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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

STUDY OF ECOLOGICAL FEATURES OF MICROMYCETES COMMUNITIES DISTRIBUTESD IN URBAN ENVIRONMENT

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INTRODUCTION

Relevance and degree of development of the topic: One of the features of the modern era in intensive development is urbanization, as a result of which both the number of cities and their territories are gradually increasing. In urbanized areas, individual components of the environment are subject to various changes and constant man-made determination as a result of intensive human activity. The state of the land of urban areas requires special attention, so that the city is engaged in transport, industrial, construction work, etc. its effect on soils creates tension. As a result of this, all components of the soil (living and non-living, organic and inorganic) undergo changes, as a result of which the soil cover in the urban environment is deprived of the opportunity to perform important environmental functions. First of all, this has its negative effect on the microbiota, biochemical parameters and biological activity of this type of soil. For this reason, they consider it appropriate to assess the state of the soil cover, especially "*in the urban environment, based precisely on Microbiological and biochemical indicators*."[1].

It should be noted that "*mainly bacteria, actinomycetes, fungi, as well as primitives (protists) are involved in the formation of the microbiota of soils,"*[2] which are actively involved in the realization of various processes occurring in soils. Those mentioned are characterized by different indicators, both according to their ecological function in nature and according to their specific gravity in the soil biota. For example, "*bacterial cells differ from other living beings in number, in the amount of biomass from which they form fungal colonies*"[3] and are characterized by higher indicators.

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[1] Гельцер, Ю.Г. Показатели биологической активности в почвенных исследованиях// Почвоведение, - 1990. № 9. -с. 47-60.

[2] Добровольский, Г.В. Экология почв. Учение об экологических функциях почв./ Г.В.Добровольский, Е.Д.Никитин. -М.: Изд-во МГУ, -2012. -415 с.

[3]Добровольская Т.Г., Звягинцев Д.Г., Чернов И.Ю. др. Роль микроорганизмов в экологических функциях почв // Почвоведение, 2015, № 9, с.1087–1096.

"*The fact that fungi are widespread in nature and actively participate in various ecological functions is one of the realities that have been confirmed in numerous studies"*[4,5], which make up the group of heterotrophic organisms. Thus, fungi have the ability to spread both in "biotopes with extreme conditions", where organic matter is present, and in "*anthropogenic environments transformed as a result of human activity*" [6].

That is why fungi are one of the components with which people live, work, rest, are treated, where for one reason or another they have been for a certain period of time, that is, "*in anthropogenic environments they have constant contact*"[7] . At the same time, "*microscopic fungi that migrate into the human body, depending on the state of the immune system, are also capable of causing certain diseases*"[8].

Therefore, due to the sharp change in environmental conditions in the period in which we live, the study of the taxonomic structure and their ecological features of the mycobiota, which is formed in the urban environment of various areas, in particular, has become a very necessary issue. Therefore, "*a wide range of research in this direction has been carried out in many parts of the world*" [7,8] for a long time. As a result of these studies, the number and species composition of mycobiota formed in anthropogenic environments of various purposes has been studied, and the fact that it is one of the main places of settlement and

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[4] Халдеева Е.В., Баязитова А.А., Лисовская С.А. и др. Микобиота почв городских территорий с различным уровнем антропогенной нагрузки// Гигиена и санитария, -2017, в.96(6), -с.505-508.

[5]Bruns, T.D. The developing relationship between the study of fungal communities and community ecology theory.// Fungal Ecol., -2019. v.39. -p.393–402.

[6] Бондаренко С.А., Георгиева, М.Л., Кокаева Л.Ю. и др. Первое обнаружение щелочеустойчивых грибов на побережье хлоридного озера Баскунчак / // Вестник МГУ, серия 16, Биология, -2019, v.74(2), p.73–79.

[7] Свистова, И., Назаренко, Н., Потапова, О. Влияние городской нагрузки на комплекс почвенных микромицетов (на примере левобережной части г. Воронежа).// Экология и промышленность России, -2016, № 20(9). -с.46–50.

[8] Hyde K.D., Chethanaa K.W.T.,.Ruvishika S. et al. The rise of mycology in Asia.// ScienceAsia 46S, 2020, -p.1-11.

nutrition of fungi in these environments, their seasonal character in both number and species composition of mycobiota of places where people live, work, rest and

"*This type of research has been found in the conditions of Azerbaijan*"[9,10,11], but, in these studies, a number of issues were not given due attention, primarily due to the Ecolo-trophical relationship of the taxonomic structure of fungi participating in the formation of mycobiota of one or another area and the comprehensive study of the forms of manifestation of Ecolo-trophical specialization. Although these issues can be considered as information useful for use in the recovery of environments from anthropogenic impact.

The purpose and subject of the research. In the presented work, the assessment of the mycobiota of the territories of Baku City used for various purposes by number and species composition, the study of the ecological characteristics of fungi participating in the formation of mycobiota was set as a goal.

