REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

RESOURCES AND ECO-BIOLOGICAL FEATURES OF SOME SPECİES OF *APIACEAE* Lindl. FAMİLY IN THE FLORA OF AZERBAIJAN

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GENERAL DESCRIPTION OF WORK

Relevance and development of the topic. New perspectives of non-traditionally used plants, determination of their bio-ecological features, scientific study of ontogenesis of individuals, as well as phytocenological regularities of population structure are always in the focus of world scientists[1,2, 3]. The limit factors and numerical dynamics of taxa must first be identified to ensure the sustainable development of such plants. The flora of Azerbaijan is a source of useful (medicinal, food, essential oils) and biologically active plants. Among them, the Celery family (*Apiaceae* Lindl.-*Umbelliferae* Juss.) occupies one of the main places. Information on resource assessments, ethnobiology and chemical composition of representatives of the same species is given superficially although S.J.Ibadullayeva studied celery of Azerbaijani flora on floristics and resources [4].

On the other hand, there are a small number of species among them (*Smyrniopsis aucheri* Boiss., *Dorema glabrum* Fisch. et C.A.Mey.,*Stenotaenia macrocarpa* Freyn et Sinth. ex Freyn, *Zosimaabsinthifolia* (Vent.) Link., *Laser trilobum* (L.) Borkh., *Smyrnium perfolatum* L., *Conium maculatum* L., *Visnaga daucoides* Gaertn, *Falcaria vulgaris* Bernh., *Szovitsia callicarpa* Fisch. et C.A.Mey., *Helosciadium nodiflorum* (L.) W.D.J.Koch and etc.) that

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[1]Mozaffari, A.S. Ethnobotany and folk medicinal uses of major trees and shrubs in Northern İran / A.S.Mozaffari, A.Kamkar, G.Archana [et al.] //Journal of medicinal Plants Research, –2013. –vol.7, –is.7, –pp.284-289.

[2]Ozturk, M. Comparative analysis of medicinal and aromatic plants in the traditional medicine of İgdir (Turkey), Nakhchivan (Azerbaijan) and Tabriz (İran) /M.Ozturk, E.Altundag, S.J.İbadullayeva [et al.] //Pakistan Bot.jour. –2018. –№ 1, –p.337-343.

[3]Pieroni, A. An Ethnobotanical study among Albanians and Aromanians living in the Rraicë and Mokraareas of eastern Albania /A.Pieroni, A.Ibraliu, A.M.Abbasi [et al.] //Genet. Resour. Crop Evol., –2015. –62, –p.477-500.

[4]İbadullayeva, S.C. Azərbaycan florasının Kərəvüzkimiləri- *Apiaceae* Lindl. (Bitki ehtiyatşünaslığı üzrə): /biologiya elm. dokt. dissert./ –Bakı, –2005, –373s.

have not been studied in detail and resource assessments have not been carried out.

Some of them are new not only for the flora of Azerbaijan, but also for the Caucasus and the whole Transcaucasia, and some are rare species, although the prospects for their use are diverse[5]. The study of such importance plants is of great important for the Republic of Azerbaijan. The development of the people and various sectors of agriculture depends on the efficient use of natural resources for the economic construction of our state[6,7]. Despite the fact that scientists have conducted a number of studies on the use of useful plants in Azerbaijan[8, 9]. We have not yet developed a scientific basis for the full use of useful plants in Azerbaijan.

Taking into account all this, the botanical analysis of Celery, bioecological features, distribution, care of some important representatives, phytochemical research and resource assessments in the biodiversity of the flora of Azerbaijan have been carried out. The research topic is part of the problem "Efficient use, restoration and protection of vegetation on a biological basis" and is one of the current problems of theoretical and practical importance.

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[5]Azərbaycan Respublikasının Qırmızı kitabı. Nadir və nəsli kəsilməkdə olan bitki və göbələk növləri: [2 cilddə] /– Bakı: –II nəşr, –2013, – 673s.

[6]Azərbaycan Respublikasının Biomüxtəlifliyin qorunması və davamlı istifadəsinə dair Milli strategiya və Fəaliyyət Planı, –Bakı: Qanun, –2006, – 24 səh.

[7]Əli-zadə, V.M. Azərbaycanın bioloji müxtəlifliyi, öyrənilməsi, qorunması və zənginləşdirilməsi //–Bakı: AMEA Botanika İnstitunun Elmi əsələri, – 2011. c. – XXXI, –s. 3-16.

[8] Новрузов, Э.Н, Мехтиева, Н.П. Ресурсы лекарственных растений Азербайджана и пути их исполъзования //Ümummilli lider Heydər Əliyevin anadan olmasının 91 –ci ildönümünə həsr olunmuş "Müasir biologiya və kimyanın aktual problemləri " adlı elmi konf. materialları. I hissə –Gəncə: –2014. –s.10-17.

[9] Serkerov, S.V. Furocoumarins whith photosensibizing properties isolated from some plants of *Apiaceae* family of the Azerbaijan flora /S.V.Serkerov, G.Q.Qasumova, İ.G.Heydarov [et al.] //Transaction of the İnstitute of Botany of Azerbaijan NAS, –2017. –vol. 37, –p.38-44.

Object and subject of research. The object and subject of research are useful species of Celery family species distributed in the flora of Azerbaijan.

The purpose and tasks of the research.

Analyze of the current state of the taxonomic composition of Celery in the flora of Azerbaijan, phytochemical study of important economic species, the study of new opportunities and ways of their resource assessment and use is the main purpose of the study. The following tasks have been set in order to achieve this goal:

- Determining the current state of the taxonomic composition of the Cerely family in Azerbaijan;
- Determination of bioecological features of the representatives of the family;
- Research of some oilseeds and essential oil plants;
- Carrying out resource assessments of species of economic importance;
- Ethnobotanical study of useful plants;
- Exploration of new opportunities and ways of efficient use of economically important species.

Research methods. Modern and classical botanical, resource science and biochemical methods were used during the research. Numerous expeditions and laboratory measurements and assessments were carried out, species identification and taxonomy were identified, life forms, phenological observations, fluoroscopic-geobotanical indicators, flora richness, areological, protection status of rare species were studied. Essential oils (EO) and fatty oils were obtained and their composition was determined. Plant reserves were calculated and populations were estimated.

The main provisions submitted to the defense:

- Bioecological research, plant mapping and resource assessments of useful species of the *Apiaceae* family in the flora of Azerbaijan provide a basis for their use as a raw material base;
- Essential and fatty oils from plants are promising as medicinal and nutritional supplements;

- Economically important species can be used in strengthening the fodder base, veterinary and scientific medicine.

The scientific novelty of the research. The current situation of Celery in the biodiversity of the flora of Azerbaijan was determined and 186 species of 70 genus were confirmed. *Helosciadium nodiflorum* was first discovered in Azerbaijan for both the Caucasus and the South Caucasus (Transcaucasia). The status and range of the species have been clarified, endemism and relict have been revealed as a result of phylogenetic analysis. The population structure of important resources has been studied and phytocenologically assessed.

