



## General characteristics of new and some rare species of Azerbaijan mycobiota

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### Abstract

During research carried out since 2016 were taken samples from ecologically different regions of Azerbaijan and in the based of them 78 species of fungi were taken to the pure culture and identified. Became clear that, species such as *Aspergillus repens*, *A. restrictus*, *Ascosphaera apis*, *Circinella muscae*, *Penicillium echinulatum* and *Zygorhynchus heterogamus* are new for the mycobiota inherent to the nature of Azerbaijan. While information about the spread of species like *Aspergillus awamori*, *Rhizopus stolonifer*, *Rh. microsporeus*, *Trichoderma asperellum* and *Trichothecium roseum* is known in Azerbaijan, they are characterized as rare species for Azerbaijani nature today.

**Keywords:** The Republic of Azerbaijan, mycobiota, species composition, new and rare species.

### Introduction

Recently, anthropogenic effects on the environment have risen to a rising line, which firstly influences to the environment and living things. It is no coincidence that today scanty of biodiversity has become one of the global environmental problem and its prevention is one current problems, facing of modern biological sciences [Muradov P.Z., et al., 2016; 2018]. The primary task in solving this issue is the clarification of features of the species of biodiversity of this or that ecosystem and their frequency of coincidence in those ecosystems, ecology trophic specialization, and so on.

It is estimated that biodiversity creatures currently contain 8,7 million species on Earth, and only 14-20% of them are known to science [<http://www.membrana.ru/particle/16627>]. Among the listed creatures, fungi are one of the most open and interesting objects for research, which performs extensive and motley ecological functions [Bakhshaliyeva K.F., 2017]. Fungi have recently

attracted attention as an indicator of some of the processes that happen in nature.

The fungi with highly adaptive properties is a constant component of the heterotrophic block of any ecosystem where is present organic matter and also actively participate in all processes taking place in that ecosystem [Samson R.A., Pitt J.I., 2000]. Therefore, their comprehensive investigation is crucial to the understanding of the processes occurring in those or other ecosystems, especially those present in anthropogenic conditions.

Taking this into account, for a long time, in this direction in Azerbaijan is also studied fungi biotype in various aspects [Bakhshaliyeva K.F., 2017, Hadciyeva N.Sh., 2017, Muradov P.Z., et al., 2016; 2018, Safarova A.Sh. et al., 2018]. Although many issues have been clarified in the researches, the discoveries of new species for the microbiota, which is inherent in the nature of Azerbaijan, allows to say is need to carry out research in this direction.

Given the importance of this, the purpose of the present study is dedicated to providing information about the fungi that have been found for the first time in recent studies, as well as rare species recorded in Azerbaijan.

Samples used for the identification of fungi were taken from the ecologically different regions of Azerbaijan (Greater Caucasus, Small Caucasus, Kur-Araz lowland and Talish Mountains). In research was taken soil, plant and water samples from sources of above mentioned areas. Soil and plant samples were taken from widespread soil types, cultivated and wild herbal plants inherent to all above-mentioned areas. During taking sampling were used known methods based on the selection of permanent areas and routes widely used in mycology and microbiological studies [Jennifer L.K. et al., 2006, Methods of soil..., 1991, Methods of experimental..., 1982, Netrusov A. et al., 2005].

In all cases, for the taking fungi to the pure cultures were used from standard nutrient environments, namely from malt juice agar (MJA), Chapek agar (CA), rice agar (RA), potato agar (PA). This nutrient environment was also used for the storage of worker cultures.

After carrying to the pure cultures of fungi collected from all of seasons as samples were conducting its identification by determinant compiling on the basis of culturally-morphological and physiological signs [Kirk P. M., 2002, Kirk P. M. et al., 2008, Milko

A.A., 1974, Sattou D. Et al., 2001]. During systematization and naming of fungi were used the information given on the official website of the International Mycological Association [http://www.mycobank.org/MycoTaxo.aspx].

Since 2016, in researches has been found 78 species of fungi belonging to the kingdom of Mycota that some of them were registered for the first time. Although information about to spread of some fungi in Azerbaijan is available on some sources, there is no information about their to spread substrate and region of the country where were taken the sample. Information about these fungi was annotated below:

***1. Aspergillus repens (Corda) Sacc., Michelia 2 (8): 577 (1882) [MB#185694].*** Syn.: *Aspergillus glaucus* var. *repens* Corda, *Icones fungorum hucusque cognitorum* 5: 53, t. 2:24 (1842) [MB#156724]; *Aspergillus reptans* Samson & W. Gams, *Advances in Penicillium and Aspergillus Systematics*: 48 (1985) [MB#114714].

The colony is white, yellowish (color from white to yellow), mycelium with partition, color of back side of colonium is unchanged and high density (Fig. 1A). Growth is not limited, and the edges are becoming yellow. The conidia is in the form of a sphere, under of microscope, the central part is more distinctly (Fig. 1B). Under the microscope, the appearance is reminiscent of carnation.