In order to achieve the set goal, the implementation of the following tasks in the course of research was also considered expedient:

- Determination of mycobiota of selected areas of Baku by number and type composition;
- Evaluation of fungi, the distribution of which is recorded in the selected areas, according to their frequency of occurrence, ecotrophical relationships;
- Study of the influence of the seasonal factor on the number and species composition of mycobiotas of selected areas;
- Assessment of the share of fungi, the distribution of which is recorded in selected areas of Baku, in ecological functions.

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[9] Əsədova, Ş.F.Bakı şəhərinin atmosfer havasının mikobiotasının taksonomik quruluşu və şərti patogenlərin ekologiyası/b.ü.f.d.dissertasiyanın avtoreferatı/-Bakı, 2016, -24s.

[10] Rzayeva, A.L. Müxtəlif deqradasiya dərəcəsinə malik torpaqların mikoloji qiymətləndirilməsi / b.ü.f.d. dissertasiyasının avtoreferatı/-Bakı, -2016, 24s.

[11] Zeynallı, K.S. Abşeron yarmadasında antropogen təsirə məruz qalmış mühitlərin mikobiotası/b.ü.f.d. dissertasiyasının avtoreferatı/-Bakı, 2012, 24s

Research methods. The studies were carried out to clarify the role of fungal biota in the ecological functions distributed in the soils of areas used for various purposes in the urban environment, and ecological and mycological methods were used in this case. During sampling, the method of selecting permanent areas was used, and sampling was carried out by chapters. The repeatability of the samples taken was at least 4 times, and the results obtained were processed statistically. The degree of purity of the reagents used in the studies and the accuracy of the devices were also at the required level.

The main provisions of the dissertation defence.

- In urban environments, various areas are characterized as one of the favorable places for the spread of fungi, regardless of the purpose of their use;
- Although the areas studied are favorable for the spread of fungi, they participate in the formation of their mycobiota in specific species, along with universal ones;
- The fungi registered in the studies, regardless of their destination, are active participants in the realization of ecological functions such as production and destruction that occur in urban environments;
- At the heart of the activity of fungi spreading in areas used for various purposes in the urban environment is their attitude to environmental factors.

Scientific novelty of the research. The soils used in various purposes in Baku City were studied according to the number and species composition of mushroom biota, ecological characteristics of mushroom species participating in the formation of mycobiota of the studied areas.

In the course of the research, it was determined that 53 species of fungi participating in the formation of mycobiota of areas where educational and medical institutions and parks are located in Baku, 88.7% of them belong to Ascomycota and 11.3% to zygomycota departments.

It was clear that the use of the sampled areas also affects the formation of the mycobiota of that place, and 24 species of

registered fungi are found in all areas (universal species), 8 species in two areas (relative specific species), and 21 species in only one area (specific species). This difference also manifests itself during the analysis of mycobiota of territories according to Serensen's coefficient of similarity.

It was established that both the number and species composition of the fungi, the distribution of which was recorded during the study, are seasonal. Thus, the difference between the maximum and minimum indicators of the number of registered mushrooms is 2.20 -2.53 times, and in the species composition-1.67-1.88 times, and in all areas the highest indicator both in number and species composition falls on the beginning of summer (June), and the lowest on the beginning of winter (December).

It has been established that the recorded fungi differ in frequency of occurrence (RT) in the general areas studied, as 5 species of the recorded fungi are characterized by frequency of occurrence (RT=50.2-55.7), 26 species frequent (RT=11.2-44.7) and 22 species random and rare (0.03-8.9) species.

All fungi, the distribution of which has been revealed in studies, take an active part in the processes of both production and destruction occurring in nature, due to the fact that in relation to temperature they belong to mesophiles, in relation to humidity most of them belong to xerohydrophiles, and acidophiles predominate in relation to the acidity of the medium. The presence of phytopathogens among the registered fungi, as well as indicator species, makes it possible to note their active participation both in the regulation of biodiversity and in the process of indicating certain processes, primarily oil pollution.

Theoretical and practical significance of the research. The results obtained are factual material that serves to expand information of an informative nature about the ecological functions of the fungal biota distributed in areas used for various purposes in the urban environment.

The use of the results obtained in the studies in biomonitoring and biological diagnostics of territorial soils used for various purposes in the urban environment, during Environmental Impact

Assessment and in other nature conservation processes may be useful.

Approbation and applications. On the topic of the dissertation have been published 19 scientific papers. The dissertation materials were presented at the scientific and practical conference on "Actual problems of modern biology" (Baku, 2018), the Republican Conference on "Modern Problems of Biology" (Sumgait, 2018), the XXXI International scientific conference on "Trends in the development of Modern scientific" (Canada, Vancouver, 2021), conferences "Actual problems of education and science at the International Scientific and Practical Conference" (Russia, Moscow, 2022), at the III International Conference of Caspian Studies (Baku, 2022), "New trends and innovations: Prospects for the development of microbiology in Azerbaijan" (Baku, 2022) and a report to the 6th International Congress of Applied Sciences (Turkiye, Ankara, 2022).