Celery family has a special medicinal value, aromatic and spicy, feed, food, etc. Resource assessments were carried out, essential oil of more than 10 species, fatty properties of 1 species were studied, physical-chemical constants and component composition of the obtained substances were revealed.

The reserves and productivity of medicinal, fodder and spicy plants were revealed.

Theoretical and practical significance of the research. The economic significance of Celery was revealed in the study, and species are very valuable food and fodder plants rich in spices, nutrients and medicines, rich in vitamins and microelements were determined.

Maps of Celery family habitats have been compiled. 1 genus and 1 species belonging to the family are included in the future new edition of "Azerbaijan flora". Information on taxonomy, systematics, ecology and care and can be used in new editions of the "Red Book of Azerbaijan".Recommendations for production, obtained essential oils and fatty oils - in the preparation of antiseptics, in the production of canned food, non-alcoholic beverages, in canning, in the confectionery industry.

Approbation and application. The main provisions of the dissertation were covered at local and international conferences: Symposium on EuroAsian Biodiversity (SEAB) (Institute of Dendrology of ANAS, Baku-2015; Turkey, Antalya-2016; Belarus, Minsk-2017; Kiev-2018); Ganja SU “Actual problems of modern

biology and chemistry" Scientific-practical conference, Ganja -2015; International Conference Innovative Approaches to Conservation of Biodiversity, 2016-Baku; and was discussed at the seminar of the Institute of Botany of ANAS and the Institute of Dendrology of ANAS.

Name of the organization where the dissertation work is performed. The dissertation work was carried out in the Institute of Botany of ANAS and in the Institute of Dendrology of ANAS.

Volume and structure of the dissertation: The dissertation is written in the Azerbaijani language and consists of 233 pages, introduction, 5 chapters, the main part, results and recommendations, two hundred and eight thousand characters (Chapter I - twenty-two thousand signs, Chapter II - sixteen thousand signs, Chapter III - seventy thousand signs, Chapter IV - twenty-eight signs, Chapter V - seventy-two signs). The dissertation is enriched with 27 tables, 36 figures, 2 diagrams and 59 maps.

CHAPTER I. HISTORY OF THE STUDY OF THE *APIACEAE* LINDL. FAMILY

Extensive comments were made on the study of the Cerely family in the world and in Azerbaijan.

CHAPTER II. OBJECT AND METHODS OF RESEARCH

The study was conducted in 2015-2019 years. Useful species of Celery in the flora of Azerbaijan were taken at the facility. Natural geographical ecosystems (60-3500m) of plants distributed have been studied, more than 200 herbary materials have been collected, and about 20 geobotanical descriptions have been made.

Botanical methods. Species identification refers to the Herbarium funds, the flora of the USSR, the flora of the Caucasus, the flora of Azerbaijan, and the naming of taxa with reference to the Conspectus of Flora of the Caucasus (2008) and Askerov (2016). Life forms were determined by Rounker (1934) and Serebryakov (1964), phenological observations by Lavrenko (1959), floristic-geobotanical indicators by Beideman (1954) and Laprina (1929). The status is

given according to the criteria of IUCN "Red data Book" (2003) and the "Red book" of Azerbaijan (2013).

Biochemical methods. Essential oils (EO) obtained by hydrodestation (Ginsberg, 1932), EO physicochemical constants (Persidskaya, Chipiga, 1981; G.V.Pigulevsky, 1938-1952) and component composition has been determined by gas-liquid chromatography. Blubber also is a cover that holds in fat. The substances were identified by IR and NMR spectra. Triacylglycerides and their monoglycerides were calculated according to the fatty acid data.

Methods of resource science. Forests, near forests, meadows, mountain-xerophytic plants were studied during the field research.In order to study the reserve and density of plants, tranches were constructed of each $25m^2$ area in the surveyed territory, and the reserve of the plant was calculated (Zaiko et al., 2007).

The integrated characterization of the demographic structure of the plant and the index of recovery and replacement of population indicators (Zhukova, 1994), the aging index (Glotov, 1998), the age index (Uranov, 1975), the efficiency index (Zhivotovsiy, 2001) were determined for the assessment of populations.

CHAPTER III. SPECTRUM, BIOMORPHOLOGY AND GEOGRAPHICAL ANALYSIS OF THE *APIACEAE* Lindl. FAMILY IN AZERBAIJAN FLORA

The current situation of the Celery family in Azerbaijan. The taxonomic composition of the family was studied, 186 species of 70 genus were identified, of which 1 genus (*Helosciadium* W.D.J. Koch) and 1 species (*Helosciadium nodiflorum*) were included in the flora of Azerbaijan for the first time. Bioecological features of all species have been studied and presented in tabular form in the appendices to the dissertation. An area map of each species has been compiled. Systematic-morphological analysis of genus and species was conducted.

Systematic and biomorphological analysis of the family. The role of seeds, in other words, fruits, in determining the Celery family is great (Fig. 1).

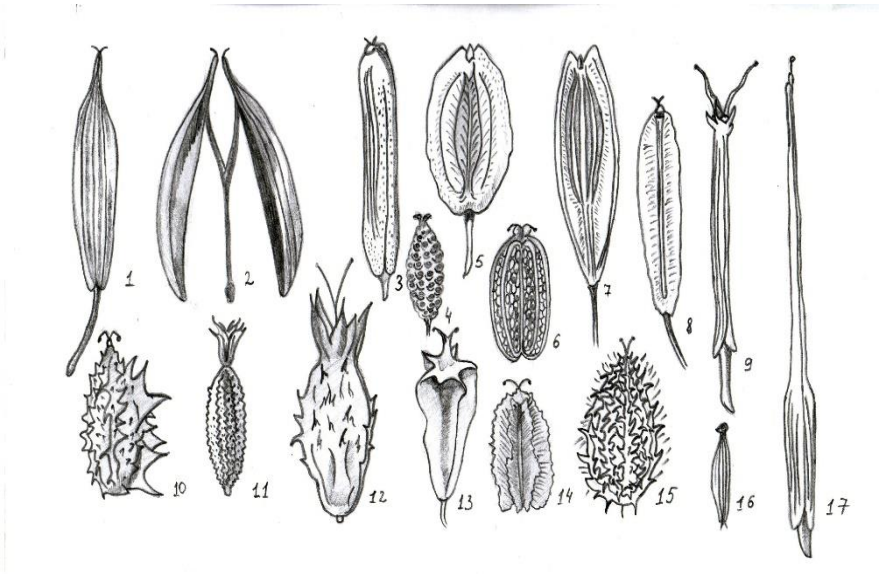


Figure 1.Seed structure of Celery family

Note: 1, 2. Helosciadium nodiflorum; 3. Prangos ferulaceae; 4. Szovitsia callicarpa; 5.Zosima absinthifolia; 6. Smyrniopsis aucheri; 7. Ferula caucasica; 8. Grammosciadium daucoides; 9. G. platycarpum; 10. Lisaea heterocarpa; 11. Actinolema macrolema; 12.Eryngium giganteum; 13. Johrenia paucijuga; 14. Laserpitium hispidum; 15.Turgenia latifolia; 16. Carum carvi; 17. Scandix pecten-veneris.

