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**ABSTRACT**

of the dissertation for the degree of Doctor of Philosophy

**BIOECOLOGICAL FEATURES AND RESOURCE  
OF TRADITIONAL USE WILD PLANTS IN  
NORTH-WEST OF LESSER CAUCASUS (TOVUZ,  
AGSTAFI AND GAZAKH DISTRICTS)**

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Field of science: Biology

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## INTRODUCTION

**The actuality of the topic.** There are about 300,000 plant species in the world, 60% of which are used as medicines and nutrients<sup>1</sup>. Recently, people have been able to obtain medicinal and food plants not only from wild flora but also through artificial cultivation, which is an indispensable part of human civilization. However, it is known that wild food plants generally have higher nutritional values, higher fiber and polyphenol content, and antioxidant capacity than cultivated species. In addition, many weeds are known to be effective in preventing chronic diseases such as cardiovascular disease and diabetes. Many of these plants have been transmitted from generation to generation and have led to the development of traditional use<sup>2</sup>. Plant extracts play an important role in the development of new drugs for the treatment of diseases. These are used in the flora of Azerbaijan for the development of new compounds have revealed under ethnobotanical research.

Unsystematic use of land and forest resources by people, industrialization and urbanization of the area, changes in natural conditions due to technical influences (irrigation, drying, cultivation, etc.) have created problems for sustainable development of biodiversity in the current situation in the Republic of Azerbaijan, on the other hand, humans interact dynamically with plants, where plants become biodiversity and people develop strategies and methods to use them<sup>3</sup>.

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<sup>1</sup>Ethnobotany: Integrating Biology and Traditional Knowledge//Missouri Botanical Garden. -St. Louis, MO. -November 7-8, -2018.

<sup>2</sup>Ozturk, M. A comparative analysis of medicinal and aromatic plants used in the traditional medicine of Iğdir (Turkey), Nakhchivan (Azerbaijan) and Tabriz (Iran)/M.Ozturk, E.Altundağ, S.J.Ibadullayeva [et al.] //Pak. J.Bot., -2018, -vol.50, -p.337- 343.

<sup>3</sup>Ibadullayeva, S.J. Study Of Treatment Advantage Of Medicinal Herbs With Anthelmintic Effect Against Neoscarisiasis /S.J.Ibadullayeva, S.H.Maharramov, L.A.Novruzova [et al.]// Inter.Jour.of Research Studies in Biosciences, -v.3, -Is.1, -2015, -p.78-81..

Survival for humans since the ancient stone has been established at paleolithic research in the Tovuz, Aghstafa, and Gazakh districts of the North-East of the Lesser Caucasus<sup>4,5</sup>.

The human body, being in complete unity, is made up of a system of organs, and the organ system is made up of a number of different organs, tissues and cells. Foods rich in vitamins and biologically active substances should be taken for the normal development of the body. Herbal foods and medicines are always natural and are better absorbed by the body than synthetic foods and medicines and have no side effects. Implementation of bioecological features and resource assessments of wild plants used in the area is actually from our view. In particular, the study of new trends in the current state, use and resources of populations of medicinal and wild food plants used by local communities in folk medicine for many years is very important. In this respect, the topic of research is the actual and aims to solve the "rational use, restoration and protection of vegetation with biological justification" problems.

**Object and subject of research.** Ethnobotanical research of useful plants and study of biological resources in Tovuz, Agstafa and Gazakh districts located in the North-East of the Lesser Caucasus were conducted. Plants with wide areas and a wide range of uses were selected as research objects and their populations were assessed.

**The main goals and objectives of the study:** to identify the taxonomic composition of wild-growing, traditional and widely used wild medicines, food and technical plants in the North-Eastern regions of the Lesser Caucasus, to assess their resource allocation, population structure, and use practices. The following tasks have been set for achieving this goal:

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<sup>4</sup>Azerbaijan ethnography: [in 3 volumes] / Chief editor. T. Bunyadov, -Baku: East-West, -I v.,-2007, -568 p.

<sup>5</sup>Mustafayev, A.H. Material culture history of Azerbaijan (typological research on the basis of ethnographic materials): Monograph / AH Mustafayev, -Baku: "Baku University" publishing house, -2009. -420 P.

- Summarizing the literature on wildlife use and the results of surveys from local communities;
- Preparation of the Flora Concept of the study area;
- Conducting ethnobotanical and ethnopharmacological monitoring of the flora of the area, revealing the methods and ways of ethnic use of medicinal, food and technical plants;
- Conducting an analysis of the regularities and ecology of useful plants;
- Determining the populations, range of some priority plants and conducting phytocenological and resource assessments;
- Food, medicine, technical, etc. developing system of measures for the protection and restoration of the gene pool of resources collected for the purpose;
- Develop classification of useful plants of the study area.

**Research methods.** Floristic, areological, phytocenological methods and expeditions were carried out in the research. Collected plants were identified and named according to modern nomenclature. Ethnobotanical, biomorphological, ecological methods and methods for determining the stock of medicinal plants were used. The regularities of plant propagation were also revealed.

**Defensive provisions:**

- Source of raw materials for useful plants in Tovuz-Agstafa-Gazakh districts;
- The use of some rare plants has created a basis for their ecobiological and phytocenological research;
- Ethnobotanical and ethnopharmacological research of the area flora can open new opportunities and ways of using plants.

**The scientific novelty of the research.** For the first time, a taxonomic spectrum of Tovuz-Aghstafa-Gazakh districts was prepared, 1526 species were identified in the territorial flora, of which 204 species of 60 families and 148 genus, which is 13.37% of the territorial flora, are used by local communities by ethnic methods. Of these, 5 (2.47%) species belong to Higher spores, 8 (3.96%) species belong to 4 families (7.1%), 4 (2.72%) genus belongs to Gymnosperms, 191 species (93.6%) of two classes

(Magnoliopsida and Liliopsida), 53 families (88.3%), 138 genus (93.2%) belongs to Angiosperms. *Asteraceae* Dumort family, which is used as a medicinal and aromatic plant among the useful plants used by humans since ancient times is the main one with 18%, *Rosaceae* Juss. - 16%, *Ranunculaceae* Juss. and *Caryophyllaceae* Juss. each by 11%, *Apiaceae* Lindl. - 9%, and *Lamiaceae* Lindl. family - 8%, the remaining families-1-5% have been shown ethnobotanical and ethnopharmacological monitoring.

The life forms of useful plants in the study area were analyzed based on the Serebryakov and Raunkier systems. Ecological analysis of useful plants revealed the predominance of mesoxerophytes.

