

REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

**RESERVE, BIOECOLOGICAL-PHYTOCHEMICAL STUDY
AND PROSPECTS OF USE OF HELMINTHOCIDE EFFECTIVE
REPRESENTATIVES OF THE COMPOSITE FAMILY IN THE
FLORA OF NAKHCHIVAN AUTONOMOUS REPUBLIC**

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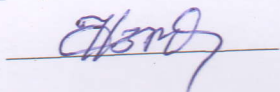
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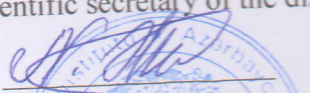
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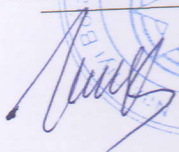
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INTRODUCTION

Relevance and degree of development of the topic. The selection of useful plants in biological diversity, determination of their bio-ecological characteristics, as well as identification of application fields of plants containing biologically active substances and calculation of reserves have a significant impact¹ on certain stages of the development of the industry. The scientific research conducted in this field is always relevant.

The plants are widely used during the research conducted in the prevention of diseases in the world. This also includes veterinary medicine². Scientific researches have been carried out in this field around the world, plant extracts and essential oils have been applied in veterinary medicine and positive results have been obtained³. Extracts and essential oils obtained from some species are known to be widely used in the food industry and medicine, as well as scientific studies are conducted in the republic towards their application in veterinary medicine and as addition to the food ration of animals⁴.

The composite family which occupies a special place in the vegetation of Azerbaijan play a fundamental role in pastures, hayfield and grazing areas, desert-semi-desert, subalpine-meadow, forest-meadow, xerophilous, phryganoid, primitive rock-scrub and other vegetations. Along with other useful properties of the species of the family, helminthocide species play an important role in animal feeding and treatment. Studying the ranges, distribution level and seasonal

¹ Azərbaycan Respublikasında bioloji müxtəlifliyin qorunması və davamlı istifadəsinə dair Milli Strategiya və Fəaliyyət planı //Azərbaycan Respublikası Prezidentinin 2358 nömrəli, 3 oktyabr 2016-cı il tarixli Sərəncamı ilə təsdiq edilmişdir. –Bakı: -2016.

² Souto, WMS. Parallels between zootherapeutic practices in ethnoveterinary and human complementary medicine in northeastern Brazil /WMS Souto, JS Mourao, RRD Barboza [et al] //Journal of Ethnopharmacology, -2011. Vol. 3(134), - pp. 753–767.

³ Rashid, M.H. An ethnoveterinary survey of medicinal plants used to treat cattle diseases in Birishiri area, Netrakona district, Bangladesh /M.H. Rashid, R. Tanzin, K.Ghosh [et.al] //Advances in Natural and Applied Scienc.. -2010. v. 4(1), - pp.10–13.

⁴ Ağayeva, E.Z., İbadullayeva, S.C. Baytarlıq təbabətində bitkilərlə qeyri-ənənəvi müalicə üsulları // Azərbaycan Aqrar Elmi-nəzəri jurnal. - Bakı: - 2012, - buraxılış 2 (225), - s.73-76.

dependence of helminthosis, which cause great damage to livestock in the Nakhchivan Autonomous Republic, facilitates the fight against them.

Although the mountainous zone forms the basis of the territory of the Nakhchivan Autonomous Republic, the foothill and plain zones also cover certain areas and have their own unique fauna and flora. The level of distribution of helminths and the diversity of species cannot be the same in zones with different climate zones. Since the mountainous, foothill and plain zones are not completely isolated from each other, their helminth fauna is not completely different. The study of helminth fauna is not only a matter of studying the characteristics of the distribution of parasites, but at the same time aims at complexing the fight against parasites.

Although the helminth fauna is similar to some extent, the periods of completion of development cycles of helminth and infecting animals occur at different times depending on the zones⁵. In this case, finding the distribution areas of plants that affect helminths and making migrations from those areas can make the issue a little easier. Depending on the climatic factors of the area, since the timing of helminth eggs shed outside reaching the invasion stage and the timing of infection of animals are different, deworming measures against them cannot be carried out simultaneously in all regions of the Autonomous Republic. In this regard, we consider our research work to be relevant, and taking into account all this, we considered it appropriate to conduct a bioecological-phytochemical study of helminthocide species of the composite family in the flora of the Nakhchivan Autonomous Republic and to investigate their biological resources. This is also a contribution to the development of veterinary medicine.

The object and subject of the research. The object and subject of the research was the study of the effect of plants belonging to the composite family on anthelmintics.

The purpose and objectives of the research. The main goal of the

⁵ Məhərrəmov, S.H. Naxçıvan Muxtar Respublikasında qoyunların kompleks helmint faunasının formalaşma xüsusiyyətləri, mədə-bağırsaq nematodlarına qarşı antihelmint bitkilərin tətbiqi və onların toksikoloji qiymətləndirilməsi: Biologiya elm. dok. ... dis. avtoreferatı./ - Bakı, 2011, -58 s.

research is to determine the taxonomic composition of the flora of the Nakhchivan Autonomous Republic and reveal helminthosis species, study their bioecological characteristics, population structure and reserves, and reveal the microbiological effect of the essential oils and aqueous extracts obtained from the species on helminths and other parasites. The conducted phytochemical, ecological, phytogeographical studies and the search for promising species containing pharmacological substances constitute the theoretical basis of the problem of reserve science.

The following tasks have been set to implement the mentioned:

- Clarification of the taxonomy of the family in the flora of the Nakhchivan Autonomous Republic
- Study of the role of species of helminthosis effect belonging to the composite family in the flora of the Nakhchivan Autonomous Republic in the vegetation type, their resources and the current state of their populations;
- Studying the qualitative and quantitative composition of substances characteristic of species of helminthosis effect, mainly essential oils, as stable chemical markers;
- Study of the morpho-anatomical structural characteristics, reserve and phytocenological characteristics of important species;
- Conducting experimental studies on helminths and detection of anthelmintic efficacy;

Research methods. Plants were studied by botanical, anatomic, floristic and geobotanical methods. Using the method of studying plant reserves, reserves were calculated and coenopopulations were evaluated by generally accepted methods, and the ontogenetic structure of some species was determined. Methods of studying the infection of animals with helminths and phytochemical studies were carried out using modern methods.

Provisions submitted to the defense.

- Determination of the taxonomic composition of the species belonging to the composite family, and identification of the bioecological characteristics, population structure and resources of helminthocidal plants are contribution to the development of healthy farming;

- Identification of helminthocide species and their impact efficacy is a new direction for animal treatment in veterinary medicine;
- Detection of the effect of essential oils and extracts on helminths is important for the preparation of medicinal preparations in the form of mixtures and the application of correct dosage.

Scientific novelty of the research. In the flora of the Nakhchivan Autonomous Republic, the taxonomic composition of the composite family was determined by 89 genera and 337 species, of which 66 species have medicinal, including helminthosis properties. As a result of taxonomic analyses, the status and range of the species were specified, the distribution and bioecological characteristics of helminthocide species were studied. The morpho-anatomical structural characteristics and population indicators of some species were determined.

The mechanism of effect of aqueous extracts of essential oil anthelmintic species and essential oil on helminths was discovered, some mixed plants were removed from the test.