During field observations and inspections of the military fund, in addition to the differences in the seed structure of the species belonging to the family, there are other signs that cause a sharp difference between the species, for example:

- There is a fibrous neck below the trunk, near the root, in other words, the trunk is covered with fibrous wires, and this feature is unique to each species in most species. Fibrosis does not occur in very rare cases;
- Leaf forms: 2 main features were revealed in compound leaves: leaf plates are not continuous when there are segments in the leaf; the leaf blades continue if it is weak. The leaves that cover the complex inflorescence of taxa can also be considered as key taxonomic indicators;

-The main structural features of taxa are the differences in the structure of the taxa and their products. While the bells are the first wings of a complex inflorescence or the legs of a simple inflorescence, the bells are definitely a sign because they form the base of the flower.

For the determination of a new species for Azerbaijan, including the Caucasus (*Helosciadium nodiflorum*), molecular phylogenetic analyzes were conducted with Russian scientists to determine the nucleotide sequences of the ITS nucleus ribosome of DNA (Fig. 2). Three samples were used for DNA isolation: in addition to the sample collected in Azerbaijan, two samples of *H.nodiflorum* were taken from different points in the area closest to the collection site of the tested plant to study intra-species changes (Afghanistan, Uzbekistan) because species samples came from distant Europe.

Species of *Helosciadium* genus and some species identified as close relatives have been included in the ITS full-nucleotide sequence analysis. Overall, our analysis was based on a selection that included 68 ITS sequences belonging to 57 species and 38 genus. *Physospermum cornubiense* DC. used as an external group.

The results of the molecular analysis presented in the form of a tree fully confirmed the identification of the species as *Helosciadium nodiflorum*[10].

The obtained molecular tree Apium graveolens is in the branch of *Apieae*, while *Berula* and *Helosciadium* are *Oenantheae*, and the latter generation species form a significantly isolated branch, *Sium* and *Berula* are closer to *Cryptotaenia*, *Oenanthe* and *Cicuta*. We considered it expedient to provide a brief nomenclature reference on *H.nodiflorum* and an updated review of the range of the species as the species and genus are new to the Caucasian flora (Table 1).

[10] Пименов, М.Г. *Helasciadium nodiflorum*- Новые род и вид Umbelliferae для флоры Азербайджана и всего Кавказа /М.Г.Пименов, Ф.Х.Набиева Г.В.Дегтярева [и др.] //Бот.журнал, –Санкт-Петербург: –2018. –103(4), –стр.517-528.

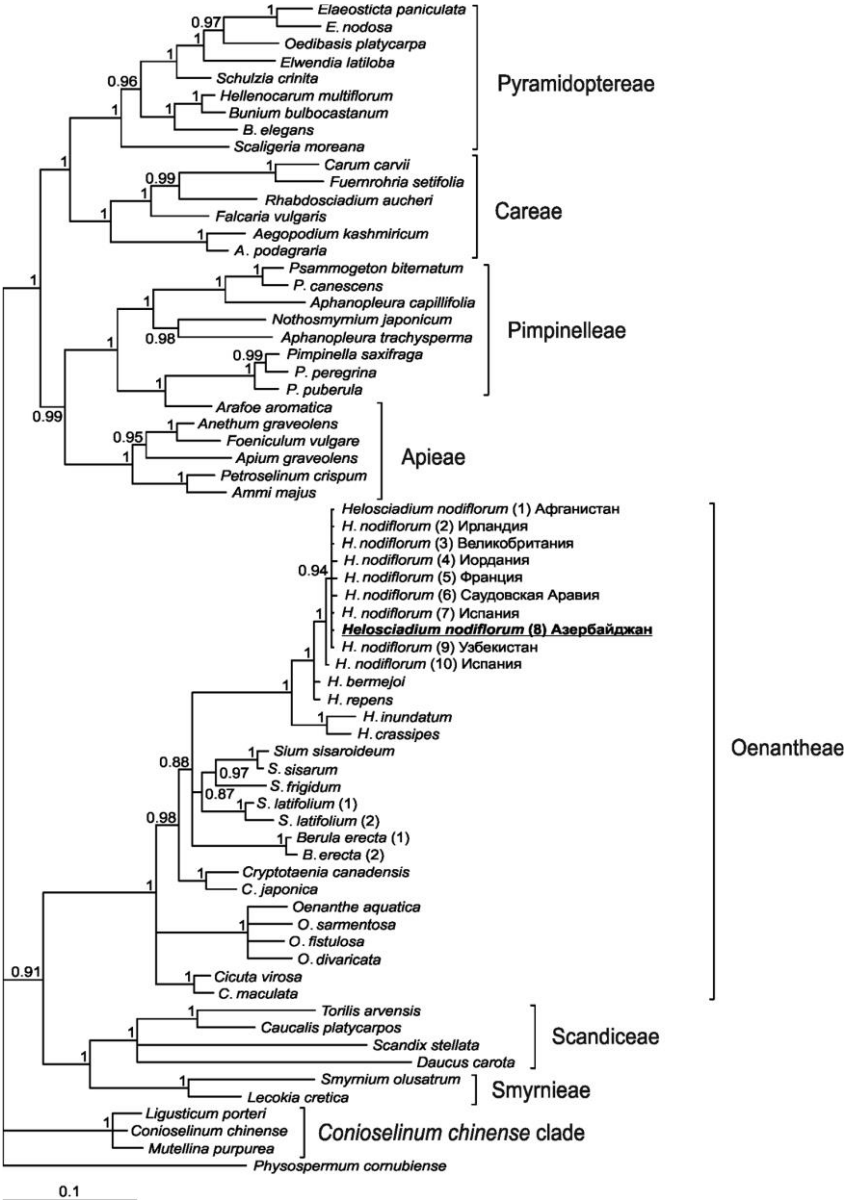


Figure 2.Consensus tree obtained by Bayes method on the basis of 19950 trees of *H. nodiflorum* species using S YM-G method

Table 1.

Positions of ITS 1-5.8S-ITS2 nuclear DNA nucleotide sequences in different areas of *Helosciadium nodiflorum* samples

Origin	ITS layout position				
	122 (109)	429 (396)	510 (453)	531 (472)	646 (578)
Afghanistan (1)	T	-	T	C	T
Ireland (2)	T	-	T	C	T
United Kingdom (3)	T	-	T	C	T
Jordan (4)	T	-	T	C	T
France (5)	T	-	T	T	C
Saudi Arabia (6)	T	-	C	C	T
Spain (7)	T	-	T	C	T
Spain (10)	G	A	T	C	T
Azerbaijan (8)	T	-	T	C	T
Uzbekistan (9)	T	-	T	C	T

Helosciadium nodiflorum (L.) W.D.J.Koch. Nova Avta Phys.-Med. Acad. Caes. Leop. – Carol. Nat. Cur. 12(1); 126, 1824.