Areal types, geographical distribution and phylogeny of the flora of the area were studied, the predominance of the Mediterranean and Palearctic (19%), Caucasus (12%), Iran-Turan (11%) elements were clarified.

Populations of some useful resources were cenologically assessed, plant age and efficiency coefficient were calculated: efficiency of *Achillea* species  $\omega=0.42-0.56$ ; efficiency of cenopopulations of *Asparagus persicus* Baker.  $\omega = 0.64-0.75$ , *Helichrysum aurantiacum* Boiss. et Huet  $\omega = 0.21-0.76$ .

The biological resources of the species collected from nature and put up for sale have been calculated, and an action plan for their protection has been implemented.

**The theoretical and practical significance of the research.** The most commonly used species, with a reserve and annual supply, can be used for both medicinal and food purposes.

Classification of plants according to their usefulness has been developed. Perspective forecasts of the use of medicinal plants were proposed, grouped according to the direction of use, dried, packaged and sold.

The results of scientific research can be used in the implementation of the State Program on food security and reliable provision of the population with food products. Thus, it is expedient to establish mini-shops in areas with sufficient reserves for the

supply of commercial wild vegetables, and small markets and national kitchens in central cities for consumption.

**Approbation and application.** Basic provisions of the dissertation have been approbated on the GSU "Actual problems of modern chemistry and biology", Ganja-2016; SEAB 2-Symposium on EuroAsian Biodiversity, 2016 - Antalya (Turkey); SEAB 3rd Symposium, 2017-Minsk (Belarus); CCFBD International Conference, Baku-2017; "New Challenges to Botanical Research, Baku-2018 and also has passed apprenticeships at the seminars of the Azerbaijan State Agrarian University and the Institute of Botany of ANAS

A total of 12 scientific works related to the dissertation were published.

**Organization where the dissertation is implemented.** The work was performed at the Biology Department of Azerbaijan State Agrarian University.

**Volume and Structure of Dissertation:** The volume of the dissertation is 243 pages and 221,000 characters including introduction, 6 chapters, results, suggestions and recommendations (introduction - 12,000 characters, Chapter I - 42,000 characters, Chapter II - 9,000 characters, Chapter III - 28,000 characters, Chapter IV - 61,000 characters, Chapter V - 40,000 characters, Chapter VI - 24,000 characters). Also includes of bibliography by 188 titles, 26 tables, 34 figures, 4 maps and attachments. The taxonomic spectrum of the area have been provides in attachment.

## **CHAPTER I: ETHNOBIOLOGICAL HISTORY OF WILDLIFE USE PLANTS: LITERATURE REVIEW**

The dissertation provides a brief overview of the world literature that the basics ethnobotany contains.

## **CHAPTER II. MATERIAL AND METHODOLOGY OF RESEARCH**

Expeditions and floristic, areological, phytochemical methods of the study were carried out in the Tovuz, Agstafa and Gazakh districts

in 2015-2020 years. Ethnobotanical studies were carried out by ethnography; request; observation; questioning; interview; comparative-historical methods, component analysis and other methods<sup>6</sup>.

Biomorphological properties, ecological characteristics and distribution patterns of useful plants were revealed. The method of determination of medicinal plant reserves was used<sup>7</sup>. Collected plants were designated according to the Flora of Azerbaijan and Flora of the Caucasus, and named was taken into account of modern nomenclature<sup>8</sup>.

### **CHAPTER III. BIOECOLOGICAL PROPERTIES OF TOVUZ- AGSTAFI -KAZAKH REGION**

#### **3.1. Geographical location and vegetation of the study area.**

The Tovuz, Agstafa and Gazakh districts are located close to Georgia and Armenia. These areas are located in the North-Western part of Azerbaijan, on the Ganja-Gazakh plain, the northern part, the left coast of the Kura River and the Jeyranchol pastures are ideal for breeding. Forest Found lands - 6.02% in Gazakh, 6.92% in Agstafa, 17.04 % in Tovuz. The dendroflora of the mosquitoes consists of pineapple, sosnowski spruce, lavender, willow, white mulberry, odor, blackberries, oak, juniper and edible trees. From the bush are found the plum, saddle, flax, lizard, hips, blackberries, forest grapes, ordinary rock climbing and other species. The grass cover mainly consists of lizards, fragrances, white seagrass, nettle, slag, wild root species. Subalpanments were formed locality in the study area. On the high hill, there is a spread of oriental wings. Eastern oak is replaced

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<sup>6</sup>Guber, R. La Etnografia. Metodo, campo y reflexividad / R.Guber, -Norma, - Bogota, -2001, -p.345.

<sup>7</sup>Zayko L.N., Pimenova R.E., Maslikov V.Yu. Review of the method and results for the study of medicinal plants in Russia (Based on the material from VILAR). Materials Int. Sci. - Pract. Conf. Modern problems of phytodesign. -Belgorod, - 2007, -p. 148-157.

<sup>8</sup>Abstract of the flora of the Caucasus: In 3 volumes / Ed. Yu.L. Menitsky, T.N. Popova. SPb.: St. Petersburg. University, -2006-2008.



by Eastern beech on the low north slope. Mountain grass combined with grains and legumes and created common xerophytes landscapes in foothills parts.

**3.2. Relief and soil cover.** Tovuz districts in 350m above sea level. 468 sq. km of the area are not suitable for cultivation, 278 sq.km includes fruit gardens is cultivated, 1 sq.km is salinity soils. The Tovuz-Gazakh region is divided into moderate-mountainous, low-altitude, low-lying and high-mountainous zones due to relief features. Gazakh district is 600-1300m an altitude, the highest altitude is 1316 m - Odun mountain. Downstream of the Aghstafa rivers and Hasansu river locates in the territory of the Aghstafa district. Mountain-chestnut, mountain-gray brown, brown, light-brown and particularly carbonate-chestnut soils are mainly distributed in Tovuz-Aghstafa-Gazakh districts.

**3.3. Climate conditions and hydro-networks.** Diagrams of the absolute maximum and minimum temperature of the study area, according to the indicators data are drawn by us (Fig. 1).