Organization where the dissertation work was performed. The main part of the dissertation was performed at the Azerbaijan State Agrarian University, a certain part at the Institute of Microbiology of the Ministry of Science and education of the Republic of Azerbaijan.

Volume and structure of the disseratation. The dissertation totals 210,500 marks, which consists of 150 computer pages.

CHAPTER I
GENERAL CHARACTERISTICS OF THE MYCOBIOTA OF DIFFERENT FACILITIES IN THE URBAN ENVIRONMENT (RESIDENCE, RECREATION, WORK, HOSPITAL, EDUCATION, ETC.)

In Section 1.1 of the dissertation, information about soils used for various purposes in urban environment is analyzed in accordance with the requirements of modern times, methods and approaches used in their systematization in modern times are touched upon.

In Section 1.2 of the dissertation, the results of studies on the participation of living beings participating in the biota of urban soils and one of their significant groups, fungi, in the ecological functions performed in urban soils are touched upon, in this regard, the current state of research carried out in Azerbaijan is assessed.

CHAPTER II
MATERIALS AND METHODOLOGY OF THE RESEARCH

2.1. General characteristics of the researched areas

The research was carried out in Baku. "*The total area of the Absheron Peninsula is 0.222 million ha, of which 86.5% (0.192 million ha) falls on Baku. 26.3% of the territory of Baku is occupied by arable land, 17.6% by residential areas, 13.5% by oil fields. 11.7% of the territory falls on unused lands, which are polluted with oil, salted, rocky places, etc. included*" [12] . The choice of Baku as a research area is also due to the fact that Baku today reflects all the features that stand out in the modern urbanization process from the effects associated with industry, transport and construction.

2.2. Methods used for analysis

The samples for analysis in the studies are mainly from 3 places of Baku City, which differ in their destination, i.e. the areas of educational institutions, (EI) hospitals (H) and Recreation Parks (RP), as well as some buildings located close to those areas (residential, classrooms, hospitals, etc.). house dust). Sampling was carried out by chapters, which was carried out in the first month of each chapter. More than 500 samples were taken in the course of research and analyzed in accordance with the set goal. Taking samples and analyzing them in the laboratory "*methods and*

[12] Гахраманова, Ш.Ш.Техногенное загрязнение почв Апшерона// Академический вестник УралНИИпроект РААСН, -2012, №1, с.25-30

approaches used by ecologists, mycologists and microbiologists" [13,14] have been used now.

Fungi extracted into pure culture by known methods in standard nutrient media identification as species is carried out according to "*determinants*"[15,16,17], compiled on the basis of cultural-morphological and physiological-biochemical characteristics of fungi.

Clarification of the systematics and names of mushrooms was carried out according to the data on the "*official website*"[18] of the International Association of Mycology.

The number composition of mushrooms is determined "*according to the formula*" [19], which is shown below:

N =abc/d

Here, N is the number of fungal colonies (KV/G of soil), a is the number of colonies in the Petri dish (PCs), b is the amount of dilution(Times), c is the number of drops in 1 ml of suspension (PCs), and d is the amount of soil taken for analysis in grams.

The frequency of occurrence of fungi (RT) was also used to comprehensively characterize the distribution of fungi in the studied biotopes. For its calculation, the formula RT (%)=(n/N)x100 was used, which indicates n – the total number of samples taken (PCs), n - the number of samples in which the fungus was detected in the

[13]Методы экспериментальной микологии. Справочник.//И.А.Дудка, С.П.Вассер, И.А.Элланская [и др.]. -Киев: «Наукова думка», 1982, 550 с.

[14]Практикум по микробиологии/А.И.Нетрусов, М.А.Егорова, Л.М.Захарчук [и др.] -М. : Издательский центр «Академия», -2005, -608с.

[15]Милько, А.А. Определитель мукоральных грибов./А.А.Милько. -Киев: Науково думка, -1974, -303с.

[16] Саттон, Д. Определитель патогенных и условно патогенных грибов/ Д.Саттон, А.Фотергилл, М.Риналди, -Москва: Мир, - 2001, - 486с

[17] Kirk, P.M. Dictionary of the fungi/ P.M.Kirk, P.F.Cannon, D.W.Minter [et al.]. — UK:CABI, -2008, -747 p.

[18] https://www.mycobank.org

[19] Мирчник, Т.Г. Почвенная микология./Т.Г.Мирчник. -М.:Из-во МГУ, -1988, -220с.

samples taken (PCs). When determining the phytotoxic activity of soils, taking into account the moisture content (according to dry weight), a 2% slurry is prepared by mixing in a magnetic mixer at room temperature for a period of 10 hours (every 3 minutes) at intervals of 10 minutes. After the expiration of the period, the suspension is separated by centrifugation and the obtained solution is used as a source, which is a carrier of toxic substances. The obtained are placed in soaking for 15-16 hours, and then their germination capacity is checked. In this case, sterile water was used as a control, which was used in the preparation of a suspension from the soil.

The assessment of the share of participation of the registered fungi in the ecological functions occurring in the research areas was determined on the basis of literature data and experiments carried out in the course of the work.