Theoretical and practical significance of research. The obtained information on the chemical, taxonomic, bioecological and reserve of the species can be used in the new edition of “Flora of Azerbaijan”, “Useful plants of Azerbaijan”, the new edition of the flora of the Nakhchivan Autonomous Republic. The obtained extracts and essential oils are offered for pharmacological studies. Medicinally important species, including obtained essential oils and extracts, can be used in veterinary medicine.

Approbation and application. The main provisions of the dissertation work and the obtained important scientific results have been presented at a number of republican and international science and scientific practical conferences: SEAB 2-Symposium on EuroAsian Biodiversity, Turkey, Antalya-2016; SEAB 4-Symposium on EuroAsian Biodiversity, Ukraine, Kyiv-2018; International scientific conference dedicated to the 95th anniversary of H. Aliyev “Actual Problems of Modern Natural and Economic Sciences” Ganja-2018; IV International Scientific and practical conference “European scientific discussion, Rome – 2021; as well as at the general meeting of the Department of Botany of Nakhchivan State University and at the scientific seminar of the Institute of Botany, MSE RA.

14 scientific works containing the main provisions of the dissertation have been published, 10 of which are articles (3 in publications included in international indexing databases abroad), 4 are conference materials and thesis.

The organization where the dissertation work was carried out. Dissertation work was carried out at the Department of Botany, Nakhchivan State University.

The scope and structure of the dissertation. The total volume of dissertation work is 201 pages consisting of 6 chapters, result, recommendations and appendices, 185-titled list of literature. The total volume of dissertation with characters is 228,233 (Introduction - 14046 characters, Chapter I - 25828 characters, Chapter II - 27546 characters, Chapter III - 50181, Chapter IV - 10312, Chapter V - 34537, Chapter VI - 61930, results - 2953, recommendations - 903 characters). The work includes 26 tables, 8 diagrams, 2 graphs, 1 map scheme, 20 figures and appendices.

CHAPTER I. LITERATURE REVIEW

This chapter of the dissertation summarizes the history of the study of species of the composite family and their use, analyzes both classical and modern literature in this direction, and indicates important points. Scientific research carried out in the direction of studying the anthelmintic effect of plants was studied, and it was found that the study of the helminthocide effect of plants in medicine and veterinary medicine is given a wider place in the works of foreign scientists.

CHAPTER II. MATERIAL AND METHODS

In 2015-2020, the research was carried out in field routes, expedition, camera-laboratory and semi-stationary conditions. As a result of the analysis, the species of the composite family spread in the flora of the Nakhchivan Autonomous Republic applied in veterinary medicine were determined. During the geobotanical routes, based on the methodology of geobotanical search in field conditions, botanical descriptions of plants were given, and phenological observations were made. During the researches, using classical and modern methods, the reserve, density of plants, their role in plant groups and generally all botanical descriptions were recorded. Coenopopulations were evaluated by generally accepted

methods, all bioecological characteristics were studied by determining the ontogenetic structure of some species⁶.

Experiments on animals were carried out mainly in private households and farms. Species used in veterinary medicine were obtained with ethnobiological information. In the studies, the helminthocide effect of plants on haemonchosis taken from sheep's read stomach, digestive system strongylates and trichocephaliosis collected from the intestines was studied *in vitro* using the helmintooscopic method⁷. Elixirs are prepared by mixing plant mass with water in a ratio of 1:5. To prepare the infusion, the crushed parts of the plant are kept in a water bath for 15 minutes.

Essential oils were obtained by the hydrodistillation method⁸, and the component composition of the oils was determined by the gas-liquid chromatography method⁹.

CHAPTER III. STUDY OF THE TAXONOMIC COMPOSITION AND ANTHELMINTIC-EFFECTIVE SPECIES OF COMPOSITE FAMILY IN THE FLORA OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

3.1. Systematic-taxonomic analysis, ecological features and life forms of the family. The main difference of the composite family is that the corolla is contiguous. Corolla - 5-petaled, and 4-shaped: 1) regular tubular and flowers bisexual (*Filago* Loefl., *Gnaphalium* L.); 2) unregular, ligulate, 5 toothed (bisexual); 3) unregular, false ligulate, bilabiate, lower lip - 3 toothed (flowers pistil or asexual); 4) unregular, funnel-shaped (*Centaurea* L.), flowers are mostly asexual. Flowers in antherode can be different.

3.1.1. Botanical characteristics of the family and main genera. The fact that many genera of the composite family are polymorphous, its

⁶ Жукова, Л.А. Многообразие путей онтогенеза в популяциях растений //Экология. – 2001. №3. – С. 169-176

⁷Антгельминтики-антгельминтные препараты. <http://www.provisor.com.ua/archive/2001/№10/art-17.htm>

⁸ Гинзберг, А.С. Упрощенный способ определения эфирного масла в эфирносах //Хим. -фармац. пром-сть, - 1932. № 8-9, - с. 326-329.

⁹ Горяев, М. И. Эфирные масла флоры СССР / М.И. Горяев, Алма-ата: Изд. АН Казахской ССР, - 1952, - 378 с.

species hybridize among themselves, produce a large number of seeds, quickly adapt to the area of distribution and and develop lead to active process of species formation and enrichment with new species. As a result, new taxa are formed and it becomes difficult to define them taxonomically. The detection of these innovations requires regular research.

As a result of our studies, 89 genera and 337 species of the family have been recorded in the flora of the Nakhchivan Autonomous Republic. The flora synopsis of the family is given in full in the dissertation. During the analysis of the family by genera, it was determined that, the genera such as *Centaurea* (24 species), *Cirsium* Mill. (18 species) and *Pyrethrum* Zinn (= *Tanacetum* L.) (16 species) are represented by the most species (Fig. 1). Other genera are found with 12 or less species.

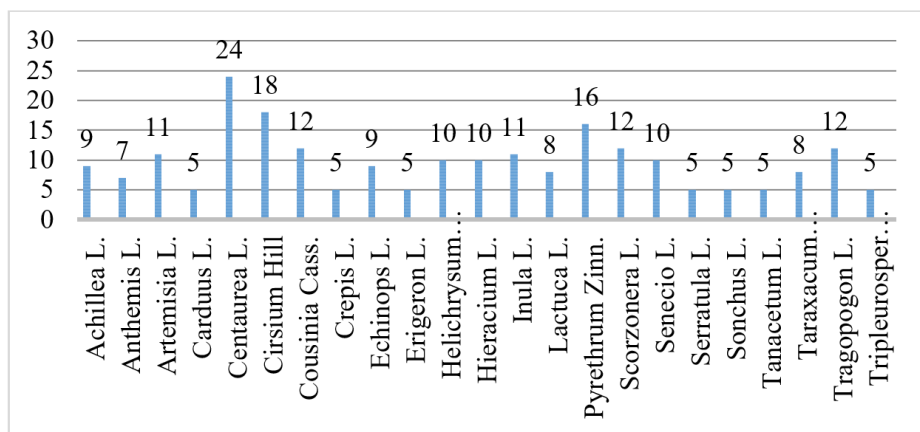
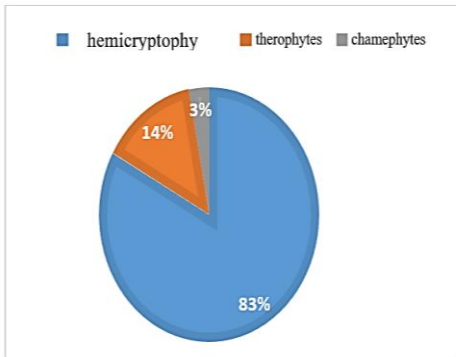


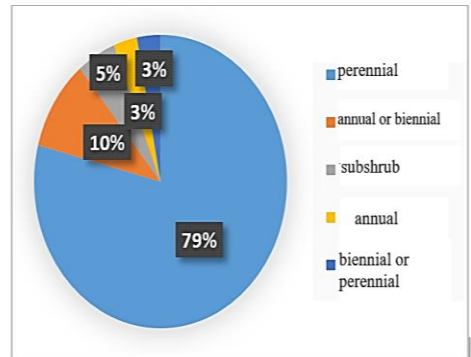
Figure 1. The genera of the composite family represented by more species in the flora of Nakhchivan AR

3.1.2. Life-forms and phytogeographical analysis of the composite family. It is known that the life form of a plant is its appearance that reflect its adaptation to environmental conditions and biological characteristics. Ontogeny, i.e. during the period of individual development, the appearance of the plant changes. Factors affecting this change include external (environmental) and internal factors in the genome.