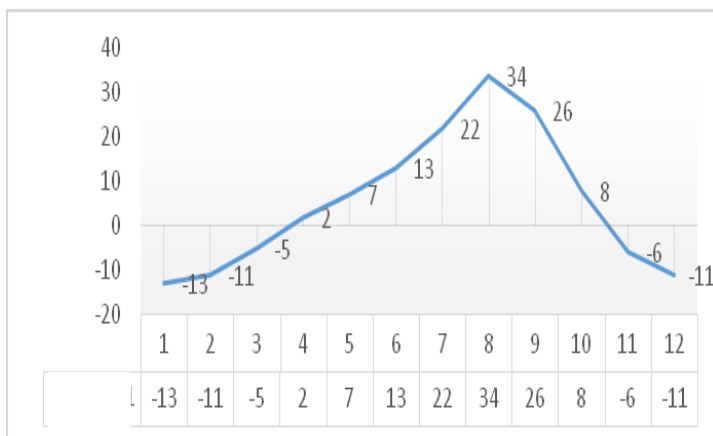


Figure 1. Absolute maximum air temperature by months

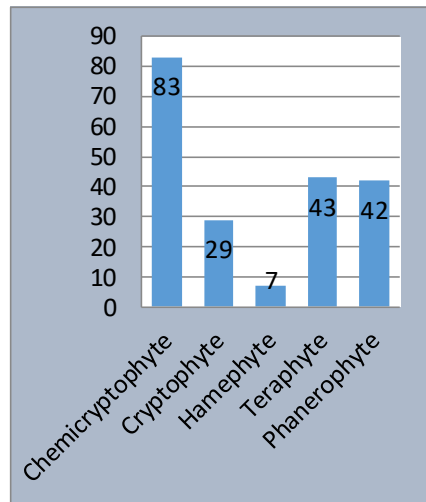
#### **CHAPTER IV. TAXONOMY, AREOLOGICAL, BIOMORPHOLOGICAL RESEARCH OF USEFUL PLANTS, AND ENDEMISM OF TOVUZ-AGSTAFI-GAZAKH FLORA**

**4.1. Taxonomic composition of the study area and biomorphological analysis of useful plants.** The taxonomic composition of the plants planted in the Tovuz-Agstafa-Gazakh flora (119 families, 540 genus, 1526 species), from which 60 families, 148 genus and 204 species are selected for their useful properties for the first time. The flora contains 86 families, 712 species of 384 genus are dominants plants and edificators also are the function of the educators of phytocenosis. Adaptation of plants to all the complex conditions of the environment is evident in their life forms. The life forms of useful plants of the study area were established (Tab.1; Fig. 2).

Table 1. Serebryakov systems

Indicators of life forms		Number
Basic biomorphs		
Trees (T/B)		26
Bushes		13
Semi-bushes and semi-shrubs		7
Grass plants	Annual (I or II)	43
	Biennial (II or more)	16
	Perennial	99
Long life cycle		
Polycarps		193
Monocarps		11
The main type of vegetation		
Mostly evergreen		7
Being green in summer		197

Figure 2. Raunkier systems



**4.2. Conservation and endemism of rare and endangered plants.** One of the main goals of the study was to identify rare species of higher plants, which are the main elements of biodiversity. *Crataegus eriantha* Pojark. (= *C. meyeri* Pojark.), *Rosa nisami* Sosn. (= *R. pulverulenta* M. Bieb.), *Taxus baccata* L., *Juniperus foetidissima* Willd., *Asparagus persicus* Baker, *Fritillaria*

*caucasica* Adam, *Pinus eldarica* Medw. (= *P. brutia* Ten.), *Punica granatum* L., *Rhus coriaria* L., *Euphorbia ledebourii* Boiss., *Iris caucasica* Hoffm. and *Eremurus spectabilis* M.Bieb. species in the flora of territory are on the verge of extinction as shown results of researches. More data and maps are presented in the dissertation. Endemic plants are present in the area flora also. Endemic plants in common area flora also widely used for their beneficial properties. Of these, 11 are Caucasian and 9 are endemics of Azerbaijan.

Seeds and planting materials of rare and endangered species have been collected from various parts of the territory. Blackberries (*Taxus baccata*) and Caucasian oats (*Iris caucasica*) reproduced by seeds. *Eremurus spectabilis*, *Crocus speciosus*, *Tulipa julia* reproduced by vegetative methods.

**4.3. Geographical and ecological analysis of flora.** To determine the role of the geographical structure in the formation of vegetation of the study area, the habitats of the species were specified and the flora was classified according to the geographical elements. According to this classification, useful species of territorial flora cover 14 geographical elements and 8 areal types. Most species are concentrated in the Mediterranean elements (37 species), followed by the Palearctic (35 species), Iran-Turan (25 species) and Caucasus (23 species) elements. The next three places are occupied by the elements of Central Asia, Atropatan and Europe. The rest is about 18%. In general, xerophilic area-type elements dominate in the formation of useful plants of the territorial flora.

The following plant types were found in the Tovuz-Gazakh territory during the investigations: meadows and carpets (small grasses); Meadows steppe (grasses with grains); Forests - elements of forests; Wetlands meadow - reeds and moutly grass botanical groups; Brushes; Steepe - restoration on the place of mountaine steppe vegetation; like as mountain meadow plantation and semi-desert vegetation-desert with predominance of meadow vegetation and culture plants restricted on the place of wormwood-frigidoid, wormwood-smoke tree, chal-meadow plantation. Vertical zoning was recorded in the region, so climate change is reflected in the fact

that plants live in different environmental conditions. Mesoxerophyte, mesophyte and xerophyte species predominate in terms of humidity have been shown analysis of 204 plant species studied by ecological groups (Fig.3).

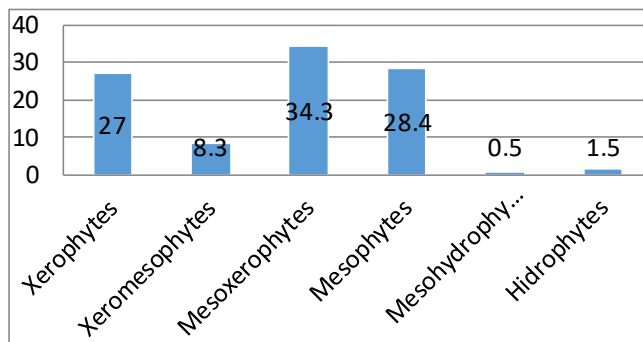


Figure 3. Distribution of useful plants by environmental groups (in%)

Spring flora is more commonly used by local communities as clear. Considering this, the study of the early spring aspects of the area was also considered relevant. 50-60% of the plant's flora and herbs form plants that are most likely to grow, which more parts are ephemeral and ephemeroids<sup>9</sup>.