During sampling and analysis, repeatability was at least 4 times, all quantitative data were "*statistically processed*"[20], and data corresponding to the formula $m/M \leq 0.05$ were used for the degree of honesty of the results.

CHAPTER III
ASSESSMENT OF THE MYCOBIOTA OF DIFFERENT PURPOSE FACILITIES IN THE CITY OF BAKU ACCORDING TO SPECİES AND NUMERICAL COMPOSITION

3.1. Evaluation of the mycobiota of different designated areas by number and designation

In connection with the study of mycobiota for its species composition, soil samples taken from the areas of Baku City used for various purposes were analyzed and as a result, 53 species of fungi settled in those areas were found during the research (table. 3.1).

[20] Плохинский, Н.А. Биометрия./Н.М.Плохинский. -М.:Из-во МГУ, -1998, -150с.

Table 3.1

Characterization of mycobiota of individual areas under study by species composition

Number of species recorded in individual areas (pieces)		
EI	H	P
41	35	32

As can be seen, the use designations of the territories affect in some way the species composition of the mycobiota of the area. Thus, according to the species composition of the individual mycobiota of the sampled places, the areas with educational institutions are relatively richer, and 77.4% of the total mushrooms recorded are found there. Hospitals account for 66.0% of the total mycobiota, while parks account for 60.4%.

When we characterize the registered mushrooms by N taxonomic Relation Departments, it becomes clear that 47 species of registered mushrooms belong to *Ascomycota* and 6 species to *Zygomycota* clades.

It is also worth mentioning the species of fungi that belong to the sacs, which is due to their characterization according to the presence or absence of the sacs stage. Thus, they divide the marsupial fungi in two according to their reproduction, which is only those that reproduce asexually(anamorphs), and those that reproduce both asexually and sexually(telemorphs). When we characterize the fungi recorded in the studies in this aspect, it is clear that the vast majority of the fungi recorded belong to anamorphs, while *Chaetonium globosum* alone belongs to telemorphs.

The fact that the species of fungi involved in the formation of the mycobiota of individual areas took part in different combinations is also one of the data recorded in the studies. This clearly manifested itself when comparing micromycetes separated from individual territories in terms of species composition, since in conditions of anthropogenic impact, along with General species, “specific” species participate in the formation of mycobiota of one or another territory. So, while some species of mushrooms are found in every 3 areas of the sample, some are observed in 2 or 1 areas (table 3.2). As can be seen,

the number of universal species is equal to 24, the number of relative specific species is equal to 8, and the number of specific species is equal to 21. The latter, that is, of those characterized as specific species, the largest number is found in samples taken from the territory of educational institutions (table 3.3). The reason for this, in our opinion, is due to the fact that the areas of educational institutions, especially schools, face the human factor more intensively, and the geography of their accumulation is also characterized by greater diversity.

Table 3.2.

Combination of participation of registered mushroom species in the formation of mycobiota of individual territories

Distribution	Suitable varieties
Universal varieties	*Alternaria alternata, Aspergillus candidus, A.flavus, A.niger, A.ochraceus, A.versicolor, Botrytis cinerea, Chaetonium globosum, Cladosporium herbarum, C.macrosporum, Fusarium sporotrichioides, Humicola grissa, Mucor circinelloides, M.plumbeus, M.racemosus, Paecilomyces variotii, Penicillium brevi-compootum, P.citrinum, P.chrysogenum, P.janthinellum, P.purpurogenum, Phoma herbarum, Rhizopus nigricans, Sporothrix alba* və *Ulocladium chartarum*
Relative specific type	*Aureobasidium pullulans, Eurotium amstelodami, Pencillium claviforme, Trichophyton terrestre*
Specific types	*Acremonium atrogriseum Alternaria tenuissima, Aspergillus terreus, Aureobasidium pullulans, Cephalotrichum nanum, Chrysonilia sitophila, Chrysosporium merdarium, Cladosporium cladosporiodes, Eurotium amstelodami, Fusarium oxysporium,* *Geotrichum candidum, Gliomastix murorum, Penicillium canescens, P. claviforme, P. decmubens, Penicillium spinulosum, Phoma glomerate, Trichoderma atroviride, T.asperellum, Trichophyton terrestre və Trichothecium roseum*

Table 3.3

General characteristic of mushrooms found in only one area in the course of research

EI	H	P
Alternaria tenuissima *Aspergillus nidulans* *Chrysosporium merdarium* *Geotrichum candidum* *Gliomastix murorum* *Mucor hiemalis* *Pencillium decmubens* *Phoma glomerata* *Stachybotrys chartarum* *Talaromyces rugulosus*	*Aureobasidium pullulans* *Eurotium amstelodami* *Pencillium claviforme* *Trichophyton Terrestre*	*Aspergillus terreus* *Cephalotrichum nanum* *Chrysonilia sitophila* *Cladosporium cladosporiodes* *Pencillium canescens*
10	***4***	**5**

Thus, as a result of the studies carried out at this stage, the species composition of mycobiota belonging to urban soils used for various purposes was as follows..