During the multi-year researches, life forms of 337 species united in 89 genera of the composite family were studied (Fig. 2-3).



Life forms of species according to C. Raunkiaer's



Life forms of species according to I.G. Serebryakov

Figure 2-3. Life forms of composite family

According to C. Raunkiaer's system of life forms, the studied species are classified as follows: hemicryptophytes – 83.0%, therophytes – 14.0%, chamephytes – 3%.

According to I.G. Serebryakov's classification of life forms of plants, perennial grasses make up 79.0% of the families studied in the Nakhchivan Autonomous Republic, i.e., the most. 10% are annual herbs, 5% – subshrubs, 3% – annual or biennial herbs, 3% – biennial or perennial herbs.

Distribution of the studied species in different mountain belts depending on the altitude has been studied, the highest number of species is found in the mid-mountain belt with 25% species, sub-alpine and lowland regions each with 13%, lower highlands with 20%, upper highlands with 18%, and the least species in the alpine belt with 11%. According to the conducted researches, the studied species are unevenly distributed in the regions of the territory. Thus, there are species that are found both in the Nakhchivan plain and in the Nakhchivan highlands (69%).

The results of the researches regarding the geographical analysis of species are presented in Figure 4. In nature, each species has a sign of adaptation to its area. External and internal factors play a very important role here.

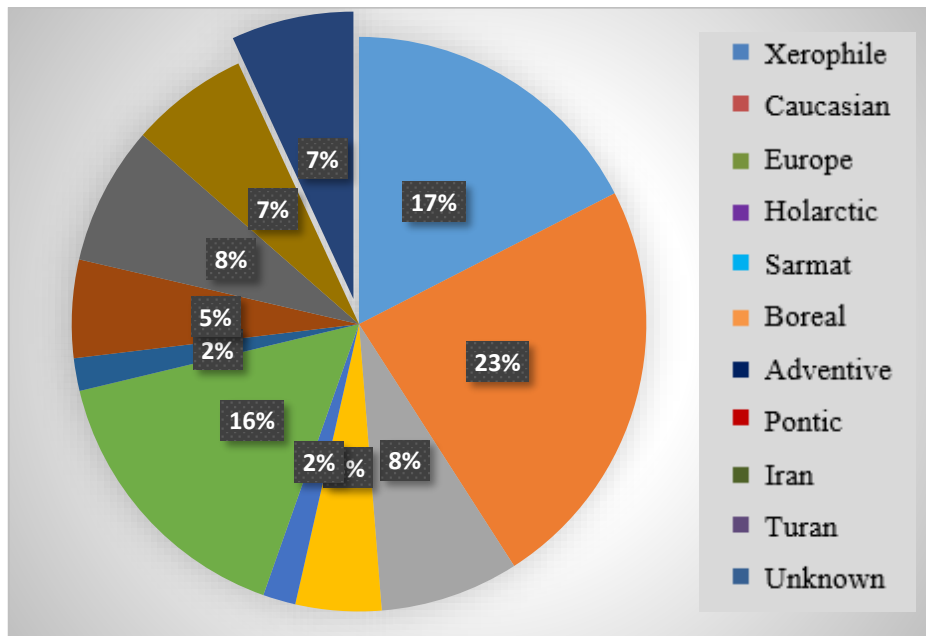


Figure 4 . Range types of the composite family

From the conducted ecological studies, according to the water demand, among the studied species, xerophytes 46% and mesophytes 11%, and within them small subgroups - xeromesophytes and mesoxerophytes, each 21%, were found.

3.2. The distribution, bioecological and morpho-anatomical characteristics of the composite family in the flora of the Nakhchivan AR. The flora of the Nakhchivan Autonomous Republic has rich and colorful vegetation. The following vegetation and its types were observed in the Nakhchivan Autonomous Republic: deserts and semi-deserts (at an altitude of 600-1100 m a.s.l.), phryganoid type xerophytic vegetation (at an altitude of 1100-1500 m a.s.l.), mountain-steppe vegetation (at an altitude of 1500-1900 m a.s.l.), mountain meadows and steppes (at an

altitude of 1900-2350 m a.s.l.), tall grass, subalpine vegetation (at an altitude of 2350-2500 m a.s.l.), alpine meadows and carpets (at an altitude of 2500-3500 m a.s.l.).

3.2.1. Bioecological characteristics of the main useful species of the family. As noted, 337 species of the composite family were distributed in the flora of Nakhchivan Autonomous Republic, 66 of which have medicinal properties, including 29 species with antihelminthic effects. As a result of the researches, the distribution areas of species in the flora of the Nakhchivan Autonomous Republic were determined. The distribution areas and bioecological characteristics of each species are described in detail in the dissertation.

3.2.2. Biometric and morpho-anatomic structure features of some species with anthelmintic importance. The morphometric and anatomic characteristics of some (*Cichorium intybus* L., *Helichrysum araxinum* Takht. ex Kirp., *Inula helenium* L., *Arctium lappa* L., *Artemisia absinthium* L.) anthelmintic plants that are widely used not only in the flora of Nakhchivan Autonomous Republic but also in other regions were studied and compared.

The organ of the *Inula helenium* L. species used as main medicine is the roots. Considering this, attention was paid to the anatomical structure of the root of the plant¹⁰. The root is circular in cross-section (Fig. 5). The outer layer is covered with a layer of dense cellular epidermis. There is a circular shell parenchyma consisting of 6-7 layers of cells from the epidermis to the inside. Among the bark parenchyma cells, 9-10, sometimes more secretory spaces are formed. Secretory spaces are of schizogenic origin. These spaces are surrounded by small tapetum cells. In the bark parenchyma cells, biologically active substances, essential oils and dyes are collected as a reserve.

¹⁰ Novruzova, L.A. *Inula helenium* L.-uca andız bitkisinin morfo-anatomik quruluş xüsusiyyətləri və istifadə perspektivləri //Naxçıvan Dövlət Universitetinin Elmi Əsərləri. Təbiət elmləri və tibb seriyası. - 2020. № 8(109), - s. 24-28.