A



B

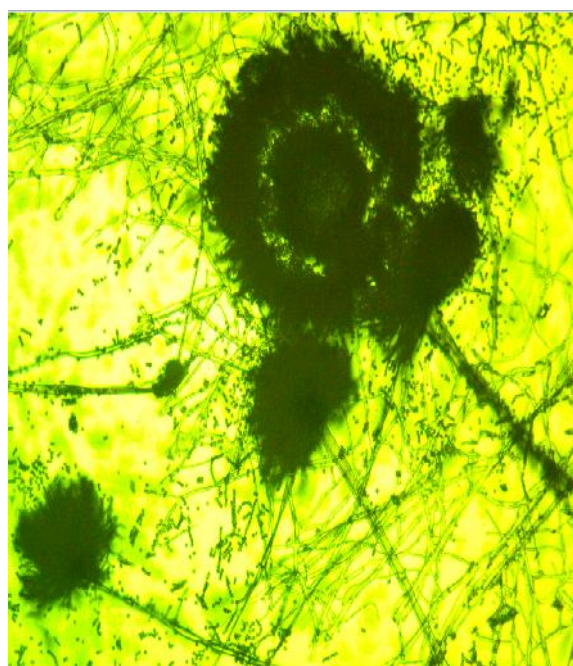


Fig. 1. General view of colonies and conidia of *Aspergillus repens*.

Fungi were found in the sample taken from the relatively clean soil in the Greater Caucasus and were taken to the pure cultures. The registration of these fungi in the territory of Azerbaijan is the first time.

**2. *Aspergillus restrictus* G. Sm., J. Textile Res. Inst.: 115 (1931) [MB#276290].** Syn.: *Aspergillus restrictus* var. *B* G. Sm., *Journal of the Textile Institute: 1115 (1931) [MB#124022]*; *Penicillium fuscoflavum* S. Abe, *Journal of General and Applied Microbiology Tokyo 2 (1-2): 64 (1956) [MB#302398]*.

The colony is white (Fig. 2A), mycelium with partition, the color of the back side of colonium is unchanged. Growth is not limited. Edges have not changed shape. The conidia are in the form of the cluster (Figure 2B).

The fungi were found in samples taken from the forest lands rich in plant remnants in the Greater Caucasus (Guba region) and were taken to the pure culture. The registration of these fungi in the territory of Azerbaijan is the first time.

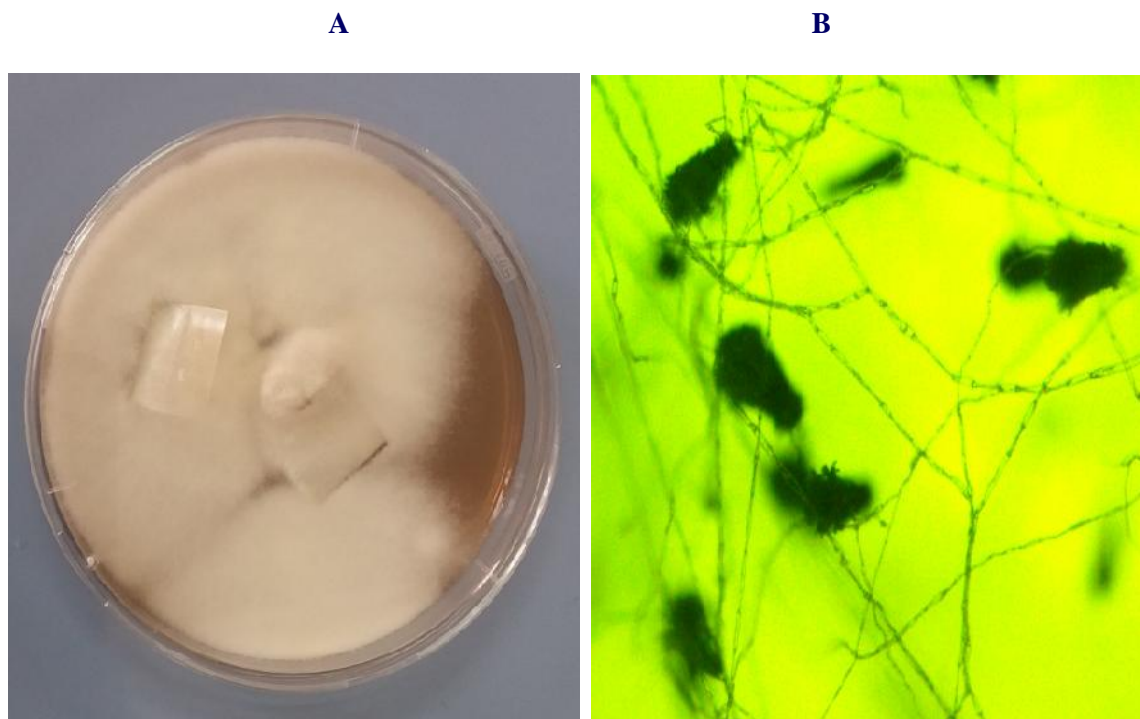


Fig. 2. General view of colonies and conidia of *Aspergillus restrictus*.