= *Sium nodiflorum* L.Sp.: 251. 1753

= *Seseli nodiflorum* (L.) Scop., Fl. Carniol. (ed. 2) 1: 213, 1771.

= *Sison nodiflorum* (L.) Brot., Fl. Lusit. 1: 423, 1804.

= *Apium nodiflorum* (L.) Lag., Amen. Nat. Espan.: 101. 1821

= *Helodium nodiflorum* (L.) Dumort., Fl. Belg.: 77, 1827

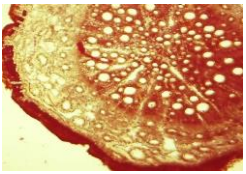
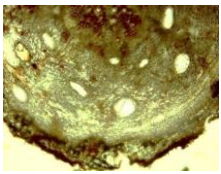
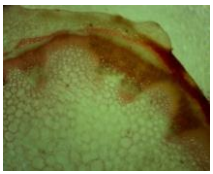
= *Lavera nodiflora* (L.) Raf., Good book: 50, 1840

= *Selinum nodiflorum* (L.) E.H.L. Krause, in Sturm (ed.), Deutschl. Fl. (ed. 2) 12: 34. 1904.

Species: In Europa ad ripas fluviorum (George Clifford bağçasından mədəni bitkilər), Herb. Clifford, 98, *Sium* 3 (lectotype BM-Cliff, designated by Jafri in Jafri& El Gadi, 1985: 78)

Morpho-anatomical features of some medicinal spicies. Morpho-anatomical features of some medicinal and food plants were studied and strong parenchymal tissue was observed (Fig. 3). Thus, in the root of the *Dorema glabrum* species, druses are formed in the area of the main parenchymal cells, which activates the osmosis process by increasing the density of cell juice. Aerenchyma tissue, which is not found in dry plants, was found as the main feature in the root of the *Daucus carota bite*.This may be due to the

fact that the plant grows in a relatively humid area. Calcium-oxalate crystals were found in the trunk of *Zosima absinthifolia*, which is considered a diagnostic indicator. These calcium oxalate crystals are found in the form of druses in the body, especially in the parenchymal cells.

Dorema glabrum Root system | *Daucus carota* Root system | *Zosima absinthifolia* Stem

Figure 3. Morpho-anatomical features of the structure of medicinal and food plants

Geographical analysis and endemics of the family. Xerophiles (72 species, 38.7%), Boreal (45 species, 24.2%), Caucasian (35 species, 18.8%) and geographical areal types with more species in general (152 species) make up 81.7% (Fig.4) have been shown the phytogeographic analysis of the family.

These species are mainly of Central Asian, Iranian, Mediterranean and Caucasian origin. The predominance of the xerophiles area in the terrestrial flora has led to the strong adaptation of these plants to the continental climate and lack of moisture should be noted.

The xerophilic area type is mainly Iranian-Turanian elements that combine mountain xerophytes, which are represented in our flora: *Cachrys longiloba* DC., *Chaerophyllum crinitum Boiss.*, *Pimpinella aurea* (DC.) Boiss., *Scandix persica* Mart., *S.aucheri* Boiss., *Zosima absinthifolia, Astrodaucus persicus* Boiss. Woron., *Trinia leiogona* (C.A.Mey.) B.Fedtsch., *Bunium paucifolium* DC., *B.cylindricum* (Boiss. et Hohen.) Freyn, *Cymbocarpum anethoides, Johrenia paucijuga, Eryngium billardieri, Prangos uloptera, Torilis nodosa* (L.) Gaertn.

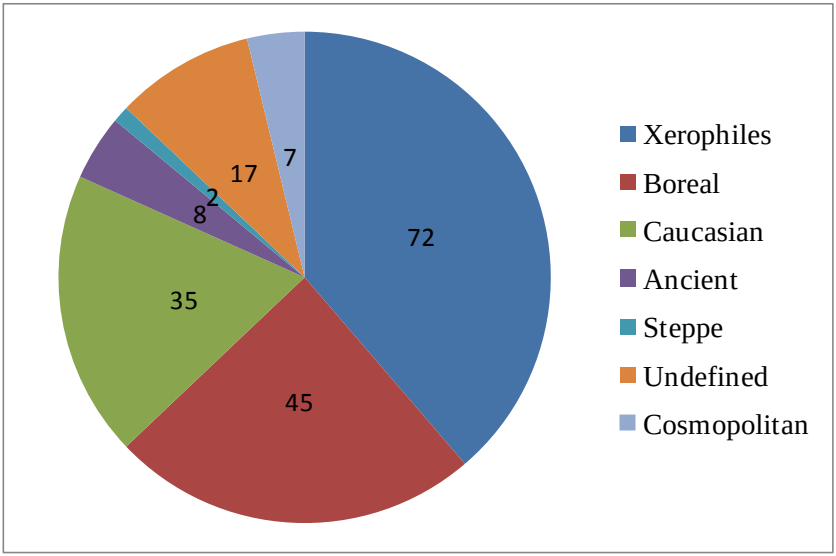


Figure 4. Types of habitats for geographical analysis of the family

The ancient species is 4.3% within the family. Ancient 3rd Period Forest Species belonging to the Ancient Mediterranean-Asia Minor class are found in a wide range of areas from the Mediterranean countries to the Gobi Steppe, through Central and South Asia.

The species *Pastinaca pimpinellifolia* Bieb., *P.glandulosa* Boiss. et Hausskn., *Chaerophyllum angelicifolium* Bieb., *Ch.humule* Stev., *Prangos uloptera* DC, *Helosciadium nodiflorum*, *Pimpinella tragium* Vill., *Peucedanum cervarifolium* C.A.Mey.of the family belong to the ancient areal type as hirkan and ancient intermediate elements in the flora.

Dorema glabrum, Aphanopleura trachysperma Boiss., *Peucedanum ruthenicum=P.luxurians* Tamamsch., *P.pauciradiatum, P.paucifolium* Ledeb.= *Johreniopsis seseloides* (C.A.Mey.) Pimen., *Elaeosticta glaucescens* (DC) Boiss., *Szovitsia callicarpa* Fisch.et C.A.Mey., *Prangos acaulis* (DC) Bornm., *P.ferulacea, Scandix pecten-veneris* L., *Pimpinella tragium* Vill.,*P.pseudotragium* DC., *Torilis tanella* (Delile) Reichenb.f., *Lisaea hetorocarpa* (DC) Boiss., *Heracleum schelkovnikowii* Woronow, *Ferula szowitsiana* DC.,

Malabaila dasyantha (C.Koch) Grossh., *Sanicula europaea* L. species were formed as a result of a combination of boreal and tropical species.