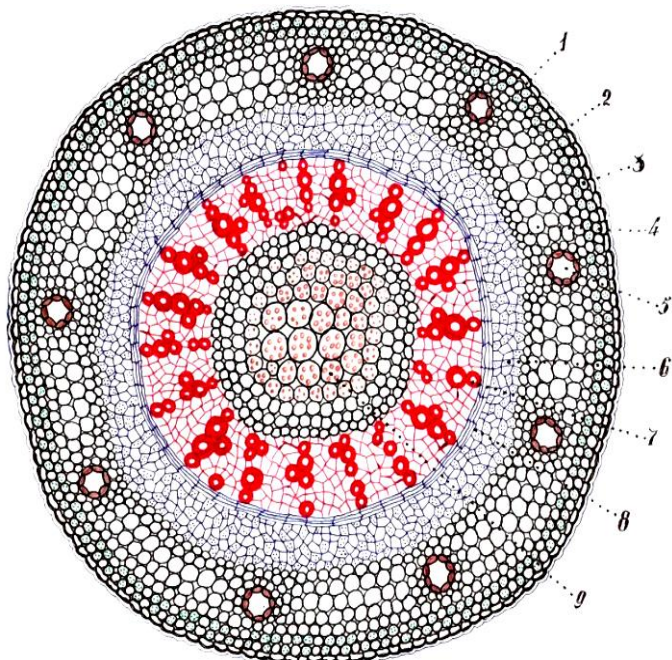


Figure 5. Anatomical structure of the root of *Inula helenium* L.: 1. cuticle, 2. epidermis, 3. chlorenchyma, 4. bark parenchyma, 5. secretion space, 6. phloem, 7. xylem, 8. cambium, 9. core

The aerial parts of *Helichrysum araxinium*, *Arctium lappa* and *Artemisia absinthium* species are mostly used as medicine. Considering this, attention was paid to the anatomical structure of those organs of plants.

In the cross section of the leaf stalk of *Arctium lappa* species, the stalk has a ribbed, angular structure. The plant consists of a layer of epidermis covered with a cuticle layer (Fig. 6) They have a strongly developed mechanical tissue (sclerenchyma) on the conducting bundles and in the corners. The circular bark parenchyma is densely located under the dermis. 5 large-sized main bundles, and 11 additional bundles are formed in the stalk in the later stages of development. Additional bundles are formed as a result of the transformation of parenchyma cells into meristem cells. The number of bundles may vary depending on soil and

climate conditions. It was surrounded with collateral-type surrounding cells from the outside. Water tubes are located in the xylem.

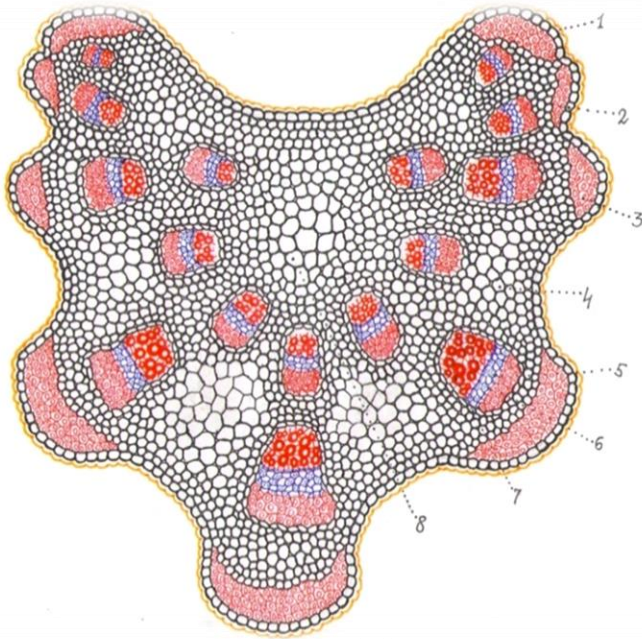


Figure 6. Anatomical structure of the stalk in the *Arctium lappa* L.: 1. cuticle, 2. epidermis, 3. sclerenchyma, 4. bark parenchyma, 5. phloem, 6. cambium, 7. xylem, 8. core

The stem of *Helichrysum araxinium* is bundle-shaped. The bundles are of taxonomic importance due to their shape, structure and formation and can be used as a diagnostic sign. Bundles are of collateral type, they are surrounded by a layer of surrounding cells from the outside. These cells provide bond between the elements of the bundle and other cells of the stem. Mechanical tissue consisting of 2-5 layers, sclerenchyma, has developed on both surfaces of the bundle (bark parenchyma and parts bordering the core). This, in turn, gives the stem special strength and flexibility. In bundles, the xylem is directed inwards and the phloem is directed outwards. There are 2-3 layers of cambium between xylem and phloem. Each bundle has 2-5 large water tubes (Fig. 7).

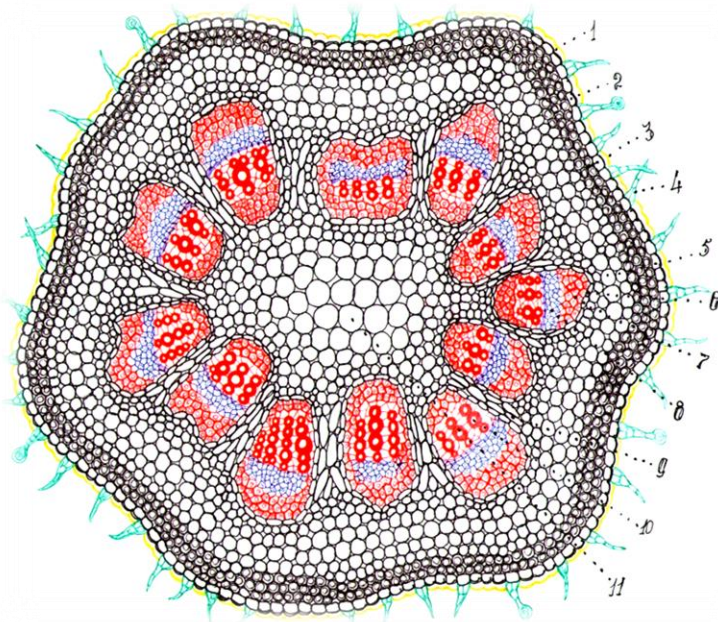


Figure 7. Anatomical structure of the stem of *Helichrysum araxinium*: 1. cuticle, 2. epidermis, 3. layered collenchyma, 4. hair, 5. bark papenchyma, 6. surrounding cells, 7. sclerenchyma, 8. phloem, 9. core, 10. xylem, 11. core

The stem of *Artemisia absinthium* species is circular in cross-section and uneven. Layered collenchyma spaces alternating with chlorenchyma are located inside the swellings that make up the unevenness. The dermis consists of single-layered, elongated cells. The cells that make up the dermis are covered with a thick cuticle layer and large and small glandular hairs from the outer layer. 2-3(4) layers of chlorenchyma have developed inside from the dermis. Chlorenchyma cells are round-shaped and densely arranged. This is a sign of adaptation to a lack of organic nutrients in a vigorous growing stem. The main part of the stem is occupied by the conducting tissue elements. The stem is bundle-shaped, the bundles are large, their number is 10-12. Bundles are of open collateral type, xylem is strongly developed. Phloem is divided into individual rays surrounded by sclerenchyma bundles. A bundle has as many water tubes as the number of xylem rays (4-6 pieces).

It was determined that in the studied species, essential oils are collected in exogenous derivatives (essential oil glands) and schizogenic spaces. In these species, mainly unspecialized parenchyma cells, schizogenous spaces, glandular hairs of the vegetative and generative structure that secrete essential oils were noted. Thus, after obtaining complete information about the general biology of the main medicinal plants, helminthocide species, extracts and essential oils obtained from them were reviewed.

