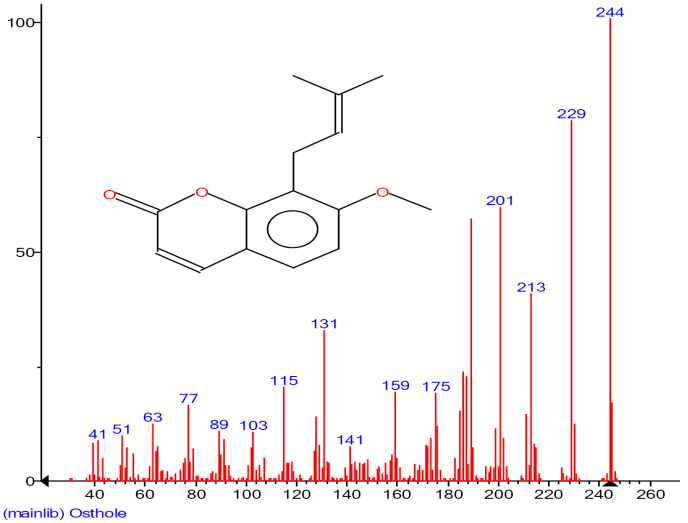

Fig. 2. Substance 2 - «OSTOL»

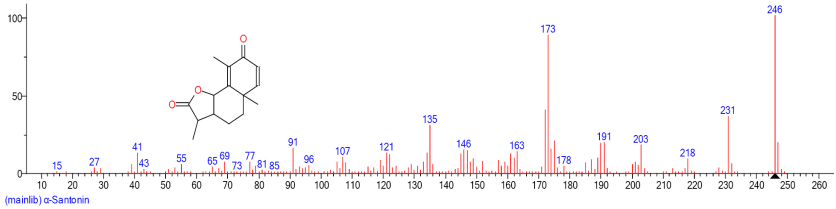

Fig. 3. Substance 3 - "α-Santonin"

Therefore, the biologically active substances obtained and identified as a result of the current research can be used in the preparation of new medicines.

Results

1. Centaurea solstitialis L. has been determined to be the most widespread species of the genus Centaurea in the flora of Azerbaijan.
2. For the first time, 2 coumarins (isoberghapten, ostol), 1 α-santonin, and sesquiterpene lactone were obtained from both the aerial part and the root of Centaurea solstitialis L., which is widespread in the flora of Azerbaijan.
3. It was determined that the components obtained for this species are new for the plant. The above-ground part and root-derived components of the species were identified.
4. The chemical composition of the obtained substances was studied by the method of Gas-Chromatography-Mass-Spectrometry.

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Adelja N. Aleskerova: development of the concept of scientific materials, study of the research material.

Lala I. Rustamova: editing of the manuscript.

Elza G. Orujeva: study of the reserch material, writing the manuscript.

Farida A. Heydarova: formating and statistical conducting of the results of the article.

Ilhama R. Jahangirova: collection and analysis of data on *C. solstitialis* L.

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