## CHAPTER V. ETHNOBOTANICAL ANALYSIS OF USEFUL PLANTS IN THE TOVUZ-AGSTAFI-GAZAKH DISTRICTS

Plants used in medicine, food, farming and feed by humans. Plants may disappear and all knowledge about them will be destroyed in any region.

**5.1. Ethnopharmacological study of plants used in folk medicine.** The purpose of the current study is to investigate the possibility of using plants in non-traditional medicine in the Tovuz-

<sup>9</sup> Ibadullayeva, S.J., Abbasova, V.N., Aslanova, Y. Analysis of cenoses of Tovuz-Gazakh territory //Xeberler (News) of Ganja Branch of ANAS, Medical and Biology series, -Ganja: -2019, -p.3-9.



a result of the surveys and observations, the composition of commercial wildflower plants in the Tovuz-Gazakh districts has been determined. Edible plants of the wild flora (14 families and 24 species of 21 genus) collected for commodity purposes are sold. Wild edible plants are sold in markets in different commodity forms (fresh, salted and dried).

Wild edible plants are sold in the markets in various commodity forms (fresh, salted and dried). Thus, in the fresh state, it is released in March-May, and when salted and dried, it is put into circulation almost all year round. Wild vegetables are stored for a long time without incurring additional costs when salted and dried, so they occupy a leading position in the trade. Wild vegetable plants are supplied in various commodity forms: fresh (*Portulaca oleracea*, *Rumex acetosa*, *Stellaria media*, *Chaerophyllum aureum*, *Falcaria vulgaris*, *Eremurus spectabilis*, *Asparagus officinalis*, etc.); salted (*Allium rotundum*, *Heracleum trachyloma*, *Capparis spinosa*, etc.); dried (*Rumex euxinus*(=*Rumex tuberosus* subsp. *turcomanicus* (Rech. f.) Rech.f.), *Ziziphora capitata*, *Satureja macrantha*, *Puschkinia scilloides* etc.). As the same product can be sold in two commodities, their range has increased<sup>11</sup>. This allows you to earn more net income by selling one product in different commodity forms.

Wild vegetable plants are supplied in various commodity forms: fresh (*Portulaca oleracea*, *Rumex acetosa*, *Stellaria media*, *Chaerophyllum aureum*, *Falcaria vulgaris*, *Eremurus spectabilis*, *Asparagus officinalis*, etc.); salted (*Allium rotundum*, *Heracleum trachyloma*, *Capparis spinosa*, etc.); dried (*Rumex euxinus* (= *Rumex tuberosus* subsp. *turcomanicus* (Rech. f.) Rech. f.), *Ziziphora capitata*, *Satureja macrantha*, *Puschkinia scilloides*, etc.). Some species of vegetables are used in several forms.

**5.3. Ethnobotanical studies in veterinary medicine.** The specific attitude to the keeping and feeding of animals in Azerbaijan has been formed over the centuries and has acquired a national-

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<sup>11</sup> Abbasova, V.N. Supply and Use of Some Wild Edible Plants in Tovuz-Gazakh Districts // - Baku: Azerbaijan Agrarian Science Journal, -2019, -p.127-130.

ethnic character. The concepts derived from all this can be clearly seen in ancient manuscripts. 67 species of plants used in the treatment and maintenance of animals (36 species in the treatment of large and small horned animals, 19 in horses, 11 in poultry, 8 species in bee hygiene and treatment) were identified and treatment methods were added, the scientific basis was tested and its use was developed based on this research, for the first time (Fig.5).

Thus, 32.4% leaves, 8.4% tree bark, 14.4% fruit and immature fruit boxes, 12% flowers, 27.6% roots, 36.6% green grass, 12% seeds and spores, 6% conifers, nuts used in folk veterinary medicine.

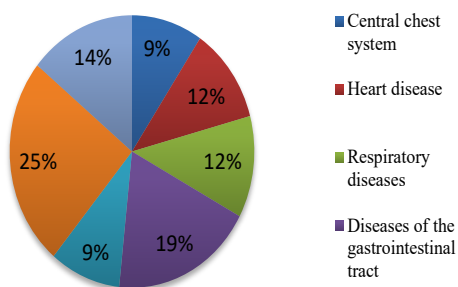


Figure 5. Plants used for various diseases in veterinary medicine (%)

Thus, information on the plants used in veterinary diseases for their useful properties has been given<sup>12</sup>. The use of some plants as antibiotic substitutes in animals has been studied<sup>13</sup>.

#### **5.4. Possibility of using ethnobotany in the present situation on the basis of principles of continuous development.** Regularly

<sup>12</sup> Abbasova, V.N. Ethnobotanical studies on the use of plants in folk veterinary medicine of the Tovuz-Gazakh region of Azerbaijan //Bulletin of Science and Practice. -Russian Science, -2019. -Tom 5, -N-6, -c. 187-191.

<sup>13</sup> Qambarli, I.J. The prospects usage for certain herbal medicinals preparation in Azerbaijan and the fighting against the spread of antibiotic-resistant microorganisms / I.J.Qambarli, E.M.Agayeva, V.A.Narimanov, V.N.Abbasova, S.J.İbadullayeva //International Journal Of Science And Research Methodology (DOI 10.25166; PIF Impact Factor3.925; CIF Impact Factor 4.598.), -India: -2018, -Vol.9, -Is.1, -p.143-148

collect the plant is possible if a planned outbreak is carried out to ensure the protection of the data collected and used for the purpose of food, medicine, vegetables, spices and more from wildlife. Delivery of information to students and schoolchildren about the protection of useful plants, hang-up information boards in residential areas near the distribution of plant species are important. Full information (species name, vegetation periods, rarity, using part of plant body and etc.) on each plant species must to collect before storing plant species. The classification of the plants for their usefulness has been developed based on these (Fig. 6).

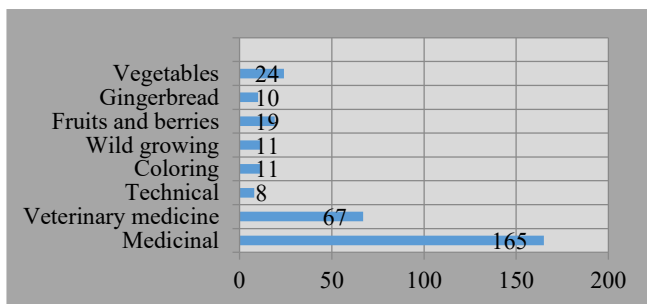


Figure 6. Classification of plants for their usefulness

165 species of medicinal plant and 67 species for veterinary medicine are present in area flora as shown from the classification. Spices and vegetables are a total of 34 species, used both for medicinal and nutritional purposes and for their aromatic properties.