CHAPTER IV. DETERMINATION OF ESSENTIAL OIL PROPERTIES OF SOME COMPOSITE FAMILY WITH ANTHELMINTIC EFFECT

One of the main properties of essential oils is that they have a killing effect against parasitic worms. Taking this into account, essential oil from the above-mentioned species and additionally *Artemisia dracunculus* L. - french tarragon plant was obtained and studied in dynamics (Tab. 1).

Table 1
Dynamics of essential oil accumulation in different phases of the composite family

Species Aerial part	Phases of vegetation			
	V	G1	G2	Color of essential oils
	Amount of essential oils in %			
<i>Artemisia absinthium</i>	0,20	0,40	1,46	Green tone
<i>Artemisia dracunculus</i>	-	2,5	3,65	Emerald green
<i>Helichrysum araxinium</i>	0,16	0,39	0,64	Straw
<i>Inula helenium</i> - root	1,13	1,19	1,32	Brick-brown
<i>Arctium lappa</i>	Traces	0,06	0,18	Yellowish-green
<i>Cichorium intybus</i>	Traces	0,03	0,09	Light

As can be seen from the table, the yield of essential oils in species is different. In order to use essential oils correctly and purposefully, the physico-chemical constants of essential oils obtained from each species (specific gravity, ether number, acid number, refraction angle, ether number after acetylation, etc.) and the identification of the component

composition were determined (Tab. 2). The composition of essential oils is composed of individual chemical substances that contain physiological properties.

Table 2.
Physico-chemical parameters of the essential oil of composite family

Species	Aerial part and root				
	Specific weight D_{20}^{20}	Refraction angle n_D^{20}	Acid number	Ether number (e.n.)	After acetylation (e. n.)
<i>Artemisia absinthium</i>	0,8866	1,4904	3,7	25	103
<i>Artemisia dracunculus</i>	0,9403	1,4698	0,37	8,41	30,01
<i>Helichrysum araxinium</i>	0,9335	1,4898	26,95	37,74	-
<i>Inula helenium</i>	1,01-1,03	1,5158	6-8	158-206	180,9-208
<i>Arctium lappa</i>	0,881-0,96	-	14,1-108	110-238,3	-
<i>Cichorium intybus</i>	0,930	1,4876	0,28	3,51	105

CHAPTER V. STUDY OF THE HELMINTHOCIDE EFFECT OF SOME SPECIES OF THE COMPOSITE FAMILY WIDELY DISTRIBUTED IN THE FLORA OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

5.1. Helminthocide effect of plants *in vitro*. Essential oil plants that are widespread in the wild flora are rich in special aromatic substances that give it biological and pharmacological value. The spontaneous healing effect of these plants has been known since ancient times, but in modern times, it is preferred to analyze the qualitative and quantitative composition of essential oils and study all their pharmacological properties that can be used in the pharmaceutical industry. Essential oils are a mixture of substances with both antiparasitic and antioxidant properties derived from secondary metabolites in plants. In our study, the

anthelmintic effect of essential oils of *Artemisia absinthium*, *Inula helenium*, *Cichorium intybus*, *Helichrysum araxinum*, *Arctium lappa* species belonging to the composite family was studied¹¹. Haemonchosis, strongylate and nematode helminths were able to survive the effects of essential oils for a very short time. Among the analyzed essential oils, the highest helminthocide effect was obtained in the essential oil of common wormwood.

In the studies on the helminthocide effect of plants, 20-25 pieces of each of the haemonchosis, nematodes, strongylates and trichocephaliasis collected from the gastrointestinal tract of sheep by the helminthological dissection method were placed in different bacteriological cups and was added with fresh brew made from the above plants, and the cups were placed in a thermostat with a temperature of 37-38°C and resistance of helminths to solutions was monitored¹². The results are shown in Table 3.

The results in the table show that the haemonchosis, strongylates and nematodes parasitic in the gastrointestinal tract were able to remain alive in brew prepared from the studied horse-heal and common succory species for 3 hours - 6 hours and 30 minutes, after which complete destruction occurred. However, under the same conditions, these helminths were active in physiological solution for 24-26 hours. Trichocephaliasis died in 28-33 hours in plant solutions, but in physiological solution they died after 39 hours. Brew made from the aerial parts of great burdock and Araz immortele plants had a high helminthocide effect against gastrointestinal strongylates. However, the results of brew prepared from the roots of burdock species were relatively low compared to other plants.

¹¹ Ibadullayeva, S.J. Study of Treatment Advantage of Medicinal Herbs with Antihelmintic Effect against Neosarcariasis / S.J. Ibadullayeva, S.H. Maharramov, L.A. Novruzova [et al] //International Journal of Research Studies in Biosciences (IJRSB), - 2015. Volume 3, Issue 1, - p. 1-3.

¹² Ibadullayeva, S.J. Study of Treatment Advantage of Medicinal Herbs with Antihelmintic Effect against Neosarcariasis / S.J. Ibadullayeva, S.H. Maharramov, L.A. Novruzova [et al] //International Journal of Research Studies in Biosciences (IJRSB), - 2015. Volume 3, Issue 1, - p. 1-3.

Table 3.

Comparison of the helminthocide effect of essential oils and extracts of the species *Inula helenium*, *Cichorium intybus*, *Helichrysum araxinium*, *Arctium lappa*

Plants \ Helminths		Haemonchosis	Strongylate	Nematode	Trichocephaliasis
Horse-heal	Essential oil	1 h.15 min	1 h.30 min	1 h.20 min	24 hour
	A/g p.extract	3 h. 30 min	3 h. 55 min	4 h.05 min	28 hour
	Root extract	5 h.10 min	4 h.45 min	5 h.40 min	32 h.30 min
Common succory	Essential oil	1 h.35 min	1 h.55 min	1 h. 40 min	26 hour
	A/g p.extract	4 h.35 min	4 h.30 min	5 h.15 min	31 hour
	Root extract	5 h.40 min	6 h.10 min	6 h.25 min	33 h. 20 min
Araz immortele	Essential oil	1 h.30 min	1 h.50 min	2 hour	26 hour
	A/g p.extract	3 h.45 min	4 h.40 min	5 h.30 min	3 h. 20 min
Great burdock	Essential oil	2 h.05 min	2 h. 20 min	2 h.45 min	27 hour
	A/g p.extract	5 h.25 min	5 h.40 min	6 h.05 min	33 hour
	Root extract	6 hour	6 h.20 min	6 h.35 min	34 h.40 min

The assessment of the helminthocide effect of plants is given by comparing the obtained results with the physiological solution. While haemonchosis, strongylates and nematodes were destroyed in plant brew for about 3-7 hours, these helminths could remain alive for 25-29 hours in physiological solution. Trichocephaliasis, as in other experiments, were resistant to brew prepared from immortelle and burdock. According to the results of experiments, trichocephaliasis were destroyed in 30-35 hours in plant brews. However, the trichocephaliasis placed in the physiological solution were fully active for 38 hours and 30 minutes,

after which they became dead. Based on this comparison, the anthelmintic effect of plant brews against trichocephaliasis can be considered satisfactory.

5.2. Anthelmintic efficacy of plants *in vivo*. In order to evaluate the anthelmintic effect of the analyzed plants, *in vivo* experiments were conducted on sheep naturally infected with strongylatosis. At this stage of our experiment, the aerial part, root and essential oil of the intended plants were used. The fact that the essential oils of these plants have high helminthocide effects *in vitro* indicates that the anthelmintic efficacy will be very effective *in vivo*. The helminthocide effect of the essential oils of the indicated species *in vivo* was studied by us for the first time (Fig. 8). According to the obtained results, it can be noted that the use of these plants in the fight against helminthosis can be considered appropriate ¹³.