**3. *Aspergillus awamori* Nakaz., Rep. Gov. Res. Inst. Formosa: 1 (1907) [MB#119955].** Syn.: *Aspergillus niger* var. *awamori* (Nakaz.) Al-Musallam, *Revision of the black Aspergillus species: 60 (1980) [MB#118405]*; *Aspergillus longobasidia* Bainier, *La Cellule 43: 227 (1934) [MB#253086]*; *Aspergillus pseudocitricus* Mosseray, *La Cellule 43: 228-229 (1934) [MB#254148]*; *Aspergillus pseudoniger* Mosseray, *La Cellule 43: 203-285 (1934) [MB#472168]*; *Aspergillus miyakoensis* Nakaz., *Simo & A. Watan., Bull. agric. chem. Soc. Japan: 963 (1936) [MB#253392]*; *Aspergillus awamori* var. *fuscus* Nakaz., *Simo & A. Watan., Bull. agric. chem. Soc. Japan: 959 (1936) [MB#250921]*; *Aspergillus awamori* var. *minus* Nakaz., *Simo & A. Watan.,*

*Bull. agric. chem. Soc. Japan: 955 (1936) [MB#250922]*; *Aspergillus awamori* var. *piceus* Nakaz., *Simo & A. Watan., Bull. agric. chem. Soc. Japan: 956 (1936) [MB#250923]*; *Aspergillus usami* Sakag., *Iizuka & M. Yamaz. ex Iizuka & K. Sugiy., J. Agric. Chem. Soc. Japan: 232 (1960) [MB#326664]*.

The colony is white-brown colors, mycelium with partition. The back side is not changed color. Growth is not limited. Edges have changes its forms and gets brown color. Conidia formed on the conidiophore is in the form of a sphere (Fig. 3 B), the central part is characterized by sinuous and spores is in the form of a sphere.



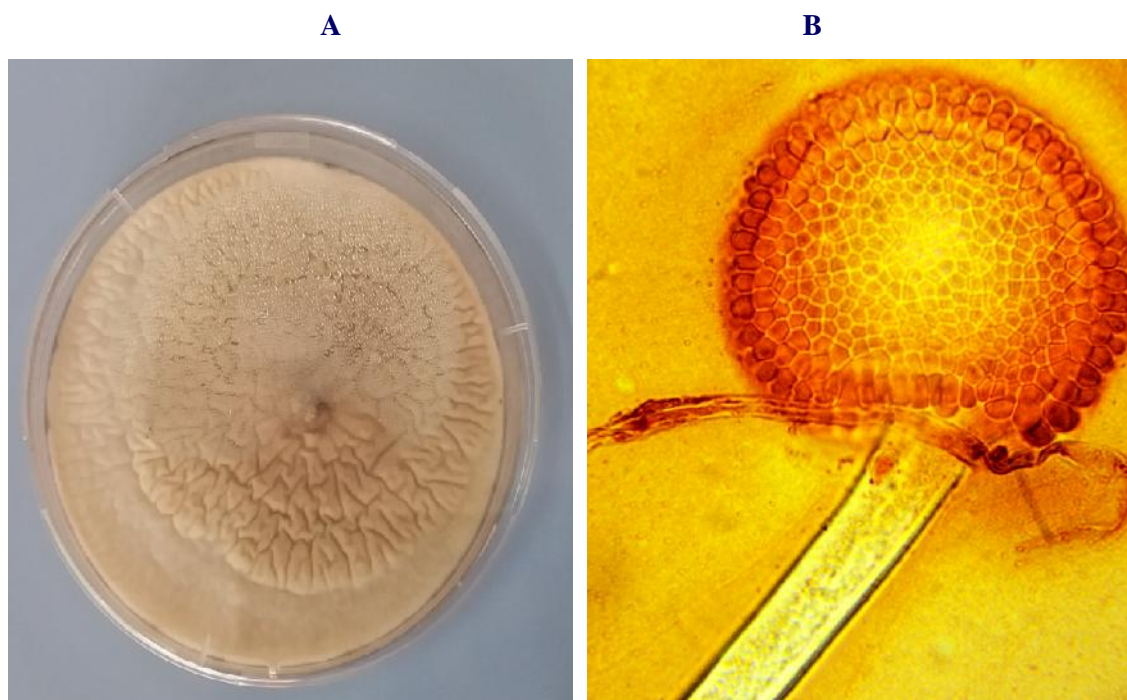


Fig. 3. General view of colonies(A) and conidia(B) of *A.awamori*.

The fungi were found in the samples of plant taken in the territory of Greater Caucasus and were taken to the pure culture. It is known that those fungi are registered in Azerbaijan, but they can be characterized as a rare species.

**4. *Rhizopus stolonifer* (Ehrenb.) Vuill., *Revue Mycologique Toulouse* 24: 54 (1902)[MB#119545].**  
Syn.: *Mucor stolonifer* Ehrenb., *Sylvae mycologicae Berolinenses*: 25 (1818) [MB#188377].

The colony is white, but, over time the colony becomes darker (Fig. 4A). It has a maximum density. Air mycelium cover the entire surface of the petri dish. The back side of the colony has not changed its color. Growth is not limited. Sporangia are in the form of a sphere (Fig. 4B). Mycelium branch out from one point. Fungi are single-celled and pathogenic.