## CHAPTER VI. RESOURCE ASSESSMENT OF USEFUL PLANTS

**6.1. Assessment of cenopopulations of some useful plants.** The score scale used to the assessment of populations is the main criterion for characterizing the quantitative composition of the cenopopulation, including abundance, coverage, and frequency of occurrence. The size of the sample sites was selected to be 4-5 m<sup>2</sup> depending on the location of the cenosis, and the density was estimated at 3-4 points during the study. The viability of the cenopopulation, the classification of populations and the analysis of



the ontogenetic structure were carried out according to modern methods. In this case, the biological characteristics of plants take into account three main elements - the life cycle of each species, the age structure of cenopopulations, the interaction of individuals.

Viability is one of the most important indicators of the general condition of individuals of a species senopopulation. The following parameters were used to determine viability: height and number of shoots; quantity and size of leaves; quantity and size of flowers; quantity and size of ovaries; quantity and size of seeds; umbrella diameter; area. Geobotanical research refers to the degree of development of phytocenosis in vitality, but for the study of senopopulation, not only the degree of development of a species in phytocenosis, but all stages of ontogeny are studied. Therefore, in order to determine the characteristics of the viability of the studied species, the degree of development of the plant at each age should be determined: the size of the roots; quantity and size of fruits.

3-year assessments were made in the cenopopulations of *Achillea biebershteini* (= *A.arabica*), *A.tenuifolia*, *A.millefolium*, *Helichrysum aurantiacum* and *Asparagus persicus* species during the study years. Juvenile (j), immature (im), virginil (v), young generative (g1), middle-age (g2), old generative (g3), subsenil (ss) and senile (s) periods of plants were registered. 6 natural cenopopulations of *Achillea biebershteini* Hub.-Mor. (= *A.arabica* Kotschy), *A. tenuifolia* Lam. and *A.millefolium* L. species in the composition of phytocenoses were selected. *Achillea* species are characteristic of each of the terrestrial plants.

In the selected 6 populations of the *Achillea* genus, 6 and 5 CP of *A.biebershteini* species are considered young, 1 and 2 CP transition, 3 CP mature. Intermediate individuals have also been found in some populations. *A.tenuifolia* species belonged to 1, 2 and 6 CP adult, 3 and 4 CP transition, 5 CP young age group. *A.millefolium* species were rated as 1, 3 and 5 CP transition, 2 and 6 CP adult, 4 CP young. Given a large number of pre-generative and generative individuals in most populations, it can be noted that the intensity of the recovery process is high in the selected populations of all three species.

According to the integrated characteristics of the demographic structure of the plant, the efficiency coefficient was higher in *A.biebershteini* species in localities 3 and 5, which was manifested in *A.tenuifolia* species in 1 and 2, *A.millefolium* in 4 and 6 localities. This is due to the fact that in these localities there were relatively many plants belonging to the juvenile and immature phases, and few individuals belonging to the aging phases.

*Helichrysum aurantiacum* Boiss. et Huet. in the phytocenoses of the steppe, semi-desert and mountain-xerophytic, 3 plant species are widespread in the first tier, sometimes in the form of fields, and sometimes singly. The study described the dynamics of individuals corresponding to different phases of ontogeny in populations where *Helichrysum aurantiacum* is widespread in different phytocenoses in sequential and scattered sites or in established tranches (Fig. 7).

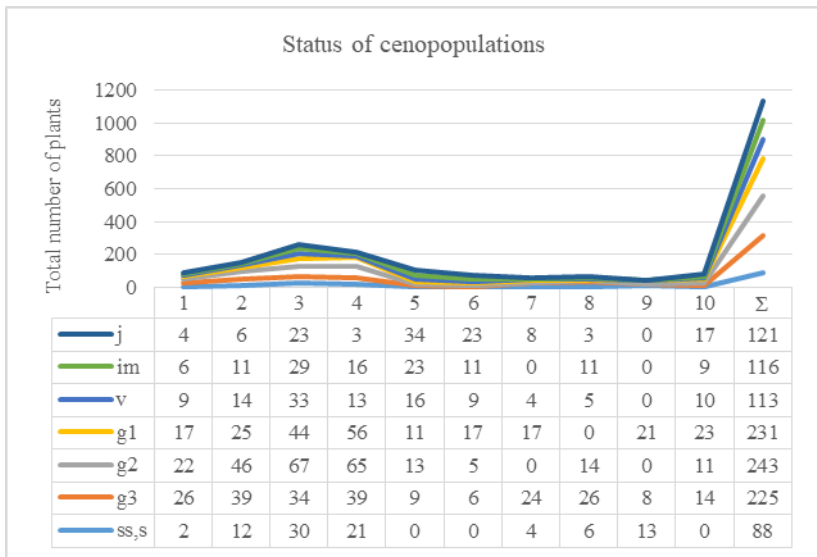


Figure 7. Dynamics of ontogeny of *Helichrysum aurantiacum* species

The number of individuals in each population was calculated for all phases, and it was found that there were more individuals in the

generative development phase. This indicates that the plant is in constant growth.

The highest rate of *Helichrysum aurantiacum* is in the generative stages (225-243 units). The stages of development in plant individuals have also been determined during the description of ontogeny as shown from the diagram. Criteria for comparison were shown by making notes in the *im*, *v*, *g1*, *g2*, *g3*, -s, ss, etc. periods of plants.

As can be seen, the coefficient of effectiveness of *Helichrysum aurantiacum* was higher in adult populations ( $\omega = 0.52-0.76$ ). This is due to the fact that in these populations the number of plants belonging to the juvenile and immature phases before the generative developmental stages is high and the number of individuals belonging to the aging (s, ss) phases is low.

Age-studied *Asparagus persicus* Baker. species is the main structural element of the formation groups and plays an important role in the formation of shrub, mountain xerophyte and steppe vegetation types have shown studies.

*Asparagus persicus* is characterized by short leaves of individuals and the formation of new vegetative shoots at an immature age. The formation of caudex is characteristic of immature individuals, the root system is formed. An immature individual consisting of 4-5 leaves 3-4 cm above the soil surface, reaching 0.6-0.7 cm has developed. Vegetative shoots began to develop at the age of virginil, the size of the shoots reached 5 cm, and the number of leaves reached 7-9. Generative shoots and shoots developed at a young generative age, the length of generative shoots varied between 10-18 cm, and the length of leaves varied between 0.6-1.3 cm. Sometimes young shoots are collected for food, so the plant does not grow. Physiological processes have already weakened in the subsenil and senile age conditions.