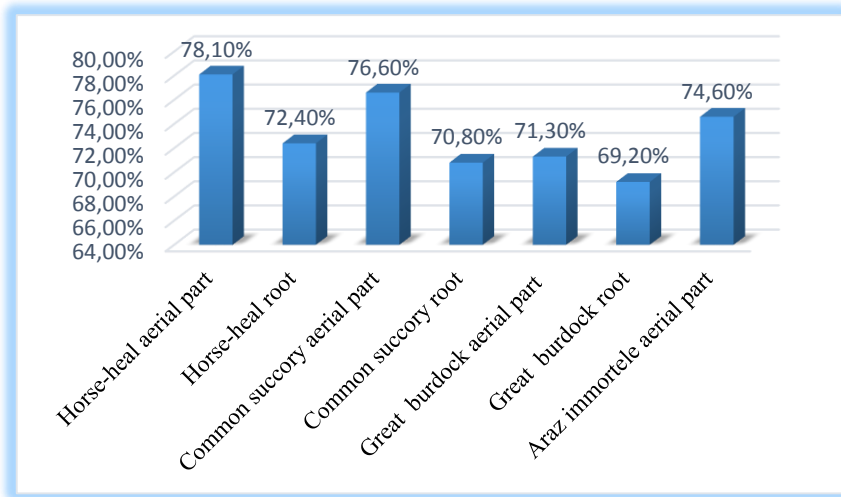


Figure 8. Comparison of anthelmintic efficacy of brew prepared from the studied plants

The animals in the experiment were examined by a veterinarian and the toxicity of essential oils was checked. During the clinical

¹³ Новрузова, Л. Антигельминтная эффективность некоторых видов растений семейства *Compositae* Giseke в условиях *in vivo* //Russian Journal of Parasitology, - 2023. V. 17, № 2, - p. 276-283.

examination, the heart rate and respiratory movements of the animals were counted, and the condition of the mucous membrane was monitored¹⁴. The experiment was carried out by observing a pharmacological dose of essential oils diluted with olive oil. After the experiment had continued for 3 days, fecal samples were taken from the groups and re-examined. At this time, the number of eggs in group I animals was 91.9, in group II - 105.6, in group III - 121.9, in group IV - 156.1, in group V - 126.7, and in group VI – 811.9. The anthelmintic efficacy of essential oils was determined by comparing the number of eggs obtained in the last examination with the number of eggs recorded before the experiment (Tab. 4).

Table 4
Anthelmintic efficacy of essential oils of the studied species

Groups	The number of eggs of parasites / 3 g in feces		
	Before the experiment	After the experiment	Anthelmintic efficacy of essential oils
Group 1. <i>Artemisia absinthium</i> essential oil	806,1	91,9	88,6 %
Group 2. <i>Inula helenium</i> essential oil	793,9	105,6	86,7%
Group 3. <i>Cichorium intybus</i> essential oil	817,7	121,9	85,1%
Group 4. <i>Arctium lappa</i> essential oil	813,2	156,1	80,8%
Group 5. <i>Helichrysum araxinum</i> essential oil	768,2	126,7	83,5%
Group 6. Control group	843,4	811,9	-

The anti-helminthic effect of essential oils with high pharmacological properties was also compared with extract solutions prepared from the above-ground and underground parts of the studied plants (Fig. 9).

¹⁴ Novruzova, L.A., Maharramov, S.H., Ibadullayeva, S.J. Management of Gastroenterostomy Illness with Herbs in Veterinary Practice in Nakhchivan Autonomous Republic (Azerbaijan) //International Journal of Veterinary Science. - 2015. Volume 4 (4), - p. 227-230.

In our last experiment, we studied the anthelmintic effect of mixtures made from the aerial parts of plants and root flour. In the coprological examination conducted before the experiments, an average of 704.8 strongyle eggs were counted in group I animals, 764.5 in group II, 791.6 in group III, and 804.1 in group IV. Group I animals were applied mixture prepared from the aerial part of horse-heal and common succory species, Group II animals – mixture prepared from the aerial part of great burdock and Araz immortele species, Group III animals – mixture prepared from root flour of horse-heal, common succory and great burdock species. During the experiment, we conducted clinical examinations on animals to determine the toxic effect of plants on the animal body after the preparation was administered. In the examination conducted after the 3-day deworming process, the number of helminth eggs in animals was: I group animals – 194.5, II group animals – 266.8, III group animals – 222.4, IV group animals – 799.5.

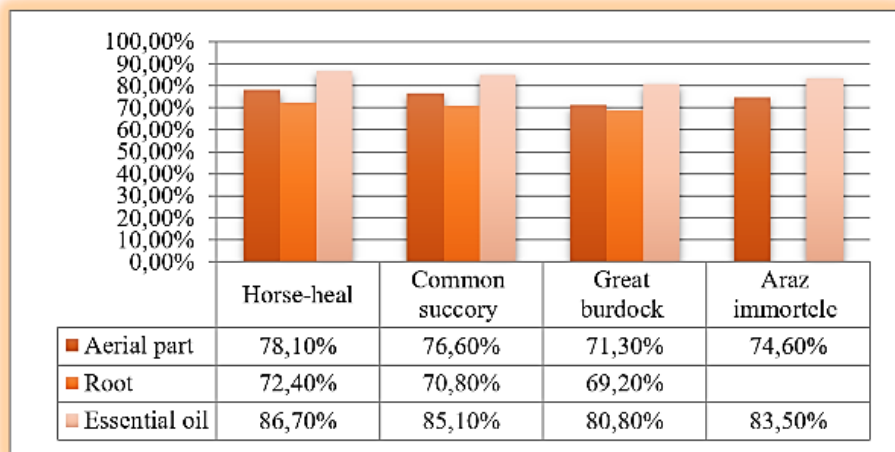


Figure 9. Comparison of the helminthocide effect of brewing prepared from the studied species and essential oil solutions of these species

The results show that 65-72% helminthocide efficacy of the mixtures prepared from both the aerial part and the root of the studied plants was obtained. The very small difference in the number of helminthic eggs in

both examinations in animals in the control group indicates that the applied plant mixtures have a high helminthocide effect. The effective results of the experiments conducted with the medicinal plants provided in our study show that medicinal preparations used as anthelmintic agents can be prepared from these plants in the future.

CHAPTER VI. ASSESSMENT, RESERVE AND PROSPECTS OF USE OF POPULATIONS OF SOME SPECIES OF THE COMPOSITE FAMILY IN THE FLORA OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC

During the study, the position of the representatives of the composite family found in the vegetation of the Nakhchivan Autonomous Republic was investigated, the pattern of distribution of some species in the flora was determined during field observations, the their general distribution areas, biological and ecological characteristics were studied.

6.1. Assessment of coenopopulation of some composite family. During the monitoring, the following parameters were recorded for each species: the number of sample plots was determined depending on the size of the total plots and those plots were numbered. The data obtained from each sample area was reflected in a proforma for monitoring individuals. Examples of this are given in the tables. Based on the collected data, a comparative analysis was conducted between species. Such monitoring was carried out on more than 20 species.

As a result of the research, it was determined that the forest slopes and bush areas of the foothill zone are richer in terms of the density of medicinal and aromatic plants of the family. Due to species richness, subalpine slopes and flat slopes can be considered richer. 60-70 species of medicinal plants, including representatives of other families, are more widespread in the Batabat area of Shahbuz region.