1.EI. *Acremonium atrogriseum, A.charticola, Alternaria alternata, A.tenuissima, Aspergillus candidus, A.flavus, A.fumigatus, A.nidulans, A.niger, A.ochraceus, A.versicolor, Botrytis cinerea, Chaetonium globosum, Chrysosporium merdarium, Cladosporium herbarum, C.macrosporum, Fusarium sporotrichioides, Geotrichum candidum, Gliomastix murorum, Humicola grissa, Mucor circinelloides, M.hiemalis, M.plumbeus, M.racemosus, Paecilomyces variotii, Penicillium brevi-compootum, P.citrinum, P.chrysogenum, P.decmubens, P.janthinellum, P.purpurogenum, Phoma glomerata, Ph.herbarum, Rhizopus nigricans, Sporothrix alba, Stachybotrys chartarum, Talaromyces*

rugulosus, Trichothecium roseum, T. viride və *Ulocladium chartarum;*

2.H. *Acremonium atrogriseum, A.charticola Alternaria alternata, Aspergillus candidus, A.flavus, A.niger, A.ochraceus, A.versicolor, Aureobasidium pullulans, Botrytis cinerea, Chaetonium globosum, Circinella circinans, Cladosporium herbarum, C.macrosporum, Eurotium amstelodami, Fusarium sporotrichioides, Humicola grissa, Mucor circinelloides, M.plumbeus, M.racemosus, Paecilomyces variotii, Penicillium brevi-compootum, P.citrinum, P.chrysogenum, P.claviforme P.janthinellum, P.purpurogenum, Phoma herbarum, Rhizopus nigricans, Sporothrix alba, Trichophyton terrestre* və *Ulocladium chartarum.*

3.RP. *Alternaria alternata, Aspergillus candidus, A.flavus, A.fumigatus, A.niger, A.ochraceus, A.terreus, A.versicolor, Botrytis cinerea, Cephalotrichum nanum, Chaetonium globosum, Chrysonilia sitophila, Cladosporium cladosporiodes, C.herbarum, C.macrosporum, Fusarium sporotrichioides, Humicola grissa, Mucor circinelloides, M.plumbeus, M.racemosus, Paecilomyces variotii, Penicillium brevi-compootum, P.canescens, P.citrinum, P.chrysogenum, P.janthinellum, P.purpurogenum, Phoma herbarum, Rhizopus nigricans, Sporothrix alba Trichothecium roseum, T. viride* və *Ulocladium chartarum.*

The similarity of mycobiota, characteristic of this or that area, also allows us to note the fact that various rash processes occurring in them occur in a similar way, so that in studies of an ecological nature, Serenson's species similarity coefficient is used for this purpose. Taking this into account, we also found it appropriate in the studies to characterize the mycobiota, which is characteristic of individual areas, also according to the coefficient of similarity. From the results obtained, it was clear that the coefficient of similarity between mycobiota typical of the areas of educational institutions and mycobiota of Parks is the least, and the one of educational institutions and hospitals is the closest (table 3.4).

Table 3.4.

Characterization of the Mycobiota of the studied areas according to the coefficient of similarity of species by Serensen

Areas studied	EI	H	P
EI	100	78,9	65,7
H	78,9	100	71,6
P	65,7	71,6	100

The similarity between parks and the mycobiota of hospitals, on the other hand, is moderate, that is, it is located between the two mentioned.

3.2. Seasonal changes in mycobiota composition and number of species of different designated areas

During the characterization of the mycobiota of the studied areas according to the species and number composition, it became clear that mushrooms are observed with the greatest number in June (early summer), and with the least number in December (early winter), which manifests itself in both the number and species composition of mushrooms (table 3.5). Apparently, this circumstance keeps itself at the same time in separate areas, that is, both quantitative and qualitative indicators of mushrooms in the winter season in all cases, regardless of the purpose of use, are characterized by a relatively low indicator. As for the number and species composition of mushrooms on individual territories, as can be seen, the territory of recreation parks is characterized by the lowest indicator in number.

Table 3.5.

Characteristics of mycobiota of the studied areas by number (x103 KV/G) and species composition

Sampling locations	December (number/type)	March	June	September
EI	1,6/24	2,4/32	3,6/41	3,4/38
H	1,3/21	2,2/27	3,3/35	3,1/31
P	1,0/17	1,6/21	2,2/32	2,0/28

In this case, the number of fungi is highest in soil samples taken from the yard of educational institutions.

CHAPTER IV
ECOLOGICAL CHARACTERISTICS OF FUNGAL BIOTA OF SOILS USED FOR DIFFERENT PURPOSES IN THE URBAN ENVIRONMENT

4.1. Evaluation of recorded fungi according to frequency of occurrence

It should be noted that one of the tasks that is important to solve in terms of clarifying the role of fungi in the processes occurring in one or another biotope is to determine the frequency of occurrence (FO) of fungi in that biotope. From the point of view of this characteristic, micromycetes are divided into dominants (FO≥50%), frequent ones (10%≥FO<50%) and random and rare types (FO<10%). When evaluating mushrooms from this aspect, it became clear that among mushrooms, the lowest number corresponds to dominants (5 species), and the highest number to frequent ones (26 species) (table. 4.1). Apparently, random and rare species, on the other hand, participate with 22 species in the formation of the mycobiota of the studied areas.

