REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

MYCOBIOTA AND FUNGICID CHARACTERISTICS OF ALHAGI MAURORUM MEDIC SPREAD IN VARIOUS ECOLOGICAL CONDITIONS

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Applicant**:**	**Aytan Shamil Safarova**

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The dissertation work was carried out in the laboratories of Microbiological biotechnology of the Institute of Microbiology of ANAS.

Scientific supervisor: Doctor of Biological Sciences, Associate Prof. **Konul F. Bakhshaliyeva**

Official opponents: Doctor of Biological Sciences, Prof. **Khudaverdi Ghanbar Ghanbarov**

PhD on Biology **Lala Novruz Bunyatova**

PhD on Biology **Afak Latifagha Rzayeva**

Dissertation council FD 1.07 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Institute of Microbiology of ANAS

Chairman of the Dissertation Council: Doctor of Biological Sciences, Prof., Academician **Mammad Ahad Salmanov**

Scientific Secretary of the Dissertation Council: PhD on Biology, Associate Prof. **Anar Teyyub Huseynov**

Chairman of the scientific seminar: Doctor of Biological Sciences, Prof. **Guler Mirchafar Seyidova**

INTRODUCTION

Relevance and degree of study of the topic. Wild and cultivated plants in nature *"are used in the fields of medicine, confectionery, perfume industry, herbal medicine and other areas and it is use is expanding last years"*[1-2]. As a result of the increasing expansion of the use of plants and increasing the effect on the anthropogenic impact on the environment, pathologies caused by various creatures, etc., the quality and yield of plants are reduced, and of which, above all, the prevention of pathologies caused by fungi is one of the areas of current research. It should be noted that *"some plants are not only one of the favorable places for the pathology of fungi"*[33], but also have in their component composition that *"slow down or completely stop the growth of pathologies*[1].

The flora of the Republic of Azerbaijan has rich and colorful plant resources, including *"more than 4,700 species of plants, of which about 1,500 species have important medical impact. These plants as a whole represent 178 families and 740 genera. Medicinal plants make up 34.3% of the total flora peculiar to the nature of Azerbaijan."*[4]. The main reasons for the transformation of these plants, as well as their components with biological activity in the objects of research in the world and in our country are their use for various purposes and the absence of any harmful effects after their use. Only some people have allergic reactions to these plants. For this purpose, the study of medicinal plants, also biologically active substances (BAS) in them that have been successfully used in the treatment of various diseases

[1] Jamshidi-Kia, F., Lorigooini, Z., Amini-Khoei, H. Medicinal plants: Past history and future perspective. // J Herbmed Pharmacol, - 2018, v.7(1), - p. 1-7.

[2] González-Minero F.J., Bravo-Díaz L. The Use of Plants in Skin-Care Products, Cosmetics and Fragrances: Past and Present. //Cosmetics, -2018, v.5, 50 -p. 1-9

[3] Bennett J.A.†and Cahill J.F. Fungal effects on plant–plant interactions contribute to grassland plant abundances: evidence from the field. //Journal of Ecology, 2016,v.104, -p. 755–764

[4] Mehdiyeva N.P. Azərbaycanın dərman florasının biomüxtəlifliyi / Mehdiyeva N.P. - Bakı: "Letterpress", - 2011, - 186 s.

and preparation of cosmetics for many years in folk medicine, as well as in modern medicine, is of great importance. In the flora of Azerbaijan there is a large stock of many medicinal plants that have significant abrasive properties, which allows them to be widely used in both medicinal and genetic-skin industry.

One of the plants corresponding to this characteristic is the plant *Alhagi maurorum* Medic. There are not much report to study various aspects of this plant both in the worldwide and in Azerbaijan. Despite the fact that this plant is widely distributed *"in the world"*[5], including *"in Azerbaijan"*[6], that is, it is among those plants which have enough resources. On the other hand, even a few studies have shown that the effect of its constituent elements can also vary depending on environmental conditions.

As it is known, *"many fungi are cosmopolitan organisms, that is, organisms that have the ability to spread over a fairly wide area."*[7] One of the main conditions for the continuation of their life is the presence of organic matter, this is due to the fact that they have a heterotrophic way of nutrition. From all this, we can conclude that fungi live on any plants, including medicinal ones, while certain relationships are formed between fungi and plants. The study of these relationships has always been the focus of researchers.

Research in this direction has been carried out for a long time, and as a result, tens of thousands of species of fungi with various trophic connections with plants have been described and their spread area has been determined. The conducted studies still retain their relevance today. This type of research has also been widely covered in Azerbaijan, and "*its start date goes back to the end of the XIX*

[5] Asghari M.A. Systematic and Mechanistic Review on the Phytopharmacological Properties of *Alhagi* Species / M.A. Asghari, M. Fallah, M. Moloudizargari [and etc.] // Anc Sci Life., -2016. v.36(2), - p. 65–71.