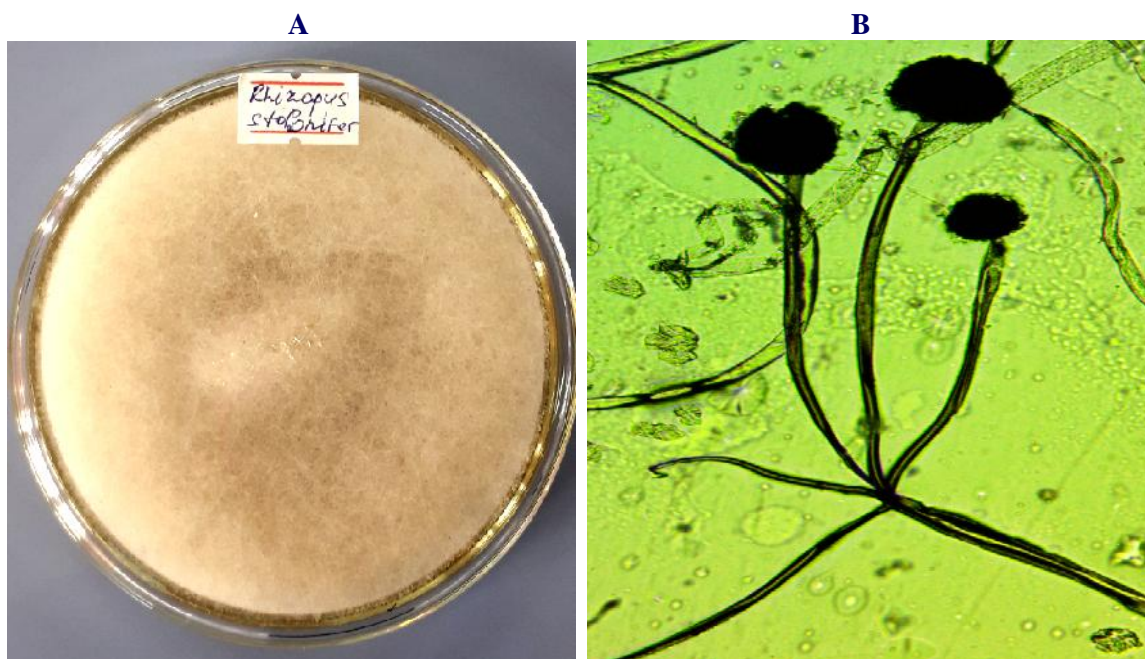


Fig. 4. General view of colonies(A) and conidia(B) of *Rh.stolonifera*.

The fungi were found in the soil sample taken from the Greater Caucasus (Guba region) and were taken to the pure clean. It is known that those fungi are registered in the territory of Azerbaijan, but they are also characterized as rare species.

**5. *Rhizopus microsporeus* Tiegh., Annales des Sciences Naturelles Botanique sér. 6, 1: 83 (1875) [MB#177331].** Syn.: *Mucor microsporeus* (Tiegh.) Mig., *Kryptogamenflora von Deutschland, Deutsch-Oesterreich und der Schweiz: 197 (1910) [MB#433182].*

The colony is white. The back side of the colony is not changed its color. Growth is not limited. The edges are relatively changing their color to darker. Mycelium with partition. The form of conidia is in the form of the round. They have well-developed rhizoids.

The fungus was found in the soil sample taken from the Greater Caucasus (Absheron Peninsula) and were taken to the pure culture. It is known that those fungi are registered in the territory of Azerbaijan, but they are also characterized as rare species.

**6. *Trichoderma asperellum* Samuels, Lieckf. & Nirenberg, Sydowia 51: 81 (1999) [MB#461012].**

Colonies are green, then becomes yellow and white. Colonies are very thick (Fig. 6A). The back side of the colony is not changed its color. Growth is not limited. Conidiophores are short and about 90 degrees is branching generates wide angles (Fig. 6B). Reminds the pyramidal appearance.