Species belonging to the Boreal areal type the exception of the arid zone of Transcaucasia, the Talish and the Mediterranean countries are distribuded in North Africa, Europe and North America. Boreal plants are Mesophytic plants of subalpine and alpine meadows and are distributed in the forest zone of the northern hemisphere. In particular, plants belonging to the choleric and Palearctic groups. Plants of this type *Chaerophyllum aureum* L., *Anthriscus cerefolium* (L.) Hoffm., *Bupleurum rotundifolium* L., *B.affine* Sadl., *Pimpinella idae* Takh., *Apium graveolens, Oenanthe aquatica* (L.) Poir., *Oe. fistulosa* L.) is often found in the species diversity of the family.

The Caucasus is made up of elements of different ages in the area type, especially the areas associated with the Greater Caucasus Mountains due to their origin. This area is called the Caucasian range because is possible to come across elements that formed in the Greater Caucasus after the glacial period, along with species that originated in the depths of the third period. *Seseli cuneifolium* Bieb., *S.grandivittatum* (Somm. et Levier) Schischk., *Pimpinella aromatica* Bieb., *P.tragium* Vill., *Bunium scabrellum* Korov., *Carum komorovii* Karjag., *Ammi visnaga* (L.) Lam, *Bupleurum wittmannii* Stev., *B.boissieri* Post, *B.polyphyllum* Ledeb., *Cachrys caspic*a (DC.) Menitsky, *Astrodaucus littoralis* (Bieb.) Drude, *Chaerophyllum roseum* Bieb., *Grammosciadium daucoides* DC., *G.platycarpum* Boiss.et Hausskn., *Echinophora supthorpiana* Guss., *Eryngium giganteum* Bieb., *E.caucasicum* Trautv.K.-Pol., *Symphyoloma graveolens, Laserpitium hispidum* species is one of the Caucasus areal plants.

However, this genus is not very old in general, and 9.1% of the species of unknown origin are also present in the flora, as no modern research has been conducted on the origin of the later species.

Laser trilobum, Aethusa cynapium L., *Pastinaca umbrosa* Stev.ex DC., *Ferulago galbanifera* (Mill.) Koch, *Peucedanum caucasicum*

(Bieb.) C.Koch, *P.paucifolium* Ledeb., *P.ruthenicum* Bieb. and etc. can be shown.

Rare and endangered species of the family in the flora of Azerbaijan *Astrantia maxima* Pall. (NT), *Dorema glabrum* Fisch. et C.A.Mey. *(*ENA2c+cd;C2a(i)b*),* *Ferula oopoda* (Boiss. Et Buhse) Boiss. (CRB2ab; C2a(ii)*),* *Ferula persica* Willd. (*VUA2c+3cB1ab(iii)*); *Ferula szowitsiana* DC. *(*ENB1abc(ii, iii, iv)*),* *Ferula caspica* Bieb. (NT), *Ferula caucasica* Korov. (VUD2*),* *Peucedanum pauciradiata* Tamamsch. *(*VU D2), *Stenotaenia macrocarpa* Freyn et Sinth. ex Freyn (VU D2), *Laserpitium hispidum* (NT), *Prangos acaulis* (DC.) Bornm. (NT), *Heracleum albovii* Manden. (VUD2), *Grammosciadium platycarpum* Boiss. et Hauss. *(*ENA2c+3c;C2(i)b), *Carum caucasicum* (Bieb.) Boiss. (NT), *Eryngium wanaturii* Woronow. (ENB1(i,ii,iii) + 2ab(i,ii,iii)*),* *Helosciadium nodiflorum* (L.) W.D.J.Koch (NT), *Bupleurum wittmannii* Stev. (NT), *Symphyloma graveolens* C.A. Mey. (NT) have been evaluated according to the criteria, an action plan for protection and restoration was developed.

CHAPTER IV. PHYTOCHEMICAL STUDY OF SOME SPECIES OF CELERY FAMILY

Identification and study of essential oil plants. The research was conducted and essential oils were collected from different regions during the field degradation in 2016-2017. These degradations took place in different ontogenetic periods of plants. Plant samples were collected from their natural habitats, and essential oil was obtained in the above-mentioned permanent geographical points of the region from June 20 to July 20.

Ether oil accumulates in special channels in any organ of the plant have been shown results of studies., Ether oil was obtained in all organs of plants at different stages of development and plant seeds contain more than any other organ was found. It varies in other organs widely depending on the phase of its development. The amount of EO in the seeds of plants studied in different years is given in Table 2.

Table 2.

The amount of essential oil in the seeds of the species studied over the years

Name of species	Place of collection	Plant phase	EO (%)surface part	
			2016	2017
Bupleurum rotundifolium	Shahbuz, Kuku mountain, 2600m	Flower	0,27±0,04	0,98±0,06
		Seed	0,60±0,01	0,62±0,01
Berula erecta	Ordubad Paraga village, 1000m	Seed	1,46±0,08	1,69±0,08
		Flower	1,28±0,07	1,30±0,07
Bunium cylindricum	Shahbuz Gomur village, 1400m	Seed	2,18±0,12	2,41±0,07
Ferula caspica	Gobustan district, 600m	Flower	0,75±0,004	1,62±0,09
F. microloba	Nakhchivan 1300 m	Flower	1,05±0,11	1,90±0,10
Astrodaucus orientalis	Yard of Inst. of Dendrology of ANAS	Seed	1,12±0,04	1,78±0,10
Daucus carota	Altiagaj, 250m	Flower	2,01±0,11	2,79±0,16
Carum carvi	Around Khoshbulag, in the forest, 1500m	Seed	0,47±0,05	0,70±0,06
Anthriscus cerefolium	Gobustan, 700m	Flower	0,36±0,04	0,32±0,04
Johrenia paucijuga	Shahbuz, Kuku mountain, 2600m	Flower	0,19±0,01	0,18±0,01
		Seed	0,35±0,03	0,40±0,03
Prangos ferulacea	Goygol and Gadabay districts, 1000-2000 m	Stem	0,31±0,012	1,05±0,044
	Nakhchivan 600-2500m	Flower	0,17±0,009	1,12±0,046
Heracleum trachyloma	Shahbuz district.1700-2500m	Flower	2,91±0,170	1,65±0,087
	Goygol, Murovdag 1200	Seed	4,49±0,270	6,41±0,561

The species studied have great medical importance. In view of this, the microbiological study of essential oils derived from the *Zosima absinthifolia* and *Johrenia paucijuga* species has been studied.

The antimicrobial properties of essential oils obtained from these plants were studied by disk-diffusion. *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa,* and *Candida albicans* were used as test specimens. Bacteria were stored in meat-peptone

agar at 37^0C for 1 day, and with mushrooms in *Saburo* for 2-3 days at 28^0C. The results of microbiological tests show that the diameter of the sterile zone (non-microbial) formed in the box planted with albicans in *Candida albicans* was 32 mm in the essential oil obtained from the *Zosima absinthifolia* species, which indicates that the species has an active fungicide. Sterile zone formed with an 18 mm diameter in *E. coli* and 16 mm in staphylococcus.

The essential oil of *Johrenia paucijuga* has a selective effect on staphylococci - 17 mm zone. Thus, the essential oil obtained from the *Zosima absinthifolia* species can be used in the preparation of drugs as an antifungal agent.