[6] Dəmirov, İ.A. Azərbaycanın dərman bitkiləri / İ.A.Dəmirov, D.Z.Şükürov; - Bakı: "Elm" nəşriyyatı, - 1974, - 230 s.

[7] Cantrel S.A. et al. Unusual fungal niches./ Cantrel S.A., Dianese J.C., Fell J., Gunde-Cimerman N., Zalar P. // Journal Mycologia, -2011, v.103, is.6, - p. 1161-1174.

century"[8] and the studies are still in progress.

It should also be noted that the results obtained in the course of the research are not enough to characterize the mycobiota characteristic of Azerbaijan, because many of the indicators necessary for the full characterization of mycobiota are insufficiently studied in the conditions of Azerbaijan. Thus, the absence of mycological studies that characterize the entire territory of Azerbaijan, its not becoming a subject of systematic studies of separate unexplored biotopes, especially those that are subject to changing anthropogenic and technogenic effects, the lack of studies devoted to the comparative study of mycobiota of the same plant grown and animals spread in areas with different ecological conditions, etc. can be an example of what is said. However, in some studies, the above is given a place. For example, the micobiota of a specific territory or a specific group of plants, bactericidal and fungicidal activity of phytocomponents got from some plants was studied and obtained some interesting results. Nevertheless, today, research on the comprehensive study of any specific plant is either not found, or it is episodic, or the methodical approach applied in due time has already lost its importance for the modern period. If we add to the above that both the mycobiota and the phytocomponents of an individual plant growing in different environmental conditions differ at least quantitatively, and the work related to the comparative study of a particular plant in this aspect is usually not found, then it is safe to say that the problem is open to research.

Goals and objectives. The purpose of the presented work is devoted to the comparative study of fungicidal properties of mycobiota and components of *Alhagi maurorum* Medic. plants distributed in ecologically different territories of Azerbaijan.

To achieve this goal it is planned to solve the following tasks:

General characteristics and determination of some physical and chemical properties of the camel thorn (*A. maurorum*) plant, which is

[8] Axundov, T.M. Azərbaycanın mikobiotası / T.M.Axundov, B.B.Eyyubov, Əhmədov S.Ə.; - Bakı: "Təhsil" nəşriyyatı, - 2008, - 352 s.

distributed in various ecological territories of Azerbaijan;

- Determination of the species and quantitative composition of fungi involved in the formation of the mycobiota of the camel thorn plant, which is distributed in various ecological territories of Azerbaijan;

- Characteristics of fungi involved in the formation of mycobiota of plants *Alhagi maurorum* by ecological-trophic relationships and frequency of occurrence;

- Study of physico-chemical and fungicidal properties of some components of *Alhagi maurorum* plants and determination of its influence on the ecological state of the territory.

Research methods. During the research, mycological, as well as biochemical methods and approaches were used. Those mehods currently in use in similar works. Sampling for the research of mycobiota and phytocomponents from selected plants to be studied was based on the routing method, fungi cleaning, removal of essential oils, hydrostatisation methods and absorption of water extracts and ether based on the diffusion method. The repetition of the experiments made it possible to statistically process the results obtained and use data whose integrity in the dissertation is not in doubt (that is, it corresponds to the formula $m / M \leq 0.05$).

Terms of the dissertation submitted to the defense.

- Natural soil-climatic conditions of the environment in which the plant is spread take an important part in formation of biological, physical and chemical properties of *A.maurorum* plants;

- Mycobiota of the *A. maurorum* plant is characterized as a unity that is formed depending on the diversity of environmental conditions and has a certain sense of specificity;

- The chemical composition of the *A. maurorum* plant also includes components with fungicidal properties which is based on essential oils (EO)with a complex composition;

- To increase the effectiveness of EO obtained from *A.maurorum* plant, you can also use its composition with EO obtained from other plants, the composition of which is different.

Scientific novelty of the research. The research included comparative studies on the chemical composition of *Alhagi maurorum*

Medic. plants, the typical and quantitative composition of mycobiota, and the fungicidal activity of components spread in ecologically different territories of Azerbaijan.

It was found that depending on environmental conditions, the chemical composition of plants, the combination of types of components of fungi involved in the formation of mycobiota, the indicator of quantitative composition and fungicidal activity, as well as some other indicators of the plant (growth size, humidity, optical density of the obtained materials, etc.) is characterized by different indicators.

It was shown that 27 species of true fungi participate in the formation of mycobiotan of *A. maurorum* plant, of which 85.2% belong to the marsupial fungi (*Ascomycota*), 11.1%-to *Zygomycetes* (*Zygomycota*) and 3.7%-to Basidiomycetes (*Basidiomycota*). Recorded *Botryosporium longibrachiatum* (Oudem.) Maireır (=*Botrytis longibrachiata*) species such as and *Chaetosartorya ornata (*Raper, Fennell & Tresner*) Bilai & Koval* (=*Aspergillus ornatus*) are new to the mycobiota characteristic of the nature of Azerbaijan.