6.1.1. Assessment of coenopopulations of *Artemisia absinthium* L. and their reserve. As a research material, common wormwood (*Artemisia absinthium*), distributed from the lowland to the highlands in the flora of the Nakhchivan Autonomous Republic, was phytocenologically evaluated and its reserve was calculated during the field trips and expeditions conducted in 2016-2017 (Tab. 5). It has been

determined that the species is distributed in 4 types of vegetation (semi-desert, mountain-xerophyte, shrub and meadow). Two natural populations were selected in each of Shahbuz, Babek, Ordubad and Julfa districts, where *Artemisia absinthium* species is distributed, and ontogenetic periods were monitored. Here, it was observed that mainly 3 types of vegetation - mountain-xerophyte, semi-desert and meadow phytocenoses spread in the II layer, sometimes in the form of glades, and sometimes forming a thick wood.

Table 5

Table 5. Assessment of coenpopulation of *Artemisia absinthium*

№ CP	CP type	Growth phases of ontogeny, in % of total							Index	
		j	im	v	g ₁	g ₂	g ₃	ss, s	D	ω
8 2	Young	10	40	10	15	25	0	0	0.19	0,28
		0	0	12.73	14.55	25.4	29.1	18.2	0.55	0,30
1 5	Transiti on	0	0	11.1	6.7	40	22.2	20	0.41	0,24
		0	0	11.76	15.7	23.5	33.3	15.7	0.43	0,32
3 7	Mature	17.1	9.43	18.87	11.32	7.55	3.77	32.1	0.46	0,49
		7.3	7.32	21.9	17.1	17.1	0	29.3	0.56	0,45
4 6	Full mature	3.5	9.3	17.4	15.11	10.5	30.2	14	0.57	0,52
		0	5.77	5.77	9.6	30.6	9.62	38.4	0.59	0,63

In the populations, all groups of the ontogeny of the plant can be found, but in populations 1, 2 and 5, juvenile and immature phases were not found, individual were not found in the juvenile period of the population 6, in the old generative phase of the population 7, and old generative, senile and subsenile of population 8. Populations 3 and 4 are complete. In other words, different phases of ontogenesis were found in the populations. Looking at the assessment of age and efficiency indices, it is clear that CP 2 and CP 8 are young ($D=0,19-0,55$; $\omega=0,28-0,30$), CP 1, CP 5 characterizes the transitional age period ($D=0,41-0,43$; $\omega=0,24-0,32$), CP 3 and CP 7 are mature populations ($D=0,46-0,56$; $\omega=0,45-0,49$), CP 4 and CP 6 are fully mature populations, where the age and efficiency indices have reached their maximum ($D=0,57-0,59$; $\omega=0,52-0,63$).

It was found that the biological reserve of the species was higher in 2017 (11.6-561 h/kg) than in 2016 (9.50-420.3 h/kg) in different years.

Although the plant reserve was studied in the same designated CP, some difference is observed in different years. This is the response of plant reserves, abundance and productivity to environmental factors.

6.1.2. Assessment of coenopopulations of the *Achillea millefolium* L. and their reserve. During field surveys and expeditions, *A. millefolium* species was identified in 7 types of vegetation (semi-desert, mountain-xerophyte, steppe, meadow, forest, bush, gamma). Ten natural populations where the species *A. millefolium* is distributed were selected (Babak 1, 2; Julfa 3,4; Shahbuz 5, 6, 7, 8; Ordubad 9, 10). Based on the population study method, the structure of ontogeny was calculated with materials collected from different phases of ontogeny. The results of the calculations prove that the highest indicator in the species *A. millefolium* is in the generative development stages (225-243 pieces) (Fig. 10).

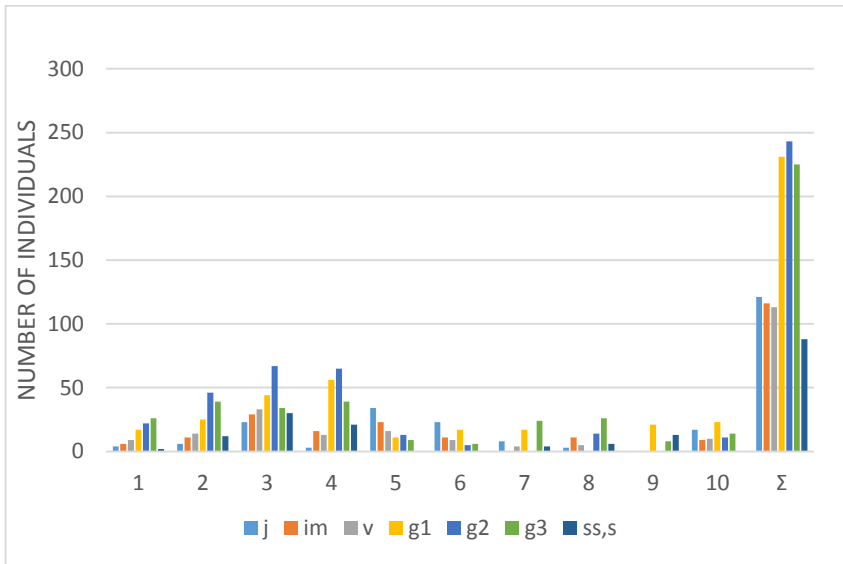


Figure 10. Number of individuals in coenopopulations

According to the integral characteristics of the demographic structure, the efficiency coefficient was higher ($\omega=0.70-0.77$) in CP 6, CP 7 and CP 10. This is related to the fact that in these populations, the number dynamics of plants belonging to the juvenile and immature phases before

the generative development phases was high, and the individuals belonging to the aging (s, ss) phases were less.

Since *A. millefolium* species is an important plant, we also calculated its natural reserves in the regions (Tab. 6). The abundance of the plant in phytocoenoses varies between 3-4 points.

Table 6.
Dry weight reserve of *A. millefolium* species by villages in Shahbuz district

Regions	Distribution area (ha)	Reserve density	Biological reserve (kg/ha)	Operating reserve (kg/ha)
Batabat massif	656	9,40±0,56	1168,00 ±71,25	584,00±35,49
Bichanak area	340	8,20±0,49	583,00±34,35	291,50±12,10
Gomur village surroundings	410	8,00±0,46	453,00±27,10	226,30±13,58
Kulus village area	578	8,70±0,52	1097,00±67,84	548,00±35,49
Gishlag village surroundings	480	8,60±0,53	645,00±38,60	322,50±19,46
Kechili surroundings	280	7,70±0,46	370,00±20,00	185,00±11,08
Total:	2744	9,3±0,55	4316,00±286,34	2158,00±137,56

As can be seen from the table, the biological reserve of the plant in Batabat massif and Kulus village area was approximately equal, and 50% of it can be exploited. The plant has high productivity around the village of Ashagi Gishlag and in the high mountain areas.

6.2. Prospects for the use of composite family. During the research conducted in the flora of the Nakhchivan Autonomous Republic, it was found that 20 species belonging to 14 genera of composite family have a wide range of uses¹⁵.

¹⁵ Novruzova, L.A. Naxçıvan Muxtar Respublikası florasında yayılan bəzi asterçəkililərin istifadə perspektivləri // Naxçıvan Dövlət Universitetinin Elmi Əsərləri. Təbiət elmləri və tibb seriyası, - 2015. №7(72), -s. 50-55.