Shrinkage of the surface of plant organs occurs at subsenil and senile wet conditions was determined as a result of the analysis of biometric signs. A large number of dead individuals were found in the first CP in 2019 (ss+ s= 9) during the drought.

Transition and mature cenopopulations were observed when assessing cenopopulations of species (Table 3).

Table 3. Assessment of cenopopulations of *Asparagus persicus* species

Periodical	Year	I CP			II CP			III CP		
		2017	2018	2019	2017	2018	2019	2017	2018	2019
Growth phases of ontogenesis, in%	j	4,4	6,5	-	-	2,8	4,8	-	6,4	6,1
	im	6,7	6,5	4,5	7,3	5,7	7,1	7,5	6,4	-
	v	11,1	11,5	9,1	12,1	11,4	11,9	12,5	12,9	12,1
	g <sub>1</sub>	20	19,7	22,7	17	22,8	21,4	22,5	22,6	21,2
	g <sub>2</sub>	24,4	21,3	22,7	24,4	25,7	26,2	20	22,6	27,2
	g <sub>3</sub>	24,4	21,3	20,4	21,9	22,8	19	20	19,3	27,2
	ss	4,4	6,5	11,4	9,7	8,6	-	10	6,4	3
	s	4,4	6,5	9,1	7,3	-	9,5	7,5	3,2	3
Indexes	$\bar{I}_b$	0,32	0,39	0,21	0,31	0,28	0,36	0,32	0,40	0,24
	$\bar{I}_s$	0,29	0,32	0,16	0,24	0,25	0,31	0,25	0,35	0,22
	$\Delta$	0,48	0,48	0,52	0,50	0,45	0,47	0,51	0,45	0,48
	$\omega$	0,68	0,64	0,67	0,67	0,70	0,66	0,65	0,65	0,75
CP type	Transition	+	+	+	+		+	+	+	
	Maturation					+				+

The efficiency in *Achillea species* is  $\omega = 0,42-0,56$ ; in *Asparagus persicus* cenopopulations  $\omega=0,64-0,75$ ; in *Helichrysum aurantiacum* cenopopulations  $\omega=0,21-0,76$ , which indicates that each species is in constant development<sup>14</sup>.

**6.2. Determination of biological resources of useful plants.** The annual biological and operational resources of some wild food, medicinal and spicy plants were explored under resource assessments of useful and the results are shown in Table 4.<sup>15</sup>

<sup>14</sup>Ibadullayeva, S. Population structure of *Achillea* species in Tovuz-Gazakh districts of the Lesser Caucasus // Ibadullayeva S., Mustafayeva S., Abbasova V.N. New challenges to botanical research, ANAS IB and BS, Conference material dedicated to the 90th anniversary of acad.V.J.Hajiyev, -Baku: -2018, -p.164-166.

<sup>15</sup>Abbasova, V.N. Determination of biological resources of useful plants: Tovuz-Gazakh territory / V.N.Abbasova // ASAU Collection of Scientific Works,-Ganja: -2019, -N-3, -p. 19-21.

Table 4. Resources of some medicinal plants on Tovuz-Gazakh territory (2016-2018years)

Species name	Village names in districts	square (hectars)	Reserve density (he/s)	Biological resources (centner)	Operational reserves(centner)
1	2	3	4	5	6
<i>Inula helenium</i>	Asrik darsi	350	15,70 ± 1,52	678,00 ± 35,68	339,00 ± 17,84
	Gushchu ayrim	580	6,90 ± 1,29	335,00 ± 20,00	167,50 ± 9,99
	Gazanchi dagi	145	8,60 ± 2,33	168,00 ± 10,00	84,00 ± 5,02
	<b>Total:</b>	<b>1075</b>	<b>36,34</b>	<b>1181,00</b>	<b>509,50</b>
<i>Achillea millefolium</i>	Kiren	380	16,60 ± 0,99	226,00 ± 27,48	213,00 ± 18,74
	Boyug gishlak	138	12,50 ± 0,82	149,30 ± 29,78	145,15 ± 13,26
	Yukhari Agbashlar	250	17,60 ± 1,05	380,40 ± 48,60	202,70 ± 24,08
	<b>Total:</b>	<b>768</b>	<b>49,56</b>	<b>831,56</b>	<b>612,63</b>
<i>Cicorium intybus</i>	Eynalli	285	17,81 ± 1,04	410,00 ± 37,26	370,11 ± 10,11
	Goycali	360	9,3 ± 0,32	379,00 ± 26,12	280,20 ± 12,63
	Hasansu	275	11,8 ± 0,21	690,00 ± 11,21	140,00 ± 11,70
	<b>Total:</b>	<b>920</b>	<b>40,21</b>	<b>1479,00</b>	<b>824,75</b>
<i>Tussilago farfara</i>	Cafarli	370	18,10 ± 1,02	470,00 ± 34,26	294,30 ± 12,14
	Gazakhbeyli	290	10,1 ± 0,64	485,00 ± 28,12	380,40 ± 9,99
	Kosalar	380	12,3 ± 0,57	810,00 ± 12,21	190,00 ± 14,40
	<b>Total :</b>	<b>1040</b>	<b>42,91</b>	<b>1839,38</b>	<b>904,53</b>
<i>Viola odorata</i>	Asrik canyon	190	14,40 ± 0,86	101,50 ± 10,61	105,80 ± 12,24
	Khatai	140	7,50 ± 0,86	294,30 ± 30,53	85,00 ± 15,27
	Khilkhina	93	11,90 ± 0,89	227,00 ± 40,23	136,00 ± 20,00
	<b>Total:</b>	<b>423</b>	<b>36,41</b>	<b>710,20</b>	<b>312,51</b>
<i>Cephalaria gigantea</i>	Forest around	80	13,00 ± 0,77	178,00 ± 4,67	98,00 ± 2,27
	Asrik	60	13,80 ± 0,82	310,40 ± 6,58	99,20 ± 3,30
	Asrik canyon				
	<b>Total:</b>	<b>140</b>	<b>28,39</b>	<b>4198,40</b>	<b>199,20</b>
<i>Arctium lappa</i>	Farakhli	318	8,00 ± 0,46	583,00 ± 34,35	291,50 ± 12,10
	Cafarli	350	8,70 ± 0,52	453,00 ± 27,10	226,30 ± 13,58
	Gazakhbeyli	280	9,40 ± 0,56	645,00 ± 38,60	322,50 ± 19,46
	<b>Total:</b>	<b>948</b>	<b>27,64</b>	<b>1781,1</b>	<b>885,44</b>
<i>Centaurea segetum</i>	Garapapaq	120	22,50 ± 1,34	270,00 ± 16,16	135,00 ± 8,08
	Agkoynnek	150	21,90 ± 1,27	854,00 ± 50,03	427,00 ± 25,01
	Ashagi Goychali	100	15,8 ± 0,94	150,00 ± 8,98	75,00 ± 4,73
	<b>Total:</b>	<b>370</b>	<b>62,5</b>	<b>1274,00</b>	<b>627,00</b>
<i>Helichrysum aurantiacum</i>	Foothills of the Goyazen mountain	180	9,3 ± 0,51	378,00 ± 20,47	189 ± 12,65

continuation of table 4.