It was found that fungi involved in the formation of mycobiotics *of A.maurorum* plant are characterized by diversity both because of their Ecolo-trophic connections and because of the manifestation of Ecolo-trophic specialization. Thus, 9.5 % of recorded fungi belong to saprotrophs, 9.5 % - to biotrophs, 81 % - to polytrophs, as well as 70.4% of them to toxins, 37.0% - to allergens, 25.9% - to opportunists. It was found that 7 species of recorded fungi do not correspond to any of these characteristics.

It became clear that the distribution of fungi on the plant is also characterized by different quantitative indicators, so the marked fungi are characterized only by the frequency of occurrence (50.2-54.3%), characteristic of the dominance of *Ascochyta alhagi* and *Rhizobus stolnifer*. 10 of the other species are characterized by the frequency of occurrence that is common (14.3-36.5%), 9-random and rare (0.2-6.7%) species.

An aqueous extract (AE) derived from the *A.maurorum* plant inhibits the growth of toxic fungi used as a test crop of essential oil (EO) at a higher level. On the other hand, it is also possible to use the

A.maurorum plant in a composite form of EO in combination with the EO derived from the other plants of the thyme, resulting in a 15% increase in its self-effect.

Theoretical and practical significance of the study. The obtained study results are factual material that contributes to the expansion of information about fungi involved in the formation of mycobiota of the same plant species, common in different environmental conditions.

The study findings are important signs that it is appropriate to use the *A.maurorum* plant as a source for future medicines.

The main component of EO obtained from the camel thorn plant is thymol, its use as a composition with EO obtained from other plants, allows to increase fungicidal activity against toxic fungi allows both to develop methods and approaches that allow more effective use of biological resources, and to take drugs with higher efficiency.

Publication, aprobation and application of the dissertation. 14 papers related to the dissertation have been published, 8 of them are scientific articles, other 6 are conference materials and abstracts. Dissertation materials are presented at the scientific conference "Actual problems of modern natural and economic sciences" (Ganja, 2018), at the scientific conference "Innovations in biology and agriculture in solving global problems" (Baku, 2018), at the Republican scientific conference "Modern problems of biology" (Sumgayit, 2018), at the international conference "Microbiology and immunology: prospects for development" (Ukraine in the scientific Symposium dedicated to the 120th anniversary of academician Valery Ulyanishev (Baku, 2018) and the scientific conference "Actual problems of modern biology" (Baku, 2019).

Organization in which the dissertation work is carried out. Laboratory of microbiological biotechnology of the Institute of Microbiology of ANAS.

Structure and volume of dissertation. The dissertation work consists of an introductory and 4 chapters, a final analysis of the research, results, a list of references, additions and a list of abbreviations used in the dissertation. The dissertation consists of 141

pages, including a table and images, as well as a list of references, which is a total of 235000 signs.

CHAPTER I
MEDICINAL PLANTS, MYCOBIOTA AND FUNGICIDAL PROPERTIES OF THEIR COMPONENTS SPREAD IN AZERBAIJAN

Section 1.1 of the dissertation analyzes data on medicinal plants of Azerbaijan against the general background of plant species included in the flora of Azerbaijan, clarifies their taxonomic affiliation, distribution by Botanical and geographical areas and bioresource.

In section 1.2. of the dissertation the results of research on the antimicrobial activity of mycobiotics of plants and their components in Azerbaijan are analyzed, the results of research in this area are summarized taking into account the results of research conducted in leading centers.

And in section 1.3 of the dissertation, the results of research conducted in connection with the plant are analyzed, and the need for research of this plant on the quantitative and species composition of mycobiota, as well as the fungicidal activity of its components and its importance for the effective use of this plant is substantiated.

CHAPTER II
MATERIALS AND METHODS OF WORK

2.1. General characteristics of the studied territories.

The research was conducted in 2017-2018 on the territory of various economic regions (ER) of the Republic of Azerbaijan (Absheron, Aran, Guba-Khachmaz and Lankaran economic regions). When grouping the territories taken for research on large geomorphological units of Azerbaijan, ER Aran Kur-Araz lowlands, Guba-Khachmaz ER-Greater Caucasus, Lankaran ER-

Talysh mountains. The Absheron ER also belongs to the greater Caucasus, but the soil and climate conditions of Absheron sharply distinguish it from other territories of the Greater Caucasus, in particular the Guba-Khachmaz ER. It is for this reason that the generalization of the results of the research was carried out precisely because of the 3 geomorphological units and one ER.

2.2. General characteristics of methods and approaches used in the analysis of samples taken

In the studies, samples from *Alhagi maurorum* Medic. plants were taken along various routes chosen by the territory, as well as on permanently selected territories. The sampling was carried out mainly on the phenological phases of plants (the beginning of growth, flowering, fruit formation and drying of the aboveground organ). In particular, over the years of the study, more than 500 samples of vegetative and generative organs of the plant were selected, and the corresponding analysis was carried out.