Among the registered mushrooms, the highest incidence is *Aspergillus niger* (55.7%), and the lowest is the fungus *Chrysonilia sitophila* (0.03%).

Table 4.1.

Characterization of fungi found in studies by frequency of occurrence

FO (%)	Suitable incoming varieties
Dominant species (50,2-55,7)	*Aspergillus niger, Cladosporium herbarum, Mucor racemosus, Pencillium chrysogenum, Rhizopus nigricans*
Frequently encountered species (11,2-44,7)	*Acremonium charticola, Alternaria alternata, Aspergillus candidus, A.flavus, A.fumigatus, A.ochraceus, A.versicolor, Botrytis cinerea, Chaetomium globosum, Circinella circinans, Cladosporium cladosporiodes, C.macrosporum, Fusarium sporotrichioides, Humicola grissea, Mucor circinelloides, M.hiemalis, M.plumbeus,Paecilomyces variotii, Penicillium brevi-compootum, P.citrinum P.janthinellum, P.purpurogenum, Phoma herbarum, Rhisopus stolnifer, Trichothecium roseum* və *Ulocladium chartarum*
Casual and rare species (0,03-8,9)	*Acremonium atrogriseum, Alternaria tenuissima, Aspergillus nidulans, A. terreus, Aureobasidium pullulans, Cephalotrichum nanum, Chrysonilia sitophila, Chrysosporium merdarium, Eurotium amstelodami, Geotrichum candidum, Gliomastix murorum, Penicillium canescens, P. claviforme, P. decmubens, Phoma glomerate, Sporothrix alba, Stachybotrys chartarum, Talaromyces rugulosus, Trichoderma atroviride, T.asperellum, T.wiride* və *Trichophyton terrestre*

During the characterization of the recorded mushrooms according to toxigenicity, it became clear that the toxigenicity of almost half of the recorded mushrooms was confirmed in various studies. For example, *Alternaria alternata, A.tenuissima, Aspergillus candidus, A.fumigatus, A.flavus, A.nidulans, A.niger,*

A.ochraceus, A.versicolor, Botrytis cinerea, Cladosporium cladosporiodes, C.herbarum, Fusarium sporotrichioides, Paecilomyces variotii, Penicillium brevi-compootum, P.citrinum, P. claviforme, P.chrysogenum, P.decmubens, P.janthinellum, P. purpurogenum, Phoma glomerate, Ph.herbarum, Rhisopus stolnifer, Stachybotrys chartarum, Trichothecium roseum, Ulocladium chartarum and etc mushrooms can be an example of this.

Taking into account the change in toxigenicity at the strain level, it was also considered appropriate to carry out the phytotoxicity of some fungi on the example of pure culture-derived fungi in our studies. From the results obtained, it became clear that according to the literature data, all the strains of the fungi, whose toxigenicity is known, recorded in our studies, have a toxic effect.

The fact that the specific weight of toxigenes is sufficient among the registered fungi is assessed negatively, and it is advisable to take into account this, that is, to take preventive measures aimed at limiting the activity of toxigenic fungi in these areas.

4.2. Evaluation of participation share of fungal biota recorded in urban soils in ecological processes

First of all, it should be noted that, in the words of most researchers, the ecological functions occurring in nature are divided into 4 areas, such as production(synthesis of various substances), destruction(decomposition of organic substances in nature), regulation (regulation of the number of species in biodiversity) and indication (indication of IndiGo properties in recording processes occurring in nature). When characterizing the fungi recorded in the studies based on this division, it became clear that the number of fungi involved in both the production and destruction process significantly exceeds the number of species involved in the performance of the other two functions, more precisely, all the fungi recorded are involved in the performance of these two functions. Despite the fact that all of the registered fungi are involved in the performance of the functions of destruction and production, the

activity indicator of their participation in these processes may be different. More precisely, the ability to synthesize this or that substance or to degrade any substance is a matter related to the genome of the organism, including fungi, but environmental factors of the environment also play a certain role in its disclosure, more precisely in the formation of a quantitative indicator of activity. From this point of view, if we look at the results of studies conducted in Azerbaijan on the registered mushrooms, it becomes clear that among the registered mushrooms there are no species that differ sharply in ecological parameters. So, most of the recorded fungi belong to mesophiles in relation to temperature, that is, those whose optimum temperature is within 28±40C (table. 4.2). It is true that among the registered fungi, those that retain their viability above 400C are also found, but they cannot be considered thermophilic, since currently their thermophiles are divided into two: thermotolerants and true thermophiles. For the former, the optimum temperature can be attributed to those in the range of 40-500C, and for the latter-higher than 550C. Among the registered mushrooms, such are not found. The mushrooms recorded in relation to moisture carry slightly different characteristics, and among them both hydrofiles and xerohydrofiles and mesohydrofiles are found (table 4.3).