1	2	3	4	5	6
<i>Salvia glutinosa</i>	Neighborhood of Goyazen	170	19,90 ± 0,58	379,00 ± 21,67	189,50 ± 10,42
<i>Saponaria officinalis</i>	Villages of Kommuna Chayli	250	7,00 ± 0,34	411,00 ± 23,35	181,40 ± 8,10
		190	7,30 ± 0,41	378,00 ± 19,10	110,30 ± 11,41
	<b>Total:</b>	<b>440</b>	<b>15,35</b>	<b>831,45</b>	<b>311,21</b>
<i>Melissa officinalis</i>	Boyuk Kesik Dag Kesemen	300	8,10 ± 0,48	510,00 ± 31,28	171,13 ± 12,23
		210	9,20 ± 0,51	390,00 ± 23,14	112,90 ± 10,48
	<b>Total:</b>	<b>510</b>	<b>18,57</b>	<b>954,42</b>	<b>306,74</b>
<i>Rumex confertus</i>	Ikinji Sikhli	150	14,80 ± 1,23	243,00 ± 23,31	94,00 ± 2,18
	Ashagi Salakhli	230	18,60 ± 1,94	310,30 ± 31,74	86,20 ± 2,11
	<b>Total:</b>	<b>380</b>	<b>37,23</b>	<b>608,35</b>	<b>184,49</b>
<i>Nepeta racemosa</i> Lam. subsp. <i>racemosa</i>	Muganli	135	14,50 ± 0,88	276,10 ± 24,38	101,00 ± 11,72
	Pirili	240	12,60 ± 0,91	310,00 ± 27,90	128,10 ± 13,64
	<b>Total:</b>	<b>375</b>	<b>28,89</b>	<b>638,38</b>	<b>254,46</b>
<i>Capsella bursa pastoris</i>	Kosalar	400	17,40 ± 1,04	554,00 ± 32,25	281,20 ± 11,13
	Janalli	314	9,00 ± 0,71	631,00 ± 26,13	301,40 ± 12,34
	Kheyrimli	280	13,10 ± 0,63	410,20 ± 11,24	180,00 ± 13,65
	<b>Total:</b>	<b>994</b>	<b>41,88</b>	<b>1595,20</b>	<b>799,72</b>
<i>Urtica dioica</i>	Neighborhood of Asrik alti bulag	330	71,30 ± 1,23	1433,00 ± 40,02	235,00 ± 12,38
		290	64,10 ± 0,93	1042,10 ± 37,13	213,10 ± 10,41
	<b>Total:</b>	<b>620</b>	<b>107,56</b>	<b>2652,255</b>	<b>470,89</b>
<i>Asparagus officinalis</i>	Chinaldag	110	16,80 ± 0,74	280,60 ± 25,31	90,18 ± 4,91
	Khinna darsi	130	18,20 ± 1,02	310,40 ± 29,43	127,5 ± 7,23
	<b>Total:</b>	<b>240</b>	<b>36,76</b>	<b>670,93</b>	<b>229,82</b>
<i>Lamium album</i>	Mountaine Boyuk Kesik	310	7,00 ± 0,66	570,20 ± 32,84	287,50 ± 11,23
	Mountaine Kesemen	300	6,80 ± 0,54	420,00 ± 23,10	190,20 ± 14,12
	Duzgishlag	240	8,40 ± 0,73	610,20 ± 34,93	310,60 ± 18,34
	<b>Total:</b>	<b>950</b>	<b>24,13</b>	<b>1691,27</b>	<b>831,99</b>

Thus, the annual biological reserves of some wild food, medicinal and spicy plants were as follows: *Urtica dioica* - 2652,255 centner / ha, *Arctium lappa* - 1781,1 centner / ha, *Lamium album* - 1691,27 centner / ha, *Achillea millefolium* - 831,56 centner / ha, *Capsella*

*bursa pastoris* - 1595,20 centner / ha, *Cichorium intybus* – 1479,00 centner / ha, *Centaurea segetum* - 1274,00 centner / ha, *Inula helenium*- 1181,00 centner / ha and others.

The operational reserves of plants have decreased due to the impact of anthropogenic factors compared to previous years. Some species (*Urtica dioica*, *Arctium lappa*, *Lamium album*, *Achillea millefolium*, *Capsella bursa pastoris*, *Cichorium intybus* etc.) are used both as medicine and eagerly eaten by animals. Some (*Asparagus officinalis*, *Urtica dioica*, *Capsella bursa pastoris*, etc.) are supplied by local communities because they are valuable food plants. The species taken spread from the lowlands to the highlands was determined as a result of bioecological research.

## CONCLUSIONS

1. The taxonomic spectrum of the Tovuz-Agstafa-Gazakh areas was prepared for the first time, distribution of 1526 species of 540 genus of 119 families was determined, from them 204 species (13.37% of the area flora) were used for various purposes. 5 species of 2 families belong to the Higher spores plants, 8 species of 4 genus of 4 families are Gymnosperms and consist 3.9% have shown results of taxonomic studies. From them more than 10 species of *Asteraceae* Dumort, *Rosaceae* Juss. and *Alliaceae* J. Agardh families used. From these 11 are Caucasian and 9 are Azerbaijani Endemics.

2. Perennial herbs from useful plants are represented by 99 species, annuals - 43, biennial - 16, semi-bushes-semi-shrubs - 7, bushes 13, and trees by 26 species have been established. 193 of these are polycarps and 11 species - monocarpous due to the large life cycle. 7 species of evergreen and 197 species - green in the summer depending on the vegetation type.