6.2.1. Composite family of medicinal importance and their use. As a result of ethnobotanical research, information was collected on the use of the useful species of the family, which are widely applied in veterinary medicine, in the treatment of various diseases, the ranges, bioecology of those species, the organs used for medicinal purposes (root, stem, leaves, flowers, etc.) and how to use them for which diseases were studied. It was found that most species of genera *Tragopogon* L., *Scorzonera* L., *Taraxacum* F.H.Wigg., *Tussilago* L., *Artemisia* L., *Arctium* L., *Xeranthemum* L., *Senecio* L., *Pyrethrum* Zinn, *Achillea* L., *Helianthus* L., *Telekia* Baumg., *Inula* L., *Helichrysum* Mill., *Centaurea* L. etc. are widely used in folk and scientific medicine.

6.2.2. Non-traditional methods of treatment with plants in veterinary medicine. The need to increase the production force of animal husbandry is determined by the development patterns of human society. The continuous growth of the population and the demand for nutrition require a constant increase in the production of livestock products. One of the main conditions of this development is the application of the achievements of veterinary science in production. Prospects of use of medicinal and fodder plants were studied, the dosage of prescriptions for respiratory organs and gastrointestinal diseases was prepared. In veterinary medicine, the plants used in non-traditional methods for gastrointestinal diseases are the following: *Cnicus benedictus* L. (= *Centaurea benedicta* (L.) L.), *Taraxacum serotinum* (Waldst. & Kit.) Fisch., *Taraxacum officinale* F.H.Wigg., *Artemisia vulgaris* L., *A. absinthium*, *A. arenaria* DC., *A. scoparia* Waldst. & Kitam., *A. monogyna* Pojark., *A. szowitziana* (Besser) Grossh., *A. fragrans* Willd., *A. spicigera* K.Koch, *Achillea wilhelmsii* K.Koch (= *A. santolinoides subsp. wilhelmsii* (K.Koch) Greuter), *A. millefolium*, *A. nobilis* L., *A. filipendulina* Lam., *Bidens tripartita* L., *Solidago virgaurea* L., *Matricaria chamomilla* L., *Senecio racemosus* Wall., *S. rhombifolius* Bolle.

6.2.3. Forage important composite family and their use. Some composite family species, which are spread everywhere in the Nakhchivan Autonomous Republic, from the lowland to the middle mountain belt, in the meadows, on the edges of forests and rivers, in bushes, on the sides of roads and ditches as a weed, in gardens and

sometimes in crops, are eagerly eaten by animals. They include: *Inula britannica* M.Bieb., *Crepis pannonica* (Jacq.) K.Koch., *C. parviflora* Pers. (= *C. capillaris* (L.) Wallr.), *Arctium lappa*, *Achillea millefolium*, *A. setacea* Waldst. & Kit., *Achillea tenuifolia* Lam., *Taraxacum officinale*, *Taraxacum stevenii* DC., *Aster alpinus* L., *Centaurea fischeri* Willd., *Pyrethrum balsamita* Willd. (= *Tanacetum balsamita* L.), *Tragopogon latifolius* Boiss. They have high fodder value and are eaten by farm animals both as wet and dry grass throughout the year.

RESULTS

1. For the first time, 66 species of plants from the composite family used in veterinary medicine, animal nutrition and hygiene were found in the flora of the Nakhchivan Autonomous Republic, of which 29 species are used in the destruction and hygiene of helminths. The bioecological characteristics and distribution areas of each species have been determined.
2. An analysis of the composite family according to their life forms: 79,0% perennial herbs, 10% annuals, 3% biennials, 3% annuals or biennials, 5% subshrubs; respectively hemicryptophytes 81%, therophytes 14%, chamephytes 3%. Ecological analyzes prove that the composite family in the area are mainly xerophytic (47% xerophytic, 21% mesoxerophytic, 21% xeromesophytic), and only 10% are mesophytic plants. More than half of them are xerophytic elements of low (20%), middle (25%) and high mountain areas (18%). The remaining plants were found to be distributed in subalpine (13%), alpine (10%) and plains (13%).
3. From the phytogeographical analysis, it appears that the areal types of composite family originated mainly from the xerophilic origin of the Mediterranean (23%), the Caucasus (18%) and the Boreal (17%) elements. There are also species of Palaeoarctic, Western Asia and Steppe origin. Remaining areal types are few in number and occupy 2-8% of the area.
4. Biometric and morpho-anatomic structure features of the species *Inula helenium*, *Artemisia absinthium*, *Helichrysum araxinum* and *Arctium lappa* with anthelmintic importance were determined for the first time in the local flora. In these species, the presence of non-

specialized parenchyma cells, schizogenous spaces, glandular hairs of the vegetative and generative structure that secrete essential oils were noted.

5. The dynamics of accumulation of essential oil in different phases of some species of the composite family (*Artemisia absinthium* 0,20-1,46%; *A.dracunculus* 2,5-4,1%; *Helichrysum araxinium* 0,16-0,64%; *Cichorium intybus* 0,03-0,09%; *Arctium lappa* 0,06-0,18%; *Inula helenium* 1,13-1,32%) and the physicochemical constant signs were determined.
6. The helminthocide efficacy in brew prepared from the root and aerial part of *Inula helenium* tested in helminthocide studies is 72-78%, brew prepared from the root and aerial part of *Cichorium intybus*- 70-76%, brew prepared from the root and aerial part of *Arctium lappa* - 69-71% and brew prepared from the aerial part of *Helichrysum araxinium* - 74,6%. The helminthocide effect of the studied essential oils was higher, the achieved efficacy was 80.8-86.7%.
7. Some composite family with anthelmintic effect have been studied phytocenologically, their age and efficiency coefficients, resource assessments and reserves have been determined: *Achillea millefolium* efficiency ratio $\omega=0,21-0,77$; age ratio $D=0,08-0,58$; reserve on Shahbuz district - 4316,00kg, efficiency ratio of *Artemisia absinthium* species $\omega=0,24-0,63$; age ratio $D=0,19-0,59$; the reserve in the Autonomous Republic for 2016 is 441.39t/h; for 2017 - 444,128t.
8. The perspectives of the use of medicinal and fodder-important composite family were studied, during the conducted experimental studies, the dosage of prescriptions for diseases of the respiratory organs and gastrointestinal tract was prepared and applied in accordance with the national veterinary medicine.

RECOMMENDATIONS

1. Antihelminthic Greater burdock – *Arctium lappa* L. and Pannonica hawksbeard – *Crepis pannonica* (Jacq.) K.Koch. are well eaten dry by all kinds of cattle. The seeds are eagerly eaten by domestic birds. From

this point of view, it is recommended to mix these species with nettles, sedges and other plants, as well as with straw and make silage.

2. It is recommended to take the infusion of chiccory and immortelle species 3 times a day in the treatment of worms, bile and liver diseases of domestic animals.
3. Since the anthelmintic efficacy is high in horseheal, common succory, Araz immortele, and great burdock species, it is considered appropriate to use it in the treatment and prevention of helminthosis. At acute times of invasion, it is possible to achieve high results by using the aerial parts and essential oils of common wormwood, horseheal and common succory species. For this reason, it is recommended to use natural raw materials as an anthelmintic agent as an alternative to chemical drugs.

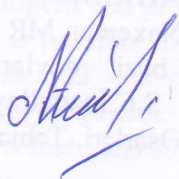
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