Table 4.2

Characterization of fungi involved in the formation of mycobiota of the studied areas by their attitude to temperature

Sampling locations	According to the temperature attitude (%)		
	Psychrophile (optimum temperature $\leq 20^0$C)	Mesophilic (optimum temperature 28 ± 4^0C)	Thermophilic (optimum temperature $>40^0$C)
Educational institutions	0	100	0
Hospitals	0	100	0
Parks	0	100	0

The pH of the medium for the growth of fungi, which is also recorded in relation to pH, is considered favorable in all cases below 7, which can also be taken as another confirmation of the literature information that the medium for the growth of fungi is acidic in all cases (table. 4.4).

Thus, the fungi recorded in the studies consist of species operating within the limits of environmental indicators characteristic of fungi as participants in the production and destruction process. Nevertheless, it would be appropriate to touch upon one point here. So, to check the durability of materials, they use a number of fungi as a test culture, and the selection of those fungi also includes a number of different types of them(construction, coating, protective, etc.).) higher activity(sometimes this is also called aggressiveness) is shown in relation to the intended materials. As a rule, these mushrooms include *Alternaria alternate*, *Asergillus niger*, *A.flavus,* Aspergillus terreus, *A.versicolor, Aureobasidium pullulans,*

Table 4.3

The attitude of fungi to moisture, which is involved in the formation of mycobiota of the studied areas

Sampling locations	According to the attitude to temperature (%)		
	Hydrophil	Xerohydrophil	Mezohydrophil
Educational institutions	25,9	47,4	26,7
Hospitals	27,6	41,2	31,2
Parks	31,4	39,5	29,1

Fusarium moniliforme, Penicillium brevicompactum Penicillium chrysogenum, Rhizopus oryzae, Cladosporium herbarum, Trichoderma citrinoviride, T.viride, Chaetomium

Table 4.4

The attitude of the fungi involved in the formation of the mycobiota of the studied areas to pH

Sampling locations	By temperature relation (%)		
	Asidophil	Neytrophill	Alkolophil
Educational institutions	100	0	0
Hospitals	100	0	0
Parks	100	0	0

globosum, Stachybotrys chartarum and so on, they use varieties such as. In this regard, if we approach the mushrooms recorded, it can be noted that most of them are also found here, that is, the level of activity of mycobiota is generally high, which most often manifests itself in the lands in the courtyards of educational institutions.

Regarding the participation of fungi in the regulation of biodiversity, it should be noted that although true biotrophs are not found among the registered fungi, their phytopathogenicity is not low in the known species. For example, *A.alternata* (alternariosis), *A.tenuissima* (alternariosis), *B.cinerea* (Gray rot) *F.sporotrichioides* (fusariosis), *Ph. herbarum* (fomoz), *T.roseum* (pink mold). The fact that such fungi cause various diseases in plants is confirmed by facts. T.roseum it is the facts that have been confirmed that fungi such as roseum cause various diseases in plants. In addition, among the fungi recorded are other species that are involved in the occurrence of mold. More precisely, the recorded fungi are also actively involved in the regulation of biodiversity.

As for the indicator function, this issue is one of those that are currently being widely studied, and there are certain data that some species of the genus Trichoderma, which are among the fungi recorded, are indicators of oil pollution. In addition, in the studies carried out, *G.candidum* fungus is noted as an indicator of

high dust content in the environment, and this fungus has been found in our studies.

It would also be appropriate to dwell on one issue related to the role of fungi in ecological functions, which is associated with toxicosis of soils. As a result of their vital activity, many fungi form various metabolites, among which, according to practical considerations, both useful and harmful ones can be found, that is, some of them stimulate the growth of other living beings inhabiting soils, primarily plants, while others cause an increase in the background indicator of their toxicity inherent in soils. As a result, there are impairments in the biological productivity of living beings inhabiting the soil, primarily higher plants. How this circumstance occurs on urban lands is of certain interest, both from a scientific and practical point of view, which is why it was considered appropriate to clarify this issue in studies as well. In order to clarify this issue, it was evaluated for phytotoxic activity of soils that differ significantly in number composition, but are in the same area. From the results obtained, it became clear that the phytotoxic activity of soils changes in accordance with the change in the number composition, and this variability is mainly accompanied by an increase in phytotoxic activity in accordance with the increase in the number composition.

FINAL ANALYSIS OF RESEARCH

One of the characteristic features of the modern era is the growth of human intervention in the environment against the background of global climate change, and as a result of this, the formation of anthropogenically transformed environments. One such environment is typical of cities. Thus, the decisive factor in the formation of the urban environment is anthropogenic influence, but the Customs and customs of people living in individual cities, the individuality of their attitude to the environment also have an impact on the urban environment, as a result of which a specific environment is formed in cities in a

certain sense. In turn, it is inevitable to take into account the specificity in the work aimed at studying the processes taking place in the urban environment, more precisely, there are no quantitative and qualitative indicators that are the same for all cities.