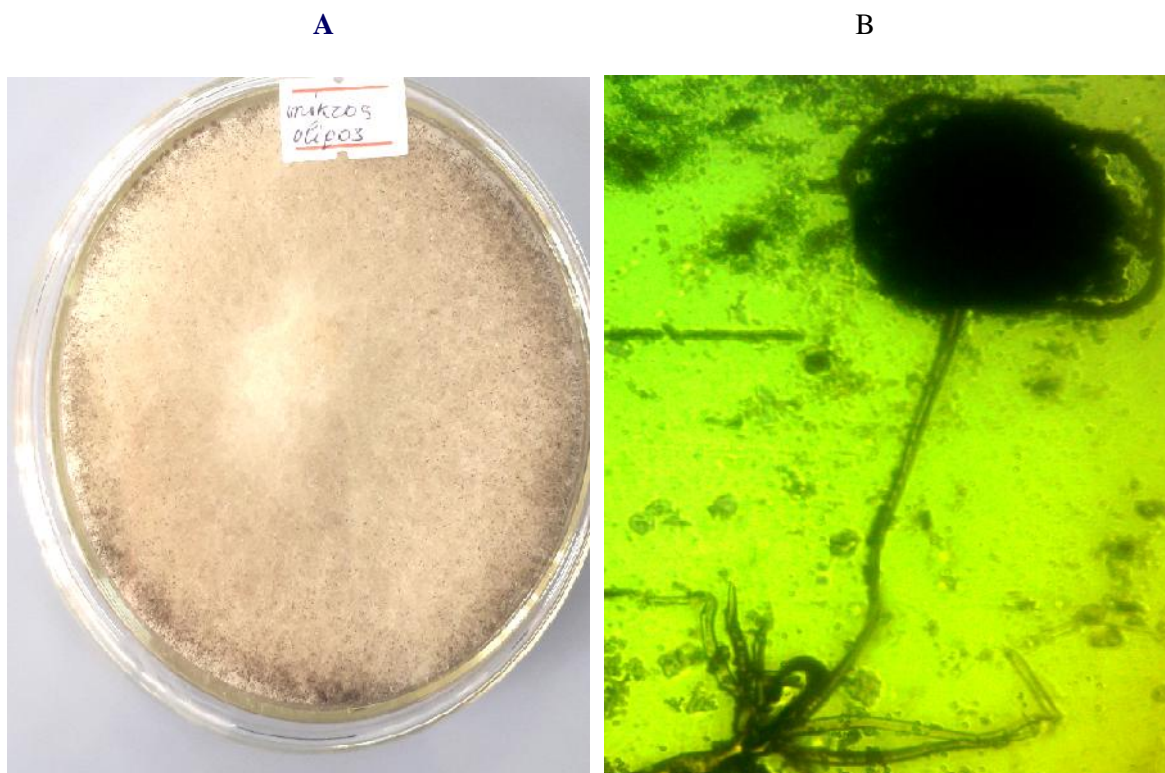


Fig. 5. General view of colonies(A) and conidia(B) of *Rh. microsporeus*.

Fungi were found in the sample taken from the forest land in the territory of Greater Caucasus (Guba region) and were taken to the pure culture. It is known

that these fungi are registered in the territory of Azerbaijan and is not considered to be widespread fungi.



A

B



Fig. 6. General view of colonies(A) and conidia(B) of *T. asperellum*.

**7. *Ascospaera apis* (Maassen ex Claussen) L.S. Olive & Spiltoir, *Mycologia* 47 (2): 242 (1955) [MB#282572].** Syn.: *Pericystis apis* Maassen ex Claussen, *Arb. biol. Reichsanst. Land- u. Forstw.*: 467 (1921) [MB#190721].

The colony of gray-brown color. Growth is not limited. The back side of the colony is not changed its color. Its thickness is average. The opened form of the conide reminds the bud. Spores are in the form of a circle.

A

B

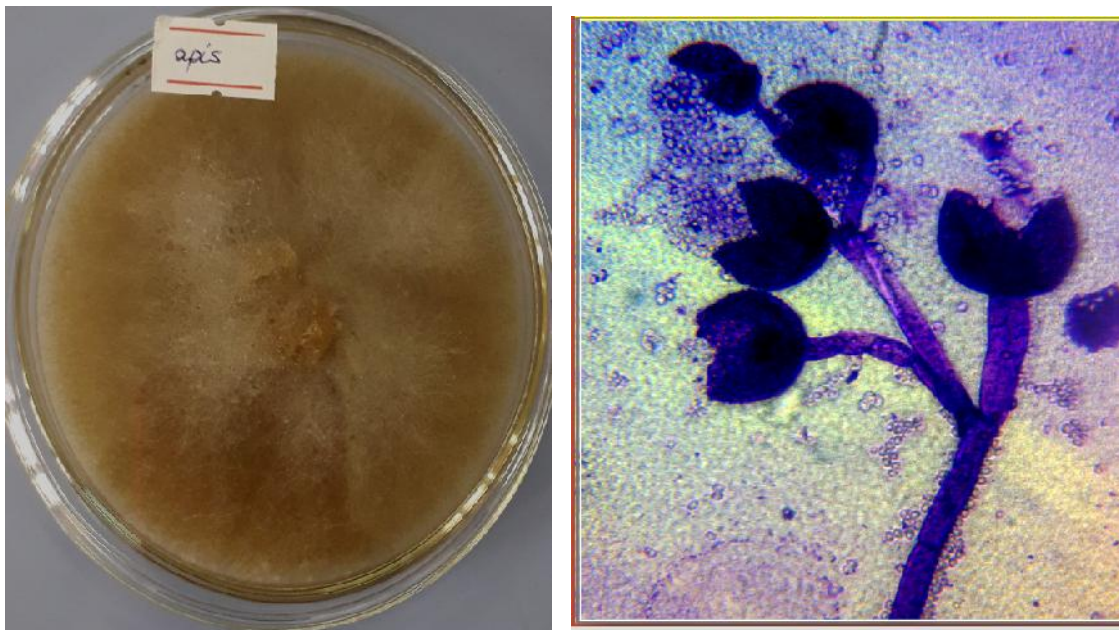


Fig. 7. General view of colonies (A) and conidia (B) of *Asc. apis*.

The fungus was discovered in the soil sample taken from the Greater Caucasus and were taken to the pure culture.

**8. *Circinella muscae* (Sorokin) Berl. & De Toni, *Sylloge Fungorum* 7: 216 (1888) [MB#197197].** Syn.: *Helicostylum muscae* Sorokin, *Bull. Soc. Imp. nat. Moscou*: 256 (1870) [MB#246689]; *Circinella spinosa* Tiegh. & G. Le Monn., *Annales des Sciences Naturelles Botanique* 17: 305 (1873) [MB#196970]; *Circinella sydowii* Lendn., *Bulletin de la Société Botanique de Genève* 5: 29 (1913) [MB#197180].

The colony is white. Growth is not limited. The back side of the colony is not changed its color. Colonies are thick. Mycelium without partition and in the form of branching. First-time conidia are reminded sphere, then the sphere opens. Spores in the form of a circle.