"Extraction and identification of fungi from samples into pure crop"[9], obtaining *"aqueous extracts (AE)"*[10] and *"getting essential oils (EO)"*[11] from components, studying *"their physical and chemical properties"* [12] and *"fungicidal activity"* [13] were carried out in

[9] Билай В.И. Методы экспериментальной микологии. / Билай В.И. - Киев: - Наукова думка, - 1982, - 500 с.

[10] Бахшалиева, К.Ф. Микобиота и антифунгальная активность Laurus nobilis L. и Acorus calamus L./ Бахшалиева К.Ф., Намазов Н.Р., Гаджиева Н.Ш., Алиева Л.Н.// Успехи медицинской микологии (Россия), 2015, т.14, -с. 328-330.

[11] Meyer-Warnod, B.,1984. Natural essential oils: extraction processes and application to some major oils. Perfume. Flavorist, 9: 93-104.

[12] Fabiane, K.G. Physicochemical characteristics of the essential oils of Baccharis dracunculifolia and Baccharis uncinella D.C. (Asteraceae). / Fabiane, K.G., Ferronatto, R., Dos Santos, A.C., Onofre, S.B.// Brazillian J. Pharm., 2008, v.18, - p.197-203

[13] Egorov N.S. Guide to practical training in microbiology. Training Allowance 3rd ed., revised and additional M.: Publishing House MSU, 1995. -224 p

accordance with the methods used in the work of various authors. *Aspergillus Niger* as a test crop in determining the fungicidal activity, *A. ochraseus, Cladosporium herbarum, Fusarium oxysporium, Penicillium citrinum* and *P. cyclopium* fungi were used, which are also related to toxigens and were derived in pure crop in the course of research.

During the research, all the experiments were repeated at least 4 times, and the results were processed by the statisticaly appropriate "*known method"*[14]. At the same time, the results corresponding to the "formula m/M=p ≤0.05" were true and included in the thesis.

CHAPTER III
CHARACTERISTICS OF THE PLANT *ALHAGI MAURORUM* MEDIC., SPREAD ON THE TERRITORY OF AZERBAIJAN WITH DIFFERENT ENVIRONMENTAL CONDITIONS, BY THE TYPE AND QUANTITATIVE COMPOSITION OF MYCOBIOTA, FREQUENCY OF OCCURRENCE OF INDIVIDUAL SPECIES AND ECOLOGICAL-TROPHIC RELATIONSHIPS

3.1. *Alhagi maurorum* Medic., spread on the territory of Azerbaijan with various environmental conditions. characteristics of the plant and its mycobiota by quantitative and typical composition

In studies conducted in 2017-2018 to study the mycobiota of the plant *Alhagi maurorum* Medic., selected as the object of research, it became clear that when forming the mycobiota of the plant, fungi differ taxonomically: *Absidia ramosa, Ascochyta alhagi, Alternaria cucumerina, A. alternate, Aspergillus awamori, A.fumigatus, A.niger, A.repens, A.ornatus, A.restrictus, Botrytis longibrachiata, Cladosporium herbarum, Colletotrichum brassicicola, Erysiphe alhagi, Fusarium moniliforme, F.oxysporum, Mucor mucedo, Pencillium cyclopium, P. chrysogenum, P.restrictum, Phoma*

[14] Лакин Г.Ф. Биометрия. М.: Высш. школа, 1973, -343 с.

spinasiae, Rhizobus stolnifer, Septoria alhagi, Stachybotrys chartarum, Trichothecium roseum, Verticillium dahile and *Uromyces alhagi* and two of them (*A. ornatus* and *B. longibrachiata*) - new for mycobiota, characteristic of Azerbaijani nature. 3 species of recorded fungi belong to the divisions of *Zygomycota*, 23 species of *Ascomycota*, 1 species of *Basidiomycota.* Of the fungi included in the *Ascomycota* division, only *Erysiphe alhagi* belongs to the telemorphs.

As for the mycobiota, expressed by the numerical composition (Colony forming unit- CFU) of the plant, it became clear that the number of fungi inherent in the plant and calculated on 1 g of dry plant mass, varies between 2.3-4, $8x10^3$ CFU /g.

3.2. *Alhagi maurorum* Medic., spread on the territory of Azerbaijan with various environmental conditions. characteristics of the plant by the frequency of occurrence of fungi involved in the formation of mycobiota, by the forms of manifestation of ecological-trophic specialization

As a result of the ecological and trophic aspects of fungal species the spread of which were recorded on camel thorns, 7.4% of them were saprotrophic, 7.4% were biotropic, and the rest were polytophilic. The results also allow us to note that 92.6% of fungi involved in the formation of the plant's mycobiota tend to one or another pathogen, which can be considered an unfavorable indicator from the phytosanitary point of view.