The percentage of EO in different organs has been studied in dynamics, in other words, depending on ontogeny in some species (Table 3).

Table 3.

Dynamics of accumulation of essential oil in the organs of plants in different phases of vegetation

Species	Vegetation phase	(%) Essential oil			
		Root	Leaf	Flower	Seed
Bupleurum rotundifolium	I beginning of vegetation	0,73	Traces	-	-
	II mass flowering	0,59	0,10	0,27	-
	III fruiting	0,16	0,06	-	0,62
	IV vegetasiyanın sonu	1,08	Traces	-	-
Berula erecta	I beginning of vegetation	Traces	0, 06	-	-
	II mass flowering	Traces	0,13	1,28	-
	III mass fruiting	0,48	0,27	-	1,46
	IV end of vegetation	0,10	Traces	-	-
Bunium cylindricum	I beginning of vegetation	0,17	Traces	-	-
	II mass flowering	0,13	0,03	0,36	-
	III mass fruiting	Traces	-	-	2,18
	IV end of vegetation	0,11	-	-	-

Physicochemical constants of EO obtained from the species have been determined: the essential oil of *Bupleurum rotundifolum* is a fragrant, green clear liquid characteristic of this plant, which is

strongly unpleasant.Specific gravity (d_4^{20}) - 0.861; angle of refraction (n_d^{20}) - 1.478; acid number (a.n.) - 0.7; essential number (e.n.) - 20.7;Essential number after acetylation (e.n.a.a.) - 33.4; essential oil of *Berula erecta* is a clear liquid with a strong odor, specific gravity - 0.879, angle of refraction - 1.432; a.n. - 0.9; e.n. - 223.4; e.n.a.a - 300.8; essential oil of *Bunium cylindricum* is a yellowish-red clear liquid with specific gravity - 0.868, angle of refraction - 1.539; a.n. - 1.6; e.n. - 23.1; e.n.a.a. - 73.29.

Determination of fatty oils. *Smyrniopsis aucheri* Boiss. is found only in the territory of Shahbuz district of Nakhchivan AR. 9 places are shown in the Red book of the former union, and in the Red book of Azerbaijan (2013) in only 3 places for the territory of Nakhchivan AR. However, the status of a species with a sufficiently expanded range in the regional assessment was restored and given in the Red book of Nakhchivan AR. Taking into account the large area in the area and the presence of fatty oils has been studied in detail.

First, vegetable oils were extracted from the seeds: 24.71% in seeds, 6.24% in leaves, 4.71% in stems and 7.60% in roots. Physicochemical parameters of *S.aucheri* oil were determined: specific gravity D_4^{20}-092; refractive index n_4^{20}-1.4920; saponification, mg KOH/q - 162.69; acidity, mg KOH / q-1.12; the amount of essential, mg KOH/q-161.57, the amount of iodine,% J_2-130.5, Reichert-Meysel quantity - 3.2%; Polensky quantity - 0.11%, the content of non-saponified substances - 1.92%.

To separate the lipid content of *S.aucheri* oil with the help of thin-layer chromatography, chlorophyll (8:2 ratio) with petroleum ether was used and chromatograms were made with witnesses. Chromatograms of fat samples by lipid classes were identical in many components: 1) carbohydrates; 2) triacylglycerols; 3) free fatty acids; 4) some components, such as free sterols and a complex mixture of a number of minor components have not been identified.

As a result, 26.98% of saturated radicals and 73.02% of unsaturated radicals were identified in the oil. Saturated fatty acids

are bound to hydroxides in the β–state. Olein and linoleum predominate the saturated acids[11].

The acids that make up triacylglycerides and monoacylglycerides derived from *Smyrniopsis aucheri* are divided into the following 4 groups:Palmitin (p) - saturated acids: 10:0; 12:0; 14:0; 15:0; 16:0; 18:0; 20:0; 23:0; Oleic acids (O) are monounsaturated and unsaturated acids; Linoleic acid (L); Linolenic acid (Le). The quantitative composition of acids belonging to each group is shown in Table 4-5.

Table 4.

Percent (%) of monoacylglycerides in *Smyrniopsis aucheri* oil

"P" acids		"O" acids		"L" acids		"Le" acids %	
12:0	1,37	16:1	1,24	18:2	68,91	18:3	-
14:0	0,87	18:1	22,68				
16:0	3,32						
18:0	1,61						
Total	7,17		23,92		68,91=100		

Table 5.

Triacylglycerin fatty acids from *Smyrniopsis aucheri (%)*

"P" acids		"O" acids		"L" acids		"Le" acids	
10:0	0,31	16:1	0,94	18:2	55,84	18:3	1,06
12:0	0,24	18:1	11,72	-	-	-	-
14:0	0,32	22:1	3,46	-	-	-	-
15:0	0,16	-	-	-	-	-	-
16:0	4,52	-	-	-	-	-	-
18:0	1,74	-	-	-	-	-	-
20:0	1,20	-	-	-	-	-	-
23:0	4,75	-	-	-	-	-	-
24:0	13,74	-	-	-	-	-	-
Total	26,98	-	16,12		55,84		1,06=100

[11]İbadullayeva, S.C., Zulfugarova, P.V. Study of lipid composition of oil Smyrniopsis aucheri boiss., growing in Nakhchevan AR, Azerbaijan // "Sylwan Journal“,–2017. –12. –pp.252-258.

As you can see, the plant contains both saturated and unsaturated fatty acids, which makes it suitable for use in medicine and other fields.

CHAPTER V. RESOURCE EVALUATIONS OF SOME USEFUL SPECIES OF *APIACEA* FAMILY

Celery has great value in the national economy, including the development of livestock, strengthening the fodder base, as food and medicine. The resource estimates, reserves and phytocenological structure of cenopopulations of *Zosima absinthifolia, Carum carvi* and *Laser trilobum* species were studied with this in mind.

The structure and species composition of phytocenoses formed by their abundance in plants was determined, distribution patterns and populations on altitude zones were determined, and a detailed explanation was given in the dissertation.

Zosima absinthifolia is found only in steppe, mountain-xerophyte and mountain-meadow vegetation. The composition of the associations in which the plant is distributed in these areas is reflected in the table below, and the phytocenological structure of each population has been studied (Table 6).

Table 6.