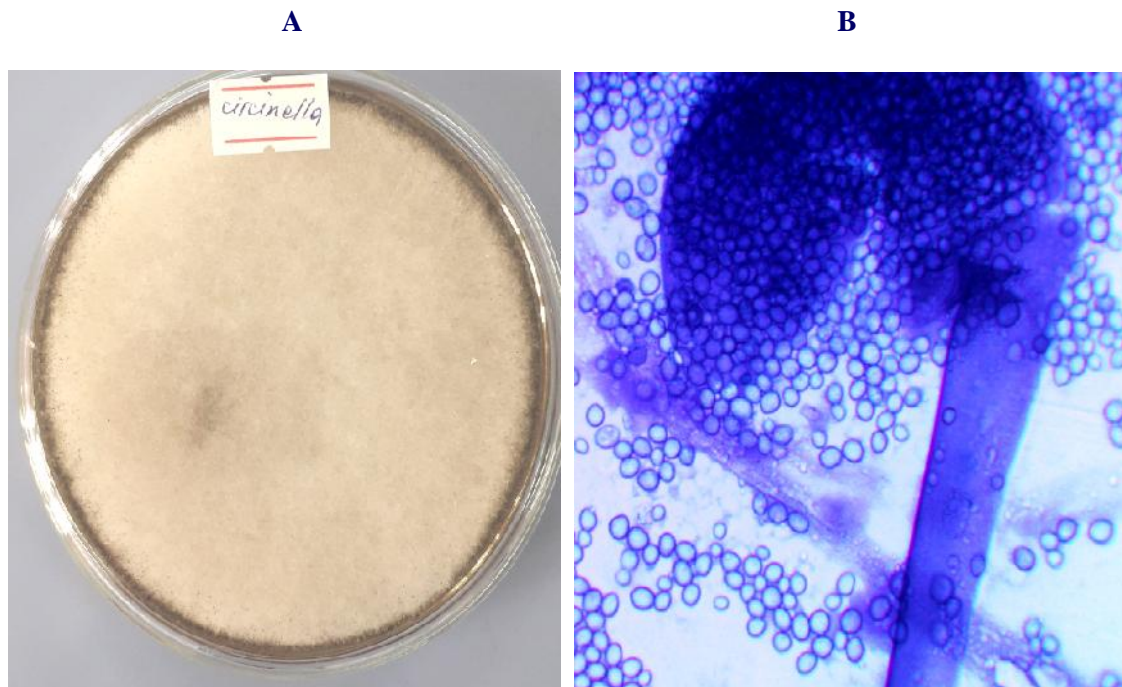


Fig. 8. General view of colonies (A) and conidia (B) of *Circinella muscae*.

The fungi were found in the soil sample taken from the Greater Caucasus (Jilov island) and were taken to the pure clean. So far this fungus was not registered in Azerbaijan, for that, fungi are a new species for the mycobiota of Azerbaijan nature.

**9. *Trichothecium roseum* Pers., *Neues Magazin für die Botanik* 1: 92 (1794) [MB#164181].** Syn.: *Hyphelia rosea* (Pers.) Fr., *Systema Orbis Vegetabilis* 1: 149 (1825) [MB#164262]; *Puccinia rosea* (Pers.) Corda, *Icones fungorum hucusque cognitorum* 1: 6, t. 2:98 (1837) [MB#166462]; *Dactylium roseum* (Pers.) Berk., *Annals and Magazine of Natural History* 6: 437 (1841) [MB#198853]; *Dicoccum roseum* (Pers.) Bonorden, *Handbuch der allgemeinen Mykologie*: 46 (1851) [MB#509136]; *Trichoderma rosea* (Pers.) H. Hoffm. (1863) [MB#172148]; *Cephalothecium roseum* Corda, *Icones*

*fungorum hucusque cognitorum* 2: 14, t. 10:62 (1838) [MB#228348]; *Didymaria salicis* Cavara, *Revue Mycologique Toulouse* 11: 183 (1889) [MB#201761]; *Didymaria prunicola* Cavara, *Agric. Ital.*: 145 (1890) [MB#201597]; *Didymaria helianthemi* G. Boyer & Jacz., *Annales de l'École Nationale d'Agriculture de Montpellier* 1894: 47 (1894) [MB#196516]; *Didymaria asteris* Oudem., *Nederlandsch Kruidkundig Archief Ser. 3, 2* (4): 901 (1903) [MB#200638].

Rapidly grows to a mature stage in 3-4 days. The colony is primarily white, during rapidly growing changes it is color from light pink to peach color (Fig. 9A). At the end of the incubation, it is getting dark orange. The back side is not changed its color. The outer parts did not change shape and color. Long, thin and flat conidiophores are less differ from vegetative hybrids (Fig. 9 B) and can be divided near their base.