It was found that of the recorded fungi, 2 species (*Asc.alhagi* - 54.3% and *Rh.stolnifer* -50.2%) is characterized by the frequency of randomness characteristic of dominants. Common species (frequency of occurrence is 14.3-36.5%) make up 48.2% of the total number of mycobiotans, while random and rare species (0.2-6.7%)make up 44.2%.

It should be noted that due to the frequency of occurrence, when characterizing fungi on individual economic regions, it becomes clear that certain quantitative differences are observed, the frequency of occurrence of the species such as *Asc.alhagi* and

Rh.stolnifer which are dominant plants varies and even new dominant species are discovered for some districts.

In recent mycological studies, fungi are systematized according to the properties of toxicity, allergenicity, and conditional pathogenicity (most often opportunists that can cause various pathologies in humans and animals), which are characterized as manifesting forms of ecological-trophic specialization. In this regard, as a result of the conducted research, it became clear that among the recorded fungi, the number of species of fungi whose toxicity, allergenicity and opportunism are unknown is 7, which is 25.9% of the total number of mycobiota. This represents 70.4% of the total number of species involved in the formation of the mycobiota of the camel thorn plant. As for the specific weight of allergens, according to the results of the analysis, the number of fungi corresponding to this characteristic is less than toxicens and is equal to 10 (37.0%). The number of species of fungi that can cause various pathologies in both animals and humans is less than that of toxicens - 7 species (25.9%).

3.3. Dynamics of change of species composition of camel thorn plant mycobiota in different zones of Azerbaijan

When the recorded fungi the studies were characterized according to separate gemological units sampled, it became clear that 18 species of recorded fungi (*A.ramosa, Asc.alhagi, A.alternata, A.fumigatus, A.niger, A.repens, C. herbarum, E.alhagi, F.moniliforme, F.oxysporum, M.mucedo, P.cyclopium, P.chrysogenum, Rh.stolnifer, S.alhagi, T.roseum, V.dahile* və *U.alhagi*) universaldır, yəni nümunə götürülən ərazilərin hamısında rast gəlinir. Qalan 9 növ (*A.cucumerina, A.awamorii, A.restrictus, B.longibrachiata, C.brassicicola, P.restrictum, Ph.spinasiae* və *St.chartarum*) are found in one or another area (table 3.3.1).

As for the spread of fungi by quantitative composition for individual geomorphological units, the difference between the maximum and minimum indicators that characterize the quantitative composition of fungi is 2.09 times higher, and reaches its highest

number in the Talysh mountains (on average for the year-4,8x10^3 CFU/g), and the lowest-in the Absheron economic region (2,3x10^3 CFU/g).

Table 3.3.1

Quantitative characteristics of the spread of recorded fungi in the studied economic regions

Areas where samples are taken	Number of species	Share in the general mycobiota
Absheron	19	70,4
Greater Caucasus	21	77,8
Kur-Araz lowland	23	85,2
Talish zone	22	81,5

The greater Caucasus has the second largest population (4,0x10^3 CFU/g) and the Kur-Araz lowland is the third (3,2x10^3 CFU/g).

It was also determined the change in the quantitative composition of fungi depends on the time of year. It became clear that in all the studied territories mycobiota occurs in the winter season (January), expressed by the smallest quantitative composition of the plant, and mycobiota-in the autumn (September).

3.4. Characteristics of the *A.maurorum* plant according to the areal classification of fungi involved in the formation of mycobiota

When characterizing 27 species of fungi that are formed in the mycobiota of the plant *A. maurorum*, it was found that only 3 species of fungi are listed in the list. The predominant species (15 species) belongs to cosmopolitans, of recorded species *A. alternate, A. cucumerina, A. awamori, A. fumigatus, A. niger, A. repens, C. herbarum, E. alhagi*, F. *moniliforme, F. oxysporum, M.mucedo, P.cyclopium, P. chrysogenum, P.restrictum* and *Rh.stolonifera* are compatible with these characteristics. According to the species number in the second (11 species) is a boreal species, which also includes

species such as *A. ramosa, Asc.alhagi, A. ornatus, A. restrictus, B.longibrachiatum, Ch.ornata, C. brassicicola, Ph.spinasiae, St.chartarum, S.alhagi, T. roseum,* and *U. alhagi.* This is 40.7% of the total mycobiota. Xerophytes are represented by one species, namely *V.dahile,* which makes up only 3.7% of the microbiota.

3.5. Annotated list of fungal species that contribute to the formation of the microbiota of the medicinal plant *Alhagi maurorum*

A total of 27 species of fungi are involved in the formation of the mycobiota of camel thorn plants selected for the study. Many of these species have been identified in pure culture and some have been identified by their disease symptoms and by the characteristics of spores at their developmental stages. The information provided, including the taxonomic significance and name of the fungi used, as well as the terms of the fungi, is annotated.

