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МИКРОМОРФОЛОГИЧЕСКИЕ ОСОБЕННОСТИ УЗКОЛОКАЛЬНОГО ЭНДЕМА *SILENE SYTNIKII* (CARYOPHYLLACEAE) В СРАВНЕНИИ С БЛИЗКИМИ ВИДАМИ

Silene sytnikii Krytzka, Novosad et Protopopova – локальный эндем флоры Украины, который иногда рассматривают в качестве синонима балканского вида S. frivaldszkyana Hampe, является близким к широко распространенному S. chlorantha (Willd.) Ehrh. Цель работы состояла в исследовании и сравнении микроморфологических признаков семян, пыльцовых зерен и поверхности листа указанных видов. Исследования проводились с использованием методов световой и сканирующей электронной микроскопии. S. Sytnikii и S. Frivaldszkyana несколько отличаются размерами экзотестальных клеток и их зубцов дистального ряда семян, диаметром пыльцы и количеством микроскульптурных элементов поры, размерами шипов листовой пластинки, клеток эпидермы и устьиц. S. Chlorantha существенно отличается более мелкими семенами и клетками экзотесты, более длинными шипами по краям листа. Таким образом, между S. sytnikii и S. frivaldszkyana существенных различий не выявлено, тогда как S. chlorantha достаточно хорошо от них отличается.

Ключевые слова: семя, пыльцевое зерно, поверхность листа, СЭМ.

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MICROMORPHOLOGICAL FEATURES OF THE NARROW ENDEMIC *SILENE SYTNIKII* (CARYOPHYLLACEAE) COMPARED WITH CLOSELY RELATED SPECIES

Silene sytnikii Krytzka, Novosad et Protopopova is a local endemic species of the Ukrainian flora, which sometimes is considered as a synonym to the S. frivaldszkyana Hampe from the Balkans and is related to the widespread species S. chlorantha (Willd.) Ehrh. The aim of the present study is to investigate micromorphological features of seeds, pollen grains and leaf surface ultrastructure of foregoing species and make a comparison. Both light and scanning electron microscopy were used in the study. S. sytnikii and S. frivaldszkyana are slightly different in the size of exotesta cells and their anticlinal teeth in distal row of seeds, pollen diameter and microechinate number on the pore, size of leaf spinule, epidermal cells and stomata. S. chlorantha significantly differs from them by smaller seeds and exotesta cells, and also longer leaf spinules. Thus, S. sytnikii and S. frivaldszkyana are quite similar in their micromorphology, while S. chlorantha is clearly distinct from them.

Key words: seed, pollen grain, leaf surface, SEM.

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MICROORGANISMS, PERSPECTIVE FOR BIOTECHNOLOGY, MEDICINE, ENVIRONMENTAL TECHNOLOGIES, IN THE COLLECTION OF MICROSCOPIC FUNGI ESC "INSTITUTE OF BIOLOGY AND MEDICINE", TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV

Analysis of the current state (composition) of collection of live cultures of microscopic fungi, which is part of the "Culture Collection of Fungi at Taras Shevchenko National University of Kyiv" (WDCM 1000) is provided. The collection including 530 isolates contains microscopic (filamentous and yeast like) fungi belonging to divisions Zygomycota, Basidiomycota (yeast fungi of the genus Rhodotorula), Ascomycota and of the Anamorphic fungi group, which is the largest on the number of genera and species of microscopic fungi. In 2014-2016 years collection was replenished by isolates of microorganisms capable of synthesizing biologically active compounds (including melanin) and resistant to toxic (heavy) metals. The main directions and results of using the collection of isolates of microorganisms, in particular those that are able to synthesize melanin are characterized in detail.

Keywords: WDCM 1000, the biologically active compounds, producers of melanin, metal resistant microorganisms.

Introducton. Microbial culture collections serve a broad base material for the implementation of basic and applied research and theoretical generalizations. A large number of collections that contain diverse biological material: Bacteria, Filamentous fungi, Yeasts, Archaea, Microalgae, Plant and Animal cell lines, Hybridomas: animal, Viruses: plants, Viruses: animals, Phages, Gene Library, Patent and safe deposits etc. are created, developed and supported in many countries. These collections have different Status: Governmental, Inter-Governmental, Semi-governmental, University, Privately owned company, Private others. Details of the collection is available at the World Federation for Culture Collections (WFCC). The WFCC-MIRCEN World Data Centre for Microorganisms (WDCM) was set up in 1966 as the data center of the World Federation for Culture Collections (WFCC) with the support of UNESCO, following a decision of the International Union of Microbiological Societies [1]. WDCM plays a crucial role in providing for a set of databases related to microorganisms, bioinformatics tools for functional analysis and a worldwide platform of communication for culture collections. To date, more than 1130 culture collections have registered in the WDCM directory of collections Culture Collections Information Worldwide (CCINFO), among of which more than 700 international culture collections [2-4].

The records in the CCINFO database contain data on the organization, management, services and scientific interests of the collections. WDCM develops an effective information environment that underpins research in microbiology via data production, sharing and exploitation, sustains progress and builds bridges within and outside the microbiologists' community. WDCM also designs and manages a series of databases for international culture collections and major intergovernmental organizations, such as WHO, ISO and others (Table 1). These solutions help culture collections on their way towards becoming modern BRC Global Standards. At present, WDCM is one of the important international organizations in the field of microbiological data worldwide [5].

***Table* 1. List of some WFCC affiliated culture collections contributed to WDCM**

Acronim of Collections of Cultures, WDCM Number	Full Name, Institution	Country / Status of Collections	Number of Strains (Bacteria / Fungi / Yeasts)
AHU WDCM 635	AHU Culture Collection, Graduate School of Agriculture, Hokkaido University	Japan / University	323 / 1342 / 835
ATCC WDCM 1	American Type Culture Collection	U.S.A. / Private	18000 bacteria and bacteriophages / 46000 Filamentous fungi and yeasts)
BCCM/IHEM WDCM 642	Belgian Coordinated Collections of Microorganisms / IHEM Fungi colleciton, Scientific Institute of Public Health	Belgium / Governmental	0/ 10340 / 4059
BCRC WDCM 59	Bioresource Collection and Research Center, Food Industry Research and Development Institute	Chinese Taipei / Governmental, Private, University, Industry	10203 / 10113 / 4866
BTCC WDCM 66	Bulgarian Type Culture Collection Institute for State Control of Drugs	Bulgaria / Governmental	4500 / 340 / 32
CBS WDCM 133	Centraalbureau voor Schimmelcultures, Filamentous fungi and Yeast Collection, CBS-KNAW Fungal Biodiversity Centre	Netherlands / Semi-governmental	87 / 63000 / 9000
CCM WDCM 65	Czech Collection of Microorganisms, Masaryk University	Czech / University	2600 / 750 / 22
CCUG WDCM 32	Culture Collection University of Goteborg, Sahlgrenska University Hospital, Department of Clinical Microbiology	Sweden / University, Regional Hospital	40000 / 100 / 400
DSMZ WDCM 274	Leibniz-Institut DSMZ-Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH	Germany / Governmental	17900 / 2000 / 450
IAM WDCM 190	IAM Culture Collection Institute of Molecular and Cellular Biosciences, The University of Tokyo	Japan / University	1548 / 1294 / 427
IFM WDCM 60	Research Center for Pathogenic Fungi and Microbial Toxicoses, Chiba University. Japanese Federation of Culture Collections	Japan / Governmental, University	590 aerobic actinomycetes / 4071 / 2129
IMI WDCM 214	CABI Genetic Resource Collection, The Centre for Agriculture and Bioscience International	U.K. / Inter-Governmental	1927 / 27485 / 421
JCM WDCM 567	Japan Collection of Microorganisms, RIKEN BioResource Center	Japan / Semi-governmental	17283 / 3371 / 3391
MUCL WDCM 308	Belgian Coordinated Collections of Microorganisms /MUCL Agro-environmental Fungi Collection	Belgium / University	0 / 18944 / 3257
NCPF WDCM 184	National Collection of Pathogenic Fungi, Culture Collections, Public Heatlh England	U.K. / Governmental	80 /1100 / 200
NRRL WDCM 97	Agricultural Research Service Culture Collection, National Center for Agricultural Utilization Research	U.S.A. / Governmental	22496 / 55733 / 17969
OUT WDCM 748	Department of Biotechnology, Graduate School of Engineering, Osaka University	Japan / University	800 / 353 / 3803

Note: The data on only selected number of standard strains of bacteria, yeasts and filamentous fungi are provided in Table after WDCM [3, 6]

Today there are 8 WDCM collections from Ukraine: Herbarium of Kharkov University – MicroAlgae Cultures Collection (WDCM 886); UPCC Ukrainian Private Culture collection (WDCM 884); Ukrainian Collection of Cholera Aetiological Agents O1 and non O1 serogroups (WDCM 967); Collection of National Center for Strains of Microorganisms (WDCM 1075); Culture Collection of Ukrainian Tairov's Research Institute of Viticulture and Oenology (WDCM 983); Collection of Ukrainian Scientific-Research Cell Bank (WDCM 855) and two collections of ESC "Institute of Biology and Medicine" Taras Shevchenko National University of Kyiv: Culture Collection of Algae at Taras Shevchenko National University of Kyiv (WDCM 994) and Culture Collection of Fungi at Taras Shevchenko National University of Kyiv (WDCM 1000) [7].

For example, the most important collections of microorganisms activities can be illustrated by American Type Culture Collection (ATCC) [8]. ATCC has been the premier source for microbial reference strains since 1925 [9]. ATCC is a nonprofit organization in the life sciences field whose mission focuses on the acquisition, authentication, production, preservation, development and distribution of standard reference microorganisms, cell lines and other materials for research and development to the public and private sector research communities. Aside from maintaining the biological resources ATCC also competes for federal grants and contracts and engages in partnerships and collaborations with academic institutions and private companies. Individuals and groups can employ a safe deposit service for their own cell cultures, providing a secure back-up for valuable biomaterials if required. ATCC also is able to retain secure samples of patented materials and distribute them according to instructions and approval of the patent holder. ATCC provides expert biological repository management services to institutions, agencies and companies wishing to outsource the handling of their own culture collections [10]. ATCC biological standards are vital to assuring reliability of research results, reproducibility of experimentation and consistency in the scientific method. Standards from ATCC also help

scientists in a wide range of industries ensure safety and quality in their products. ATCC reagents are cited as standards by such agencies as the U.S. Food and Drug Administration and the U.S. Department of Agriculture, as well as organizations such as the Clinical and Laboratory Standards Institute, the U.S. Pharmacopeia, and the World Health Organization.[5] ATCC-produced standards are used in a wide range of applications including the development of therapeutic and diagnostic medical products, food safety, water and environmental testing, and to obtain actionable forensic information.

Among the industries represented ATCC's customer base are the pharmaceutical, biotechnology, agricultural and diagnostics industries, as well as food, beverage and cosmetics makers and reference and testing laboratories. The ATCC also has working links with several other international culture collections.

The aim of this work is the analysis and characterization of the current state of collections of living cultures of microscopic fungi that are part of the collection Culture Collection of Fungi at Taras Shevchenko National University of Kyiv (WDCM 1000).

Results and discussion. At the beginning of its establishment research on replenishment of a collection of microscopic fungi (hereinafter – the Collection) was focused on selection of microscopic fungi isolates – destructors of various technical products, materials and objects of cultural heritage (paintings, books and various attractions on paper, film and photo documents etc.) [11-12]. Collection was also increased with isolates of fungi that removed from the air spaces and surfaces of various purpose (libraries, residential and industrial buildings, etc.) [13-15]. The staff member (engineer G.M. Volkova), graduate students of the Botany Department (Y.A. Krupskaya, S.V. Skrebovska, O.V. Miroshnik, S.V. Martynenko) and of the Department of general microbiology and Immunology (A.I. Kalinichenko) were involved in the work on the systematization of collections, replenishment of new isolates of maintaining a viable state and to conduct related studies of microscopic fungi ranging from 2005 to 2015 [16-19]. The name "culture collection of Micromycetes – destructors" of ESC "Institute of Biology," Taras Shevchenko National University of Kyiv was defined after a certain direction of selecting isolates at the beginning. The Culture Collection of Fungi at Taras Shevchenko National University of Kyiv was registered in the WDCM (WDCM 1000) in March, 2012 within the performance of scientific topics 11BF036-02 "Biodiversity and comprehensive study of adaptation strategies of phyto-, zoo- and virobiots of Ukraine with the usage of bioinformational technologies" [3]. The FCKU is an acronym of the Collection. There are two curators of collections, i.e.: Prof. Maryna Sukhomlyn (Mycologist) and Dr. Tatiana Kondratiuk (Microbiologist). A collection of microscopic fungi (Curator – Dr. Tatiana Kondratiuk) is part of the Culture Collection of Fungi at Kyiv University.

Today the collection contains 530 isolates of microscopic (filamentous and yeast) fungi belonging to divisions Zygomycota, Basidiomycota, Ascomycota and the Anamorphic fungi group. Anamorphic fungi, which is represented by particular isolates of the genera Acremonium, Aspergillus, Penicillium, Cladosporium, Fusarium, Paecilomyces, Scopulariopsis, Trichoderma and others is the most numerous group in collection. To support the collection of strains in the viable state they oversow on dense nutrient media at regular intervals. In parallel, the purity of isolates are tested (Fig. 1).

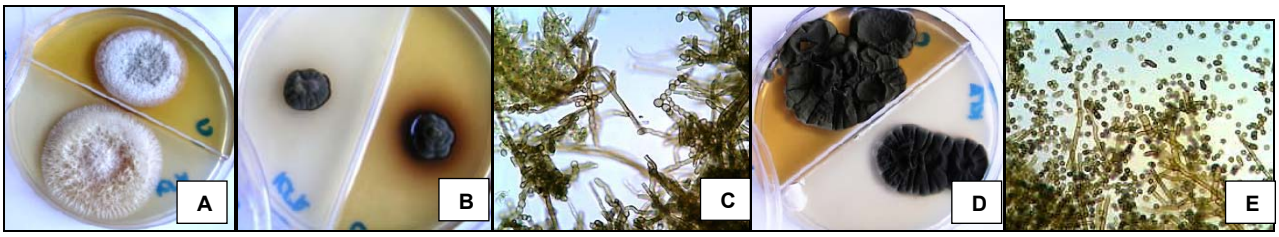

Fig. 1. Microscopic fungi Sarocladium strictum (W. Gams) Summerbell (=Acremonium strictum) 175/h FCKU (A) and Cladophialophora bopii (Borelli) de Hoog, Kwon-Chung & McGinnis 377/1 FCKU (B,C), Cladosporium sp. 197/h FCKU (D), C. sphaerospermum Penz. 212 FCKU (E) on different media (CA and PDA). C, E – ×400

In collections today there are 98 isolates of the filamentous fungi that according to the literature found to be active destructors of products and materials and include a test culture to the relevant standards and copyright certificates of testing for resistance to microscopic fungi: Aspergillus niger, A. terreus, A. oryzae, Aureobasidium pullulans, Alternaria alternata, Fusarium moniliforme (є синонімом is synonym to Fusarium verticilloides), Paecilomyces variotii, Penicillium brevi-compactum, P. chrysogenum, P. funiculosum, P. aurantiogriseum, P. ochro-chloron, Scopulariopsis brevicaulis, Trichoderma viride, Chaetomium globosum, Aspergillus ustus, Aspergillus sydowii. Keeping isolates of microscopic fungi-destructors in collection is very important because a significant number of products and materials should be biostable, and therefore they should be tested for resistance to microorganisms using the test cultures of collection isolates. Damage to products and materials by microorganisms can cause threat of accidents (resulting deterioration in quality, breach of the performance of devices, equipment), economic losses, endangering the health of people as a result of entering the environment opportunistic pathogenic, allergenic species of microscopic fungi. The usage of collection fungal species as the test cultures allowed us to establish the degree of fungus resistance and antifungal activity of polyamide 12 (PA-12) films modified with polyhexamethylene guanidine dodecylbenzenesulfonate (PGMG-DBS). PA-12 is therefore an excellent material for manufacturing many different products, including barrier and jacket layer in oil, gas and water pipelines, electrical cables insulation, flexible tubes and hoses, protective coatings, medical catheters etc. Antifungal activity of modified PA-12 films was studied according to ISO 846: 1997. Antifungal properties of PA-12 films were found to be developed at a presence of 5% PGMG-DBS [21]. The fungus resistance of papers, which are widely used in the restoration of documents on paper was identified with the wide range of test cultures of this collection too [22].

The usage of biocides of different nature (synthesized byhuman and natural) is one solution of the problems of biological stability of products and materials, and for the

removal of microorganisms. Our studies using collection test cultures of fungi allowed to find out the impact of PGMG drugs, essential oils [23], silver (nano) drugs [24] etc on them.

Microscopic fungi are characterized by wide range of amplitude of adaptive reaction on influence of various factors of environment. Exchanges of morphology, speed of radial growth, accommodation of inorganic polyphosphates in cells of microscopic fungi of the genera Alternaria, Aspergillus, Cladosporium and Penicillum in condition of carbon limitation are characterized. Results obtained confirm existence of various ways of realization of adoptive responses of microscopic fungi to this stress factor [25]. The following structural-functional reorganization of Exophiala alcalophila 304 FCKU, i.e.: exchange of morphometric indices of cells, colony morphology, intensity of budding, dimorphous transition 'yeast-mycelium' were observed under influence of benzalconium chloride and plant essential oils. These exchanges illustrate wide adaptation possibilities of black yeast culture investigated [26].

Microorganisms which are capable of synthesis of biologically active substances (BAS) and are promising for use in various fields of human activity: biotechnology, medicine, environmental technology and more form separate portion of the Collection. Thus, the genus Chaetomium (3 types, 21 isolates), represented by powerful characteristic cellulolytic enzyme complex, is one of the most numerous among Division Ascomycota by the number of isolates in the collection. Cellulases of microorganisms have shown their potential application in various industries including pulp and paper, textile, laundry, biofuel production, food and feed industry, brewing, and agriculture [27]. Totally 20 cultures of microscopic fungi were isolated from paper archival documents. Of them the high level of cellulolytic activity is found for 4 test cultures (Aspergillus niger, species of the genera Chaetomium and Cladosporium). The high level of cellulolytic activity was also determined for the collection isolates (Trichoderma viride Pers. 172 FCKU, Trichoderma viride Pers. 125 FCKU, Chaetomium globosum Kunze 47 FCKU).

Dark pigmented micromycetes that produce the pigment melanin, are represented in the collection by 18 species (63 isolates). Among them there are species of the genera Cladosporium, Alternaria, Phoma, Scolecobasidium, Stemphylium, Ulocladium, black yeast-like fungi of the genera Pseudonadsoniella and Exophiala and others. For a number of species of the genus Cladosporium, as well as for Exophyala alcalophila and Pseudonadsoniella brunnea molecular genetic studies were performed and phylogenetic analysis was conducted. Status of black melanin-containing fungus is proved by combined phylogenetic analysis based on sequences of the internal transcribed spacer 1 (ITS1), the 5.8S gene and the internal transcribed spacer 2 (ITS2) nrDNA, beta-tubulin gene and translation elongation factor 1–alpha gene. [28-30]. In our previous studies cultural-morphological, physiological, biochemical and genetic characteristics of the strain of Antarctic black yeast-like fungus (producer of melanin), which revealed belonging to a new genus Pseudonadsoniella and new species Pseudonadsoniella brunnea were found and described [30]. Ps. brunnea 470 FCKU synthesizes and excretes a dark pigment – melanin to culture medium. The latter is an important feature of Ps. brunnea. The first data on antioxidant, antibacterial, fungistatic wound healing properties of the gel containing 0.05% melanin ("Melanin-gel"), which was synthesized by Ps. brunnea are obtained. Application of the "Melanin-gel" on wound area enhanced wound cleaning from dead tissue and reduced eschar, stimulated the early growth of granulation tissue, and improved epithelialization of the wound [31]. The high fungicidal effect of melanin producer Ps. brunnea culture fluid on test cultures of pathogenic fungi Fusarium oxysporum 150 FCKU, F. oxysporum 328 FCKU and Gibberella fujikuroi (anamorph: F. verticilloides) (Gibberella fujikuroi 234 FCKU, G. fujikuroi 333 FCKU, G. fujikuroi 338 FCKU, and G. fujikuroi 434 FCKU) for the first time found in our previous studies [32-33]. The black yeast fungus Ps. brunnea under the influence of heavy metals (lead salts) is studied. It is found that Ps. brunnea does not lose viability and developing under the conditions of nitrate content of lead concentrations of 100, 200, 500, 750 and 1000 mg l (in terms of metal cation) in the environment [34]. Dark pigmented fungi, which are distinguished by resistance to various extreme impacts, are the subject of our further experimental studies towards establishing ways manifestation of adaptation strategies (clarify the morphological and physiological changes) in terms of the stress factors of various kinds and to obtain melanin.

Since 2014 the collection updated and isolates the mycelium of fungi, yeasts and bacteria extracted from samples 18-20th Ukrainian Antarctic expeditions. 37 isolation of pure cultures of microscopic fungi (species of Mortiriella, Mucor, Eurotium, Cladosporium, Fusarium, Geotrichum, Pseudogymnoascus, Penicillium, Phoma, Rhodotorula, etc.) were obtained from the samples of mosses, lichens, soil and stones obtained from 18-20th Ukrainian Antarctic expedition (Galindez, Pitterman, and Yalur Islands). Among them Pseudogymnoascus pannorum and Mucor circinelloides are characterized by a pronounced activity to the synthesis of complex of biologically active lipids. 11 pure cultures of bacteria were also isolated that synthesize biologically active substances which can inhibit the growth of other microorganisms (pronounced antagonistic properties were observed). Collection of microorganisms replenished with new srains of microscopic fungi bacteria – producers of biologically active compounds [37]. The microorganisms (bacteria, yeast, filamentous fungi), resistant to toxic metals (lead, silver, chromium, copper), are isolated and included in the Collection from Antarctic samples. These microorganisms resistant to toxic metals and collection isolates that are able to digest complex carbohydrates aviation fuels, can be used for bioremediation of soil and wastewater treatment and water contaminated with toxic metals and hydrocarbons (oil) [38].

Thus collection isolates of microorganisms can serve a broad base material for use in the educational process, studying their physiological, morphological, genetic features a variety of research, including determining the effect of compounds of chemical and natural origin, renovation and expansion of test cultures to conduct relevant research biological resistence of various products and materials, finding strains-producers looking to biotechnology, medicine, environmental technologies, and more.

It is appropriate to change Collection name to "The collection of microscopic fungi and bacteria" given the expansion of the collections of microscopic fungi and bacteria isolates supplement.

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List of References

1. WDCM. WFCC-MIRCEN World Data Centre for Microorganisms. History. http://www.wdcm.org/history.html, http://www.wdcm.org/50th/

2. Casaregola S. An Information System for European culture collections: the way forward / S. Casaregola, A. Vasilenko, P. Romano [et al.] //Springerplus. – 2016 – Vol. 5(1). – P. 772-783. doi: 10.1186/s40064-016-2450-8.

3. Culture Collections Information Wordlwide. http://www.wfcc.info/ccinfo/collection/by_acronym

4. Wu L. WDCM: an information infrastructure for the exploration and utilization of microbial strains preserved worldwide / L. Wu, Q. Sun, Ph. Desmeth [et al.] // Nucleic Acids Research. – 2017. 45 (D1). – D611-D618. doi: 10.1093/nar/gkw903. PMCID: PMC5210620

5. WFCC Statutes. http://www.wfcc.info/index.php/about/statutes

6. WDCM. Reference Strain Catalogue. http://refs.wdcm.org/affiliatedcclists.jsp

7. WDCM. Culture Collections Information Wordlwide. http://www.wfcc.info/ccinfo/collection/col_by_country/u/380/

8. American Type Culture Collection. ATCC. https://www.atcc.org/en/Products/Collections/Microbiology_Collections.aspx

9. Clark W.A. The Story of the American Type Culture Collection – Its History and Development (1899-1973) / W.A. Clark, D.H. Geary // Adv. Appl. Microbiology. – 1974. – 17. – P. 295-309. PubMed ID 4609142

10. Berns K.I. The American Type Culture Collection / K.I. Berns, E.C. Bond, F.J. Manning // In: Resource Sharing in Biomedical Research. – 1996, Washington, National Academies Press (US). – 2. – P. 23-32. Available from: https://www.ncbi.nlm.nih.gov/books/NBK209072

11. Кондратюк Т. О. Біопошкодження паливної системи літака та палива ТС-1 / Т. Кондратюк, О. Харкевич, Л. Наконечна [та ін.] // Фізико-хімічна механіка матеріалів. Спецвипуск: Проблеми корозії та протикорозійного захисту матеріалів. – 2006. – Т.2. – №. 5. – С. 937–940.

12. Кондратюк Т. Мікобіота книгосховищ Національної бібліотеки України імені В. І. Вернадського / Т. Кондратюк, В. Коритнянська, В. Захарченко [та ін.] // Наук. праці Нац. бібліотеки України ім. В. І. Вернадського. – 2007. – Вип. 17. – С. 53-64.

13. Кондратюк Т. О. Мікроскопічні гриби, виявлені на пошкоджених оздоблювальних матеріалах (штукатурці та фарбі) стін всередині приміщень / Т. О. Кондратюк, Л. Т. Наконечна, О. С. Харкевич // Укр. ботан. журн. – 2011. – 68, № 3. – С. 407– 419. Available from: http://www.botany.kiev.ua/content_ubj_11.htm#u3_11.

14. Кондратюк Т. О. Мікроскопічні гриби в повітрі сховищ кінофотодокументів / Т. О. Кондратюк, Л. Т. Наконечна, О. С. Харкевич // Мікробіол. журнал. – 2012. – Т. 74, № 3. – С. 48-53. Available from: http://www.imv.kiev.ua/images/doc/MBJ/2012/MB_3_2012.pdf

15. Кондратюк Т. Чорні дріжджоподібні гриби Exophiala alcalophila Goto et Sugly із пошкодженого герметика в умовах високої вологості приміщень // Modern Phytomorphology. 2013. – Vol. 3. – С. 225-229. doi: https://doi.org/10.5281/zenodo.166571

16. Кондратюк Т.О. Особливості розвитку мікроскопічних міцеліальних грибів в авіаційному паливі / Т. О. Кондратюк, О. В. Мирошник // Мат-ли XI Міжнар. наук.-техн. конф. "АВІА -2013" (Київ, 21–23 травня 2013). – К. : НАУ, 2013. – Т. 5. – С. 31.115–31.118.

17. Кондратюк Т. Мікроскопічні гриби у приміщеннях багатоповерхового житлового будинку м. Києва / Т. Кондратюк, А. Калініченко // Вісн. Львів. ун-ту. Серія біологічна. – 2013. – № 61. – С. 144–153.

18. Мартиненко С. В. Гіфоміцет Engyodontium album (Limber) de Hoog як збудник ураження павуків у підземних колекторах м. Києва / С. В. Мартиненко, Т. О. Кондратюк, М. М. Сухомлин // Укр. ботан. журн. – 2011. – 69, № 2. – С. 423–432. Available from: http://www.botany.kiev.ua/content_ubj_12.htm#u2_12

19. Мартиненко С. В. Мікобіота підземних об'єктів антропогенного та природного походження / С. В. Мартиненко, Т. О. Кондратюк, М. М. Сухомлин // Укр. ботан. журн. – 2016. – Т. 73, № 6. У друці.

20. Березовська М. А. Значення колекцій у збереженні біорізноманіття та у сучасній науковій діяльності / М. А. Березовська, М. М. Павловська, В. В. Карбовська [та ін.] // Вісн. Київ. нац. ун-ту ім. Т. Шевченка "Проблеми регуляції фізіологічних функцій". – 2012. – Вип. 15. – С. 44–47.

21. Kondratyuk T.O. Antifungal activity of polyamide 12 films modified with polyhexamethylene guanidine dodecylbenzenesulfonate / T.O. Kondratyuk, J.-F. Bardeau, V.M. Sobko [et al.] //Modern Problems of Surface Chemistry. Internat. Conf. (May 19-23, 2014 Kyiv, Ukraine): Abstracts. – 2014. – С. 124.

22. Володіна О. П. Дослідження впливу біоцидних препаратів на старіння реставраційних паперів: метод. рекомендації. / О. П. Володіна, Н. М. Жданова, Л. М. Канарьова [та ін.]. – К. : Держкомархів України, УНДІАСД. – 2005. – 35 с.

23. Кондратюк Т. А. Вплив ефірних олій та полігексаметиленгуанідину на чорні дріжджеподібні гриби Exophiala alcalophila / Т. А. Кондратюк, А. И. Калиниченко // Вісн. Київ. нац. ун-ту ім. Т. Шевченка. Біологія. – 2014. – 3 (68). – С. 75–79. Available from: http://biovestnik.com/index.php/biology/article/view/37

24. Kondratiuk T. O. Antibacterial and antifungal effect of silver nanoparticles in compositions with polymer/inorganic hybrids / T.O. Kondratiuk, O.O. Morgaienko, T.B. Zheltonozhskaya, N.M. Permyakova // Intern. research and practice conf.“Nanotechnology and Nanomaterials (Nano-2015)" (Львів, 26-29 серпня 2015р.) – Lviv, Ukraine, 2015 – С. 449.

25. Кондратюк Т. Мікроскопічні гриби–деструктори в умовах лімітування джерела вуглецю: особливості морфології та накопичення неорганічних поліфосфатів // Modern Phytomorphology – 2014. – Т. 5. – С. 267–273. Available from: https://phytomorphology.org/archive/volume-5/

26. Кондратюк Т. О. Структурно-функціональна реорганізація диморфних чорних дріжджів Exophiala alcalophila під впливом рослинних ефірних олій / Т. О. Кондратюк, А. І. Калініченко // Вісн. Київ. нац. ун-ту імені Тараса Шевченка. Біологія. – 2015. – Т. 70, № 2. – С. 42–46. Available from: http://biovestnik.com/index.php/biology/article/view/52

27. Kuhad R.C. Microbial Cellulases and Their Industrial Applications / R.C. Kuhad, R. Gupta A. // Singh Enzyme Research. 2011; 10 pages. Article ID 280696. doi:10.4061/2011/280696.

28. Кондратюк Т. О. Філогенетичний аналіз мікроскопічних грибів родів Cladosporium та Exophiala за ядерною ДНК / Т. О. Кондратюк, М.-Х. Джеонг, Дж.-С. Хо, С. Я. Кондратюк. – В кн.: Молекулярна філогенія і сучасна таксономія наземних спорових рослин / под ред. С. Я. Кондратюка. – К. : Наук. думка, 2013. – 228 с.

29. Kondratyuk T.O. Pseudonadsoniella brunnea (Meripilaceae, Agaricomycotina), a new brown yeast-like fungus producing melanin from the Antarctic; with notes on nomenclature and type confusion of Nadsoniella nigra. / T.O. Kondratyuk, S.Y. Kondratyuk, O.O. Morgaienko [et al.] //Acta Botanica Hungarica. – 2015. – 57(3–4). – P. 291–320. doi: 10.1556/034.57.2015.3-4.5

30. Kondratiuk T.O. Confirmation of taxonomic status of black yeast-like fungus by three gene phylogeny / T.O. Kondratiuk, S.Y. Kondratyuk, M.V. Khimich, T.V. Beregova, L.I. Ostapchenko // Acta Botanica Hungarica – 2016. – 58(3–4). – P. 287–302. doi: 10.1556/ABot.58.2016.3-4.5

31. Taburets O.V. The effect of "Melanin-Gel" on the wound healing /O.V. Taburets, O.O. Morgaienko, T.O. Kondratiuk [et al.] // Res. J. Pharm., Biol. Chem. Sci. – 2016. – Vol. 7 (3). – P. 2031-2038.

32. Кондратюк Т. О. Антифунгальний вплив культуральної рідини продуценту меланіну Pseudonadsoniella brunnea / Т. О. Кондратюк, Т. В. Берегова, Л. І. Остапченко // ScienceRise: Biological Science – 2016. – №3 (3). – С. 74–78.

33. Kondratiuk T. Antifungal influence of a melanin producer Pseudonadsoniella brunnea culture fluid on Gibberella fujikuroi (anamorph: Fusarium verticilloides) / T. Kondratiuk, T. Beregova, L. Ostapchenko // Acta Botanica Hungarica. – 2017. – 59 (1–2). doi: 10.1556/ABot.59.2017.1-2.X (in press)

34. Кондратюк Т. Особливості розвитку продуценту меланіну Pseudonadsoniella brunnea в умовах впливу нітрату свинцю / Т. Кондратюк, В. Собко, Т. Берегова, Л. Остапченко // Вісн. Київ. нац. ун-ту ім. Т. Шевченка. Проблеми регуляції фізіологічних функцій. – 2016. – Т. 21, № 2. – С. 8–14. Available from: http://biovestnik.com/index.php/problems/article/view/135

37. Kondratiuk T. O. Diversity of Antarctic microorganisms – potential producers of biologically active substances / T. O. Kondratiuk, T. V. Beregova, L. I. Ostapchenko // Ukrainian Antarctic Journal – 2016. – №15 – С. 153-159.

38. Dixit R. Review Bioremediation of Heavy Metals from Soil and Aquatic Environment: An Overview of Principles and Criteria of Fundamental Processes / R. Dixit, Wasiullah, D. Malaviya [et al.] // Sustainability – 2015. – 7. – P. 2189-2212; doi:10.3390/su7022189

References

1. WDCM. WFCC-MIRCEN World Data Centre for Microorganisms. History. http://www.wdcm.org/history.html, http://www.wdcm.org/50th/

2. Casaregola S, Vasilenko A, Romano P, Robert V, Ozerskaya S, Kopf A, Glöckner FO, Smith D. An Information System for European culture collections: the way forward. Springerplus. 2016 Jun 17; 5(1):772. doi: 10.1186/s40064-016-2450-8. PubMed PMID: 27386258.

3. Culture Collections Information Wordlwide. http://www.wfcc.info/ccinfo/collection/by_acronym

4. Wu L, Sun Q, Desmeth Ph, Sugawara H, McCluskey K, Smith D