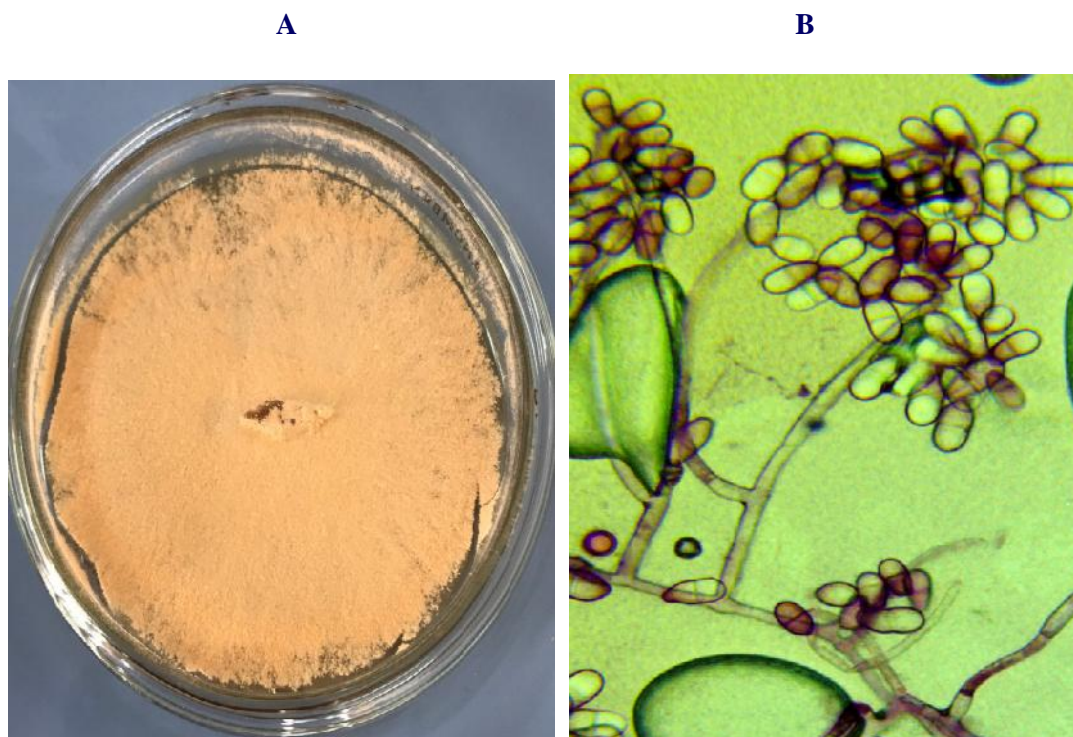


Fig. 9. General view of colonies (A) and conidia (B) of *T.roseum*.

The fungi were found in the sample taken from the fruits of the grape plant grown in the territory of Kur-Araz lowland and were taken to the pure culture. It is known that the fungi were registered in the territory of Azerbaijan, but it should be noted as a rare species for the fungi biota inherent to the nature of Azerbaijan.

**10. *Penicillium echinulatum* Raper & Thom ex Fassat., Acta Universitatis Carolinae Biologica 12: 326 (1977) [MB#319269].** Syn.: *Penicillium cyclopium* var. *echinulatum* Raper & Thom, *A manual of the Penicillia*: 497 (1949) [MB#346309]; *Penicillium palitans* var. *echinoconidium* S. Abe, *Journal of General and Applied Microbiology Tokyo* 2 (1-2): 111 (1956) [MB#123963]; *Penicillium echinulatum* var. *echinulatum* (1976) [MB#434088].

Colonies are white, with limited growth and excessive density (Fig. 10A). After some time, the dew drops are formed on the colony. The back side is 4 parts by changing the color: light brown, dark brown, purple and again light brown. Mycelium without partition. The conidia are in the form of broom and branching into several places from one point (Fig. 10 B).

Separated branches are also divided into several places and, in their end there are spores in the form of a sphere.

The fungi were found in samples taken from the soil rich in plant remnants in the Greater Caucasus and were taken to the pure culture. This fungus was not registered in Azerbaijan, for that, fungi is new for the mycobiota of Azerbaijan nature.

**11. *Zygorhynchus heterogamus* (Vuill.) Vuill., Bulletin de la Société Mycologique de France 19: 117 (1903) [MB#178925].** Syn.: *Mucor heterogamus* Vuill., Bull. Séanc. Soc. Sci. Nancy: 8: 50 (1887) [MB#249261]

The colony is gray-brown and its growth is not limited (Fig. 11A). The backside was not changed its color. The overlayer is covered with hairs and reminiscent of the carpet. Mycelium without partition. Sporangia at an early stage to remind strawberries (Fig. 10B), but in the mature stage becomes a form of a sphere. The edges are not smooth. There is thickening where mycelium joining to conidia.