Phytocenological structure of the *Zosima absinthifolia* species

№ CP	Distribution areas	Z. absinthifolia is typical for each of the associations (the main elements are marked in the table)	Projective cover (%)	Abundance
1	2	3	4	5
1	Zarnatun, meadow steppes	1.Volga fescue-Stipa (*Stipa capillata+ Festuca valesiaca*) 2.Astragalus-Thyme-Volga fescue (*Festuca valesiaca+ Thymus kotschyanus + Astragalus euoplus*)	60	Cop_2
2	Gonaggormez, mountain steppes	Astragant-Juniper (*Juniperus communis + J.foetidissima +Astracantha microcephala*)	70	Cop_3

Table 6 continuation

1	2	3	4	5
3	Khinzirek, meadow steppes	1.Volga fescue- Nardus (*Nardus stricta-Festuca sclerophylla*) 2.Flattened meadow-grass-Stipa (*Stipa capillata–Poa compressa*)	70	Cop_3
4	Salvarti, xerophytic phytocenoses	Yarrow-Fireweed (*Chamaenerion angustifolium-Achillea millefolium*)	80	Cop_3
5	Around Nakhchivanchy, meadow associations	Thyme-Dropwort-seseli-Stipa (*Seseli peucedanoides + Filipendula vulgaris+ Stipa capillata+Thymus collinus*)	80	Cop_3
6	Gotur su area, shrub-mountain xerophytes in the	Sea buckthorn-Rosehip-Almond (*Amygdalus fenzliana +Rosa buschiana +Crataegus orientalis*)	50	Cop_2

The structure of ontogeny was calculated with materials collected from different phases of ontogeny according to the method of population research.

Criteria for comparison were shown for the *Zosima absinthifolia* species by making notes in j, im, v, g_1, g_2, g_3, s, ss periods (Fig. 5).

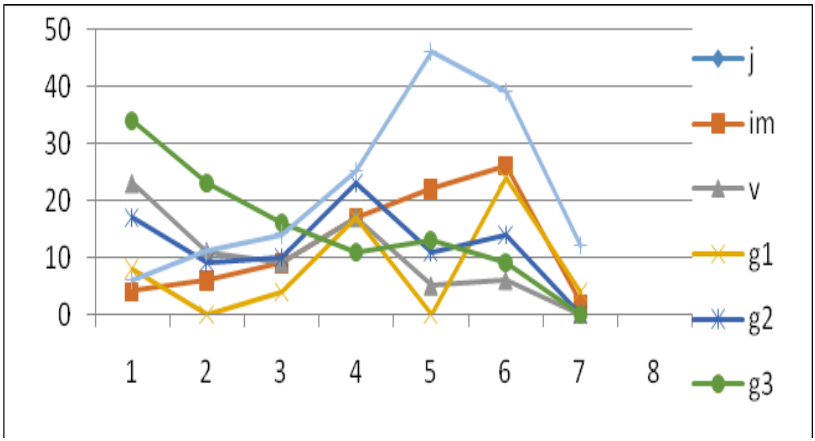


Figure 5. Dynamics of ontogeny of the *Zosima absinthifolia* species

The highest rate of *Zosima absinthifolia* is in the generative stages of development (125-143 units) has been shown results of the calculations.

9 CPs were selected to study the population performance of the *Laser trilobum* species in different years, and the integrated characteristics of the demographic structure were determined (Table 7).

Table 7.

Assessment of *L.trilobum* cenopopulation (CP)

№	Type of CP	Growth phases of ontogeny, total%							Indexes	
		J	İm	v	g_1	g_2	g_3	ss, s	Δ	Ω
82	M	17.1 7.32	9.43 7.32	18.87 21.95	11.32 17.1	7.55 17.1	3.77 0	32.1 29.3	0,46 0,56	0,49 0,45
15	T	3.5 10	9.3 5.77	17.4 5.77	15.1 19.62	10.5 30.77	30.2 9.62	14 38.46	0,57 0,59	0,52 0,63
379	Y	0 11.76 0	40 17.65 0	10 41.2 12.73	15 17.65 14.55	25 11.76 25.45	0 0 29.1	0 0 18.2	0,19 0,16 0,55	0,28 0,17 0,30
46	F. m.	0 0	0 0	11.1 11.76	6.7 15.7	40 23.53	22.2 33.3	20 15.7	0,41 0,43	0,24 0,32

Note: M-mature, T-transition, Y-young, F.m-fully mature

All groups of plant ontogenesis are found in populations, but no juvenile and immature phases of CP 4, 6, and 9 are found in the juvenile phase of populations 3, in the adult generative (g_3) phase of populations 2, and in adult generative in populations 3 and 7, no individual belonging to either the senile (s) and subsenile (ss) groups was found.

Phytocenological assessments were carried out in 15 CPs of *Carum carvi* species and a relative decrease in the number dynamics of the plant in nature was found (Table 8).

Age (Δ = 0.08-0.58) and efficiency level (ω= 0.19-0.77) were determined in plant localities. High efficiency was observed mainly in the Lesser Caucasus area.

Reserves of all 3 species were calculated (Table 9). Abundance of biological resources of *Zosimia absinthifolia* was registered in Shahbuz and Julfa districts, *Laser trilobum* in Babek and Shahbuz districts, *Carum carvi* in Shahbuz and Dashkasan districts.

Table 8.

Phytocenological assessment of *Carum carvi* species in some districts of Azerbaijan

CP	Type of CP	Age conditions,% of total amount							Indexes	
		J	im	v	g_1	g_2	g_3	ss, s	Δ	Ω
2	Y	50,2	20,5	11	8,6	6	2,2	1,5	0,08	0,22
5	«	63,8	13,7	6,9	4,2	7,8	3,6	0	0,09	0,21
7	«	14,1	10	26,2	19,0	11,7	12,1	6,9	0,27	0,46
11	«	25,1	20,9	12,1	7	11,6	17,6	5,6	0,28	0,42
12	«	0	0	0	10,3	59,2	32,1	0	0,06	0,19
3	T	41,1	24,6	20,1	4,5	6	2,2	1,5	0,08	0,22
6	«	18,9	64,6	0,9	4,6	7,8	3,2	0	0,09	0,21
10	«	18,3	5,8	26,2	19,0	11,7	12,1	6,9	0,27	0,46
13	«	5,6	6,3	18,1	30,9	18,5	11,1	9,4	0,37	0,64
14	«	9,8	9,5	16,5	8,1	27,1	12,3	15,8	0,42	0,58
1	A	4,5	2,9	19,1	12,7	13,6	31,8	18,2	0,53	0,61
4	«	6,2	10,4	16,7	16,7	18,8	6,2	25	0,44	0,54
9	«	1,2	0,9	18,4	19,5	24,1	25,3	11,5	0,49	0,71
8	O	8,4	6	6,7	27,2	26	19	7,7	0,43	0,71
15	«	0	0	0	21,2	33,1	33,3	11,4	0,58	0,77

Note: A-adult, T-transition, G-young, Q-old.

Table 9.

Biological resources of some species

№	The name of the species	Biological reserve (tone)	Operational reserve (tons)	Possible volume of annual reserves (tons)
1	*Zosimia absinthifolia*	2461,1±256,1	1230,5±128,05	123,05±19,8
2	*Laser trilobum*	530,57±89,2	265,28±45,1	26,52±4,51
3	*Carum carvi*	1647,2±288,2	823,6±136,7	82,36±14,27

Possibilities of use of plants: ethnobotanical researches. A number of folk methods have been identified on the basis of

ethnobiological information about Celery, reflecting our traditional culture, application of information stored in folk medicine in some diseases, new ways of using wild food, vegetables, industrial plants on a scientific basis.