After finding out the distribution of 27 taxon species recorded in individual taxa, it was found that the recorded fungi included *A. ramose, M. mucedo* and *Rh.stolonifer Zygomycota* and *Uromyces alhagi*. The remaining 23 species belong to the *Ascomycota* branch of modern taxonomy. All species except *E.alhagi* (22 species), which are marsupial fungi, carry all life cycles in the anamorphic phase.

It should be noted that conidial sporulation is considered as one of the taxonomic features of anamorphic fungi. When describing the recorded fungi from this point of view, it was found that they belong to three groups. In the first group, conidial spore formation is directly observed in mycelium, *Alternaria alternate, A. cucumerina, Aspergillus awamori, A. fumigatus, A. niger, A. repens, A. restrictus, B.longibrachiata, C.brassicicola, Cladosporium herbarum, Fusarium moniliforme, F. oxysporum, Pencillium cyclopium, P. chrysogenum, P. restrictum, Stachybotrys chartarum, Trichothecium roseum,* and the *Verticillium* fungi. The second group is the fungus *Colletotrichum brassicicola*, the process of spore formation, and the third group includes fungi such as *Ascochyta alhagi, Phoma spinasiae,* and *Septoria*, which form conidia in pycnids.

Finally, those derived from the influence of various materials (selection and extraction material) from certain plants (*Centaurea acmophylla* and *Malabaila sulcata*) on the growth of fungi that contribute to the formation of the micobiota of camel thorn plants were also included in the annotated list of fungi. In this regard, it was found that an extract from *C. acmophylla is more effective than Aspergillus awamorii, A. niger, A. repens, A. restrictus, Alternaria cucumerina,* and *Fusarium oxysporium*, which are involved in invasive plant microbiota. As for the use of fragrance, *A. niger* not only negatively affects the growth of the fungus, but even stimulates it.

CHAPTER lV
FUNGICIDAL PROPERTIES OF COMPONENTS OF *ALHAGI MAURORUM* MEDIC. PLANT

4.1. Characteristics of biological and chemical elements of *Alhagi maurorum* Medic. plants spread on the territory of Azerbaijan with different environmental conditions

Changes in certain characteristics of the *A. maurorum* plant, which are both medicinal and at the same time characterized as toxic, allergenic, and common pathogenic fungi, were investigated. It became clear that the camel thorns, which grow in different areas, differ in size and humidity. Thus, in the Kur-Araz lowland, the size of plants is 1.1-1.2 m, humidity is 69%, 1.0-1.1 m and 67% in the Greater Caucasus, 0.5-1.0 m and 61% in Absheron, in the Talysh mountains-1.2-1.3 m and 72%.

Differences from environmental conditions were also observed in the optical density of EO and AE obtained from the plant. (table 4.1.1).

Table 4.1.1

Optical density of AE and EO from the *A. maurorum* plant collected in different areas

EA	Optical density (656 nm)	
	AE	EO
Kur-Araz lowland	0,716	1,254
The Great Caucasus	0,697	1,201
Absheron	0,737	1,267
Talish zone	0,568	1,197

As you know, the action of plants depends on the compounds they contain in the form of BAS, and how these components affect the bactericidal and fungicidal activity of medicinal plants is important both from a scientific and practical point of view. Therefore, the component composition of the EY plant A. mourorum was determined using the GPC (gas-phase chromatography) method. It became clear that there are quantitative and qualitative differences depending on the environmental situation. For example, although the main component of camel thorn in all zones is drymenol, its number varies between 19.2 and 23.2%. Although a camel thorn that grows in the Greater Caucasus does not have the octagon, it is found in camel thorns in other areas. In short, environmental conditions also affect the EO composition of the plant.

4.2. Fungicidal properties of materials obtained from *A. maurorum*

The plant material obtained during the research consisted of AE and EO, as well as compositions based on them. The results of their research on fungicides showed that most fungicides contain fungicidal compounds, and the quantitative indicator of their action is determined by the biological characteristics of the fungi used. (pic. 4.2.1).

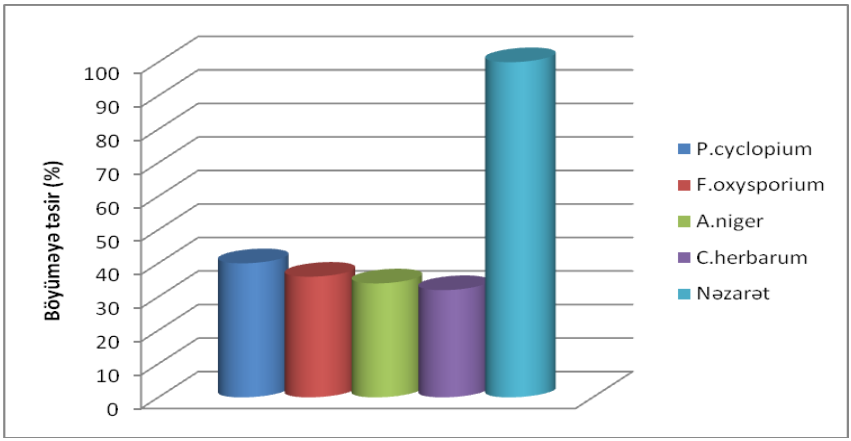

Figure 4.2.1. The influence of aqueous extracts of obtained from the *A.maurorum* plant on the growth of fungi.