3. 64 species are concentrated in 28 families used in the early summer flora of the area according to the results of the research. 83 are hemicryptophytes, 29 - cryptophytes, 7 - khamephytes, 42 - teraphytes and 43 - fanerophytes according to life forms was found.

4. Mesocherophytes in the area make up 34,3% of the total flora, Mesophytes occupy 28,4% and xerophytes 27% have been revealed

in results of geographical and environmental analysis. Archeological analysis shows that the basis of useful species are Mediterranean (18%), Palearctic (17%), Iranian-Turan (12%) and Caucasus (11%).

5. For the first time, the population of 80 to 90 years of age from general population of Tovuz-Agstafa-Gazakh districts was identified from the flora and the perspectives of the species. A database on diseases and their spread in the villages has been created, different uses of the same medicinal plant in different diseases have been revealed.

6. The possibilities of using in the current ethnobotany situation were studied on the basis of the principles of sustainable development, specific proposals to strengthen the commodity nature of plants, prevent the threat of extinction and their sustainability in trade have been developed.

7. Some useful plant populations are cenology assessment and calculated for the age and efficiency of the plant: efficiency of *Achillea* species  $\omega=0,42-0,56$ ; for cenopopulations of *Asparagus persicus*  $\omega=0,64-0,75$ , for *Helichrysum aurantiacum*  $\omega=0,21-0,76$ , these data indicating that each species is in constant development.

8. The annual reserves of some species commonly used by the population are determined (c/ha): *Īnula helenium*- 509,50; *Achillea millefolium*-612,63; *Cichorium intybus*-824,75; *Tussilago farfara*-904,53; *Viola odorata*-312,51; *Cephalaria giganteae*-199,20; *Arctium lappa*-885,44; *Centaurea segetum*- 627; *Helichrysum aurantiacum*-189; *Salvia glutinosa*-189,5; *Saponaria officinalis*-311,21; *Melissa officinalis*-306,74; *Rumex confertus*- 184,49; *Nepeta racemosa* Lam. subsp. *racemosa* -254,46; *Capsella bursa pastoris*-799,72; *Urtica dioica*-470, 89; *Asparagus officinalis*-229,82; *Lamium album*-831,99.

## SUGGESTIONS AND RECOMMENDATIONS

➤ Conducting monitoring, soil inventory (modern condition, fertility, resistance to erosion) for protection natural potential of area vegetation is important;



- Implement complex measures in order to prevent degradation of vegetation and soil cover and erosion of mountain soils is expedient;
- Improved survival of phyto- remedial measures in the adjacent slopes of rivers and streams. It would be better to avoid frostbite, sloping slopes, and the presence of conifers, also to establish protective forest strips is recommended;
- Accumulation of commodity wild vegetables from areas for commodity purposes with sufficient reserves, and to establish small markets and national kitchens in cities for consumption are expedient;
- Create small brands and national printing houses in the cities for the sake of talent is introduce and propagates some plant species in the cultural flora in order to meet domestic and foreign demand and strengthen trade turnover would be expedient;
- Prohibit the supply of rare and endangered species (f.e. *Puschkinia scilloides*, *Eremurus spectabilis* and etc.) is recommended.

### **Dissertations Publications**

1. İbadullayeva, S.C., Shiraliyeva, G.S., Abbasova, V.N. Traditional medicinal plants spread in Azerbaijani flora and ways of their use // Actual problems of modern chemistry and biology, International Conference. Botany, General Biology. –Ganja: -2016, -pp.47-49.
2. İbadullayeva, S., Shahmuradova, M., Abbasova, V. Traditionally used wild plants of Azerbaijan in an example of Tovuz-Gazakh regions// SEAB 2-Symposium on EuroAsian Biodiversity. -Turkey – Antalya: -2016, -p.212.
3. İbadullayeva, S.C., Abbasova, V.N. Some recommendations on the collection of useful plants // Ganja Branch of ANAS, Medical and Biological Series,-Ganja: -2017. -2 (68), -pp. 20-24.
4. İbadullayeva S.C., Abbasova, V., Shiraliyeva G.Sh., Asgerova N.A. Ethnobotany: Use of wild medicinal plants by the local population in Azerbaijan // SEAB 3-Symposium on EuroAsian Biodiversity, -Belarus - Minsk: -2017 may. -p.644.

5. İbadullayeva S.C., Abbasova, V., Shiraliyeva G.Sh., Asgerova N.A. Medicinal trees and bushes used in Azerbaijani flora // CCFBD International Conference “Impact of Climate Change on Plant Biodiversity. –Baku:- 2017 Sept., -pp.169-173.
6. İbadullayeva, S.C., Abbasova, V.N. Ethnopharmacological Importance of Medicinal Plants Spread in Ganja-Gazakh Territory // News of ANAS, Biological and Medical Sciences series, -Baku: - 2017. –N.2, -s.66-70.
7. İbadullayeva, S., Mustafayeva, S., Abbasova, V.N. Population structure of the Boymadarən-Achillea species in the Tovuz-Gazakh regions of the Lesser Caucasus // New Challenges to Botanical Studies, Institute of Biology and BC Acad. Proceedings of the Conference on the 90th Anniversary of V.J. Hajiyev, -Baku:-2018, -pp.164-166.
8. Qambarli, I.J. The prospects usage for certain herbal medicinal preparation in Azerbaijan and the fighting against the spread of antibiotic-resistant microorganisms /I.J.Qambarli, E.M.Agayeva, V.A.Narimanov, V.N.Abbasova, S.J.İbadullayeva //International Journal Of Science And Research Methodology (DOI 10.25166), -India: -2018, -Vol.9, -Is.1, -p.143-148
9. Abbasova, V.N. Supply and use of some wild plants in Tovuz-Gazakh districts //Azerbaijan Journal of Agrarian Science, -Baku: - 2019. -pp.127-130.
10. Abbasova, V.N. Ethnobotanical studies on the use of plants in folk veterinary medicine of the Tovuz-Gazakh region of Azerbaijan //Bulletin of Science and Practice. -Russian Science, -2019. -Tom 5, -N-6, -c. 187-191.
11. Abbasova, V.N., Aslanova, Y., İbadullayeva, S.C. Analysis of cenosis forming of Tovuz-Gazakh districts //Ganja branch of ANAS, Medical and Biological Series, -Ganja: -2019, -pp. 3-9.
12. Abbasova, V.N. Determination of biological resources of useful plants: Tovuz-Gazakh territory // ASAU Collection of Scientific Works,-Ganja: - 2019, -N-3, -p. 19-21.

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