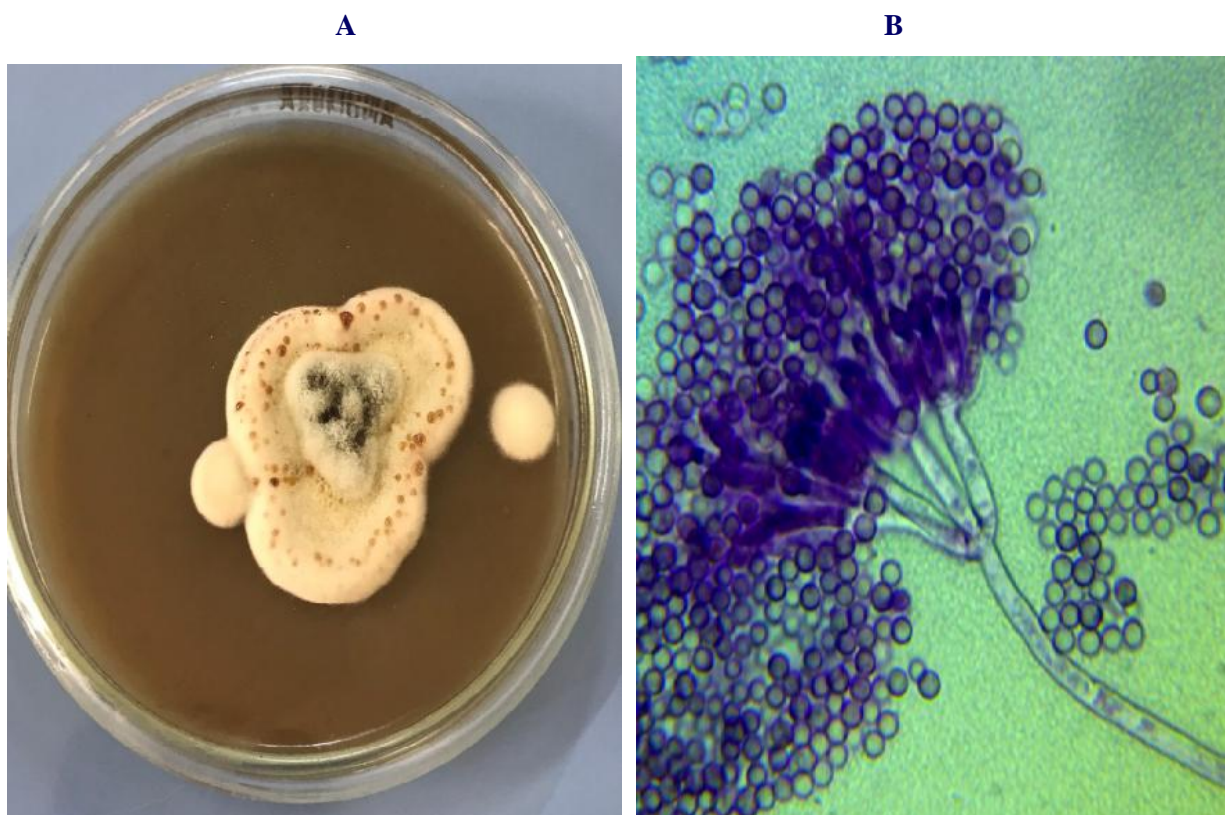


Fig. 10. General view of colonies (A) and conidia (B) of *P.echinulatum*.

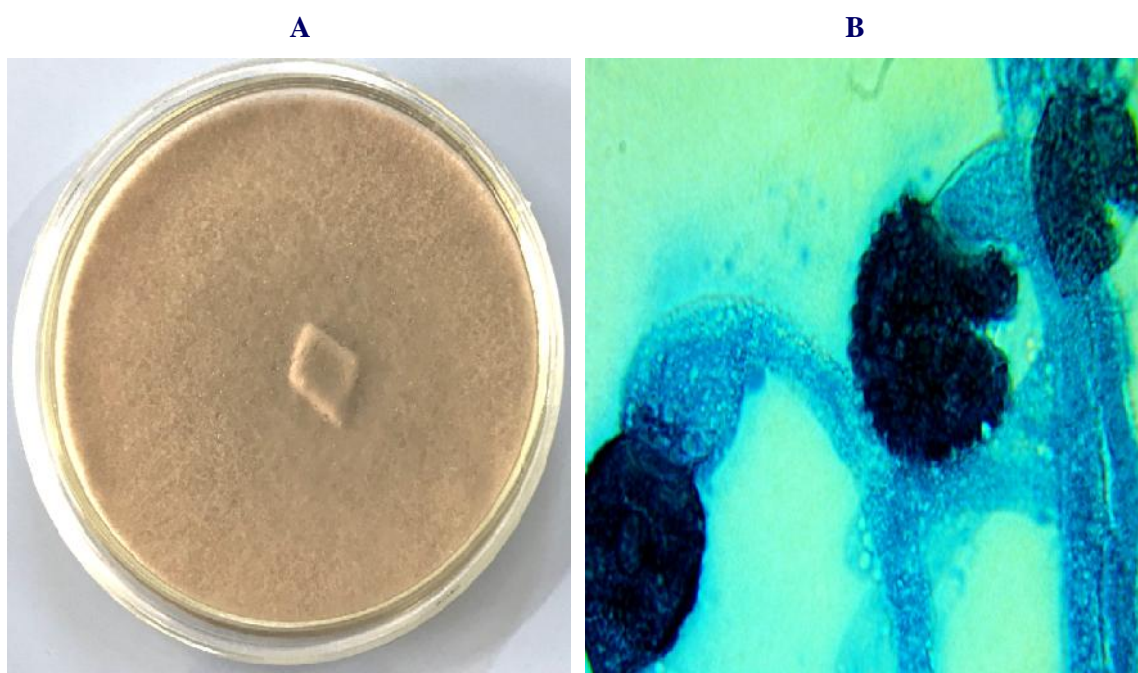



Fig. 11. General view of colonies (A) and conidia (B) of *Zygorhynchus heterogamus*.

The fungi were found in the relative clean soil sample taken from the Greater Caucasus and were taken to the pure clean. The registration this fungi in Azerbaijan is the first time.

Thus, 5 species of fungi recorded as a result of researches are characterized as new, 6 species are rare species for the nature of Azerbaijan. The fact itself, the found of new species allows to note that mycobiota of the Azerbaijan nature is studied insufficient, and that problem is open to research.

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