As can be seen, the growth of fungi is slow due to the 10% aqueous extract, and the highest amounts are observed in C. herbarium fungi. Thus, the yield of biomass is reduced by 46% compared to control fungi obtained with 10% extract. For the fungi *Aspergillus niger*, *Fusarium oxysporium* and *Penicillium cyclopium*, the same figure is 34%, 36% and 40%. Consequently, the plant also attracts attention as a source of drugs that limit the growth of toxigenic fungi as a carrier of fungicidal properties.

The activity of EO obtained from the plant *A. maurorum* was determined by the diameter of the lysis zone and the yield of biomass. The results show that EO obtained from both plants has a higher fungicidal activity. (table. 4.2.1).

It was found that the fungicidal activity of EO obtained from the plant collected from the territory of Absheron EA is relatively high, and when collected from Talysh mountains it is low, that is, ecological conditions also affect the fungicidal activity of the plant.

Table 4.2.1

Fungicidal properties of EO from camel thorn

EO	Test crops	Activity	
		According to biomass yield (According to control %)	According to the diameter of the lysis zone (mm)
Camel thorn	*F. oxysporium*	0,8	24
	A.niger	1,2	21
	A.ochraseus	1,0	22
	P.citrinum	1,4	20
	P.cyclopium	1,3	20

Note: the biomass of fungi in the Chapek nutrient medium taken as control was accepted as 100%.

At the end of the study, the fungicidal activity of compositions based on camel spikes and other EO extracts was also investigated. It was found that although the performance characteristics of the compositions in some fungi do not change at all, in some cases there is an increase effect, that is, the fungicidal properties of the composition increase, which is associated with an increase in the composition and test properties of the composite components. This is evident in compositions made on the basis of EO, which is the main component (table 4.2.2).

FINAL ANALYSIS OF RESULTS

One of the places where fungi are most commonly found are plants that use plants as a habitat and food. One of the manifestations of their relationship is the appearance of various pathologies. As a result, the productivity of plants, as well as the influence of their components, is reduced. For this reason, it is important to clarify the relationship between fungi and plants, to study the species composition of the plant microbiota from the point

Table 4.2.2

Fungicidal properties of compositions of camel thorn EO obtained from EO of various plants

Composition	Test crops	Activity	
		According to biomass yield (According to control %)	According to the diameter of the lysis zone (mm)
Bitter wormwood / Camel thorn 1:1	*F. oxysporium*	0	29
	A.niger	0	31
	A.ochraseus	0	32
	P.citrinum	0	33
	P.cyclopium	0	36
Cat mint / Camel thorn 1:1	*F. oxysporium*	2,2	21
	A.niger	1,7	22
	A.ochraseus	1,1	24
	P.citrinum	0,9	25
	P.cyclopium	0,7	26
Yarrow/ Camel thorn 1:1	*F. oxysporium*	0,1	28
	A.niger	0,2	28
	A.ochraseus	0	31
	P.citrinum	0	32
	P.cyclopium	0	30

of view of the ecological and trophic relationships of fungi involved in the formation of the microbiota, as well as for their effective use of ecological trophic specialization. This is also important when developing regulations to ensure the safety of food, feed, and medical uses other than any other plants. All this is a good reason to note the need to study the microbiota of the camel's thorn and other features of fungi involved in the formation of the microbiota. Research in this area has shown that "one of the plants inhabited by fungi and causing various pathologies is the camel spike, with 27 species of fungi (mycotes) involved in the formation of plant

microbiota in Azerbaijan, and they are also characterized by diversity in all aspects of the study. For example, 70.4% of registered fungi are exposed to toxins, 37.0% to allergens, 25.9% to opportunistic microorganisms, 9.5% to saprotrophs, 9.5% to biotrophs, and 81% belong to politicians. Although 92.6% of the fungi involved in the formation of the invader microcomplex come from fungi that are widely distributed in various studies in Azerbaijan, this does not apply to species such as *Botryosporium longibrachiatum* (Oudem.) Maire and *Aspergillus ornatus* Raper. This is the first time that their distribution in Azerbaijan has been recorded.

In the second part of the study, the fungicidal activity of AE and EO plants of camel thorns was studied. The importance of research in this area is that the world's ever-growing population and, consequently, the expansion of urbanization is inevitable. As a result, the state of land used for various purposes, including unused land, is changing, and one of the results is a reduction in vegetation. These plants also contain medicinal value. Therefore, increasing the efficiency of their use, developing scientific and practical bases for the production of drugs with higher efficiency using fewer medicinal plants is one of the most urgent tasks of the modern era. If we add an increasing anthropogenic load on the environment and, as a result, change the number and nature of the disease, there is no need for additional evidence to support this.