This information is a method created by our people over the centuries and tested in many ways. The data were collected mainly from personal conversations with the older generation, who are well versed in folk medicine and have been practicing lojman throughout their lives, and wild-eating plants were conducted among housewives and the older generation. As a result, a classification of useful plants of the family was prepared: 140 species of fodder, 64 - essential oils and spices, 32 - medicines, 17- foods, 12 - resins and 3 - dyes.

Introduction of some species. Introduction of plants was carried out on the endangered speciesduring the research years. Cultivation of 5 species of Celery family: *Bifora radians, Bifora testuculata, Ammi visnaga, Carum carvi* and *Foeniculum vulgare* were studied in the experimental field of the Institute of Dendrology of ANAS. The use of these plants as food and medicinal raw materials among the peoples of the world has instilled in us the need for their widespread use in production.

CONCLUSION

1. The current situation of Celery in the biodiversity of the flora of Azerbaijan was determined, 186 species of 70 genus were confirmed. *Helosciadium nodiflorum* was found for the first time in Azerbaijan for the Caucasus and the South Caucasus (Transcaucasia). Identification of the species by morphological features was confirmed by analysis of the nucleotide sequences of the ITS nucleus ribosome of DNA.

2. Morphological anatomical studies were carried out on the roots, stems, shoots and leaves of some useful species (*Dorema glabrum, Daucus carota* and *Zosima absinthifolia*), the main diagnostic features of the family were identified, the strength of the parenchymal tissue group and the formation of reserve nutrients were determined.

3. The status and range of the species have been clarified, endemism and rare species have been identified. The areal types of Celery distributed in the flora of Azerbaijan have been identified in the result of phylogenetic analysis and shown separately for each species: xerophilous 72 species, boreal 45 species, Caucasian 35 species, ancient, desert, adventive, steppe and indefinite species. Also 15 species of Caucasian and 2 species of Azerbaijani endemics are proved. There are 18 species of celery in the flora of Azerbaijan, 2 of which are listed by us.

4.For the first time, essential oils of some species (*Bupleurum rotundifolum, Berula erecta, Bunium cylindricum, Prangos ferulacea, Zosima absinthyfolia* and *Johrenia paucijuga*) were obtained, and their antimicrobial properties were discovered. The yield of essential oil in the same plant organs in different years and at different phases was studied and compared: *Zosima absinthifolia* 1.89-2.01%, *Johrenia paucijuga* 0.19-0.35%, *Prangos ferulacea* 0.17-1.05%.

5.The fatty properties of *Smyrniopsis aucheri* were studied and the physicochemical constants and component composition of the obtained substances were revealed. The amount of fat in the seeds of the plant is 24.71%, which is higher than in other organs. Lipids are composed of hydrocarbons, triacylglycerides, free fatty acids and free styrene was determined based on the physicochemical parameters of the oil.

6.Celery has a special medicinal value, aromatic and spicy, feed, food, etc. Resource assessments of species were carried out (*Zosima absinthifolia*-1230,5 t/ha, *Laser trilobum*-265,28 t/ha, *Carum carvi*-823,6t/ha), population of species were phytocenologically assessed: *Zosima absinthefoliation* coefficient (Δ= 0,08-0,53), efficiency factor (ω = 0.21-0.71); for *Laser trilobum* species Δ= 0.16-0.59, ω = 0.17-0.63, recovery coefficient I_r = 0.16-2.4, aging coefficient I_a = 0.14-0.38; for *Carum carvi* species Δ = 0.06-0.58, ω = 0.19-0.77.

7.Ethnobotanical researches on the use of Celery in the flora of Azerbaijan were carried out, their classification was determined: 47% belong to the foraging group, 31% to essential oils and spices, 11% to medicinal, 6% to food, 4% to resin and 1% to coloring plants.

Among them, a few (*Ammi visnaga, Foenoculum vulgare*) food plants (*Bifora radians, Bifora testuculata* and *Carum carvi*) were introduced.

RECOMMENDATIONS

- Essential oils of Celery can be widely used in medicine due to their antibiotic and antimicrobial properties.
- Fatty oil of *Smyrniopsis aucheri* contains important in the preparation of creams and medicinesboth saturated and unsaturated fats.
- Abundance of biological and annual reserves of *Zosima absinthifolia, Laser trilobum* and *Carum carvi* species provides a basis for their use as a medicinal raw material base.
- *Bupleurum wittaminnii* (NT), *Helosciadium nodiflorum* (NT) are recommended to include in the next edition of the Red List of Azerbaijan.

List of published scientific works on the topic of the dissertation:

1.Ibadullayeva, S.J., Zulfugarova, P.V. The use of essential oils of some species of the *Apiaceae* family in aromatherapy //Conf.Mat. Ganja - GSU "Actual problems of modern biology and chemistry" Scientific-practical conference, –Ganja: –2015, –p.122-125.

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3. Ibadullayeva, S.J. Ethnobiological and phytotherapeutic analysis of medicinal herbs of Azerbaijan flora used at cardiovascular diseases treatment /S.J.Ibadullayeva, J.Gahramanova, H.Z.Gasymov [et al.] // Global Journal of Biology, Agriculture & Health Sciences, –2015. –Vol4 (1), –p.38-43.

4. İbadullayeva, S.J.Medico-ethnobotanical inventory (Liver And Gallbladder Ducts Illnesses) of Nakhchivan AR, Azerbaijan/S.J.İbadullayeva, H.Z.Gasimov, M.J.Gahramanova,[et al.] //International Journal of Sciences, –2015.–Vol-4,–(6), –p.80-88. Impact factor: 2.17.

5.Ibadullaeva, S.J. Wild plants growing in the flora of Azerbaijan: ethnobotanical studies / S.J.Ibadullaeva, G.Z. Gasymov, G.Sh.Shiralieva, P.V.Zulfigarova [et all.]// Scientific journal of Academic research. Multidisciplinary Journal BLACK SEA.– Georgia:–2015.–p.73-84

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9.Ibadullayeva, S.J. Zulfugarova, P.V., Babayeva, Z.B. On the systematics of Celery // Proceeding of Scientific Works of the Institute of Botany of ANAS, -2016. –XXXVvol., –p.72-76.

10. Gasimov, H.Z., Akhundova, S.T., Zulfugarova, P.V. Possibilities of use of some useful plants of *Apiaceae* family in the flora of the Lesser Caucasus // - Nakhchivan: Proceeding of Scientific Works of Nakhchivan State University, -2016. - p. 169-174.

11.Zulfugarova, P.V.Some wild food plants of *Apiaceae* Lindl family spread in Azerbaijan flora //SEAB - 2-Symposium on EuroAsian Biodiversity. –Belarus:–2017,–p 380 .

12.İbadullayeva, S.J., Zulfugarova, P.V. Study of the lipid composition of oil Smyrniopsis aucheri boiss., growing in Nakhchevan AR, Azerbaijan // "Sylwan Journal“,–2017.–12. – pp.252-258.

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