Baku is also among the major cities of the world, but only the environmental conditions of the region in which it is located, natural soil and climatic conditions are characterized as an urboecosystem with specific features. If we add to this opinion that Baku is not only the largest city in the country, but also the largest industrial center in the country, but a significant part of its territory is suitable for cultivation and is used for this purpose, and the complex environmental situation in all this gives additional shades, then the need to conduct research in terms of In all this, it has been set as a goal to carry out studies dedicated to the assessment of the environmental situation in Baku with appropriate methodical approaches to research carried out in the world.

It was considered expedient to use as objects both soils used in various purposes in Baku City and fungi as soil biota.

Based on the above-mentioned, samples were taken from the areas used for various purposes in Baku, i.e. the lands of the areas where educational institutions , hospitals and city parks are located, the selected areas were evaluated according to the physical-chemical characteristics, the number and species composition of mycobiota, the frequency of occurrence of fungi participating in the formation of mycobiota, ecotrophical As a result of these studies, 6 final conclusions and 2 practical recommendations were expressed.

MAIN RESULTS

1. It has been established that 53 species of real fungi are involved in the formation of mycobiota of the lands located in the territory of Baku and used for various purposes (educational institutions, hospitals and parks), of which 88.7% of real fungi

(Mycota) belong to Ascomycota and 11.3% to zygomycota clades.

2. It has been established that the formation of mycobiota is also influenced by the purpose of the territory, and in the formation of mycobiota of individual territories, both specific(found in only one territory), relative specific(in 2 territories in different combinations) and universal(in all territories) species with different numbers participate. So, the number of universal species is equal to 24, the number of relative specific species is equal to 8, and the number of specific species is equal to 21.

3. Aydın olmuşdur ki, tədqiq edilən ərazilərdə qeydə alınan növlərin Serensenin oxşarlıq əmsalına görə analizi tədris müəssisələrinin ərazilərinə xas mikobiota ilə parkların mikobiotasının daha uzaq, tədris müəssisələri ilə xəstəxanalarınkının isə nisbətən yaxındır.

4. It has been established that the number of fungi participating in the formation of mycobiota of the studied areas is most observed in June (early summer) and least in December (early winter), which manifests itself in both the number and species composition of fungi. Thus, the number of fungi participating in the formation of the mycobiota of educational institutions varies from 1.6-3.6x10^3 g of soil, and the species composition ranges from 24 to 41 species. The similar indicator is 1.3-3,3x10^3 and 21-35, 1.0-2,2x10^3 and 17-32 types in hospitals and parks, respectively.

5. It has been established that the recorded fungi differ in frequency of occurrence (FO) in the studied general areas, as 5 species of the recorded fungi are characterized by frequency of occurrence(RT=50.2-55.7%), 26 species frequent (FO=11.2-44.7%) and 22 species random and rare(0.03-8.9%) species.

6. In determining the share of fungi, the distribution of which was revealed in the studies, in the ecological functions occurring in nature, it became clear that all of them are actively involved in both the production and destruction processes, and

this allows their active activity in the environment in which they spread to be mesophilic in relation to temperature, most of them in relation Thus, the natural climate and soil indicators of the city of Baku are favorable for organs bearing these signs. Among the registered fungi, the presence of phytopathogens, as well as IndiGo species, allows us to note their active participation both in the regulation of biodiversity, as well as in the indication process of certain processes.

PRACTICAL RECOMMENDATIONS

1. When assessing the ecological state of any biotope, be it water or soil, either chemical or biological indicators are used, and in this case the "*is used permissible concentration limit (PCL)*"[21]. Thus, during the influence of any factor, agent on a person, yvqh can manifest or implicitly indicate immunological reactions to biological change (disease, change in its reactivity, violation of physiological cycles, psychological disorders, etc.) is a non-causal quantity indicator. As a rule, PCL is used for various purposes, primarily in the assessment of chemical, nutrient microbiological contamination of soils and waters. Despite the fact that the methodological approaches that are currently being implemented and define PCL are easy, but their use is not always justified. Firstly, in most cases, these indicators are applied without taking into account regional factors, and secondly, the numbers intended for PCL are used in most cases, especially in biological indicators (for example, bacteria, yeast fungi, mold fungi, etc.) that in our opinion it is unacceptable. So, the one that is involved in the formation of that number, but is characterized by pathogenicity, toxigenicity, allergenicity, etc. biological agents that differ in properties are mentioned in general terms. Therefore, in order to ensure that the soils

[21]Семенков И., Королева Т. Мировой опыт нормирования содержания химических элементов в почве // Экология и промышленность России, - 2019, т.23, №2. -с.62-67

currently in the urban environment are ecologically safe for humans, it is necessary to develop methodological approaches that make it possible to identify biological indicators, including those that include the dangerous aspects of fungi, according to indicators.

2. It is advisable to use selective antagonism of fungi among themselves, as well as plants containing components that limit the growth of fungi in order to limit the activity of fungi, the distribution of which is determined in the studied urban lands.

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