When studying the fungicidal properties of components obtained from the plant *A. maurorum*, it was found that both AE and EO contain components that have a negative effect on the growth of fungi. Although EO effects are usually characterized as fungicidal activity, AE effects are evaluated as fungiostatic and sometimes weak fungicidal effects. Testing used in the formation of quantitative indicators of fungicidal and fungicidal effects also plays a role in the biological properties of crops, that is, the effects of the same substance are described as fungal in some fungi, and in others as fungicides. However, in all cases, both AE and EO have the ability to significantly reduce the growth of toxigenic fungi.

It should be noted that quantitative indicators of the influence of the test crop on the growth of camel thorns (AE and EO) can play a role in the formation of the number of the crop itself, as well as the time of year and part of the sample. Studies have shown that both droughts in arid areas may be more active than those collected in areas with relatively low humidity. In addition, the effect of the material obtained from the surface organ of the plant is more effective than the effect obtained from its roots. All these results are important indicators for the use of camel thorn plants.

An approach used in other plants was also used to enhance the EO effect in plants with camel thorns, which differs from the camel thorn in the main component. For this purpose, EO was used from plants such as bitter wormwood (EO's major component timol), Yarrow (EO's major component timol) and cat mint (EO's major component mentol), and the ratio of oils in their composition prepared with camel thorn was 1:1. It was found that using EO, which is the main component of thymol, is more effective for preparing the composition. As a result, their fungicidal activity against toxigenic fungi increases to 15%. This also increases the effectiveness of the drug used and the effective use of biological resources.

MAIN RESULTS

1. *Alhagi maurorum* is a Medicinal plant spread in ecologically diverse regions of Azerbaijan. it was studied for its chemical composition, microbiota, and fungicidal activity of its components, depending on environmental conditions, the chemical composition of the plant, and the diversity and composition of fungi. The effect of camel thorn on the microbiota of species varies. This difference is also evident in the size of the plant, in the moisture content, and in the optical density of the extracted elements [2, 5-7, 10-11, 14].

2. It was found that 27 species of fungi participate in the formation of the microbiota of the plant *A. maurorum*, of which 85.2% are found in the marsupial fungi (*Ascomycota*), 11.1% in

Zygomycota (3.7%) and basidiomycetes (3.7%). The first recorded species of registered fungi are *Chaetosartorya ornata (*Raper, Fennell & Tresner*) Bilai & Koval* (=*Aspergillus ornatus*) və *Botryosporium longibrachiatum* (Oudem.) Maireır (=*Botrytis longibrachiata*) in Azerbaijan [1, 4-5, 12, 16].

3. It was found that the fungi involved in the formation of A. microbiota of the *A. maurorum* plant are characterized by various ecological and trophic relationships, as well as manifestations of ecological trophic specialization. So, of 9.5% was mushrooms - saprotrophic, 9,5% - biotrophy and 81% of polytropy. 70.4% of registered fungi have toxicity, 37.0% have allergens and 25.9% have opportunistic properties, and 7 species do not meet any of these characteristics [2, 4, 9].

4. It was found that the spread of fungi by plant is also characterized by a different quantitative index, since the plant is characterized only by the recorded dominant species *Ascochyta alhagi* and *Rhizobus stolnifer* (50.2–54.3%). Of the remaining species, 13 are characterized by frequent occurrences (14.3-36.5%), and 12 are characterized by frequent cases of random and rare species (0.2 - 6.7) [4].

5. Although both aqueous extract (AE) and essential oil extracts (EO) from *A. maurorum* have a negative effect on the growth of toxigenic fungi used as test crops, the fungicidal properties of EO are relatively high in water fungicide's extracts [8, 13, 15].

6. It was found that the EO of the plant *A. maurorum* contains various components, including the main components by the amount of drimenol (19.2-23.2%) and 9-octyl heptadecan (7.2-10.2%). it is also possible to use EO, obtained from the plant *A. maurorum*, in the form of composites, and the combined use of EO, which contains the main component of the composition, is more effective. As a result, their fungicidal activity can be increased up to 15% in relation to toxigenic fungi, which increases their ability to use resources more efficiently [3, 8, 13-15].

PRACTICAL GUIDELINES

As a result of research, it is advisable to use the following sources of fungicides:

1. It is desirable to use the surface of the plant for the preparation of fungicides, and the collection of plant material should be carried out in the summer, that is, in June-July;
2. It is desirable to use it mainly in arid areas, primarily in the Kura-Araz lowland and on the Absheron EA, and the drying of the collected plant material should be stored in the sun for less than 3-5 days, and the humidity should be less than 20%. the mass of the plant should be used;
3. EO obtained from invitations to prepare fungicidal preparations is more suitable both in the 1: 1 form and in combination with other EY of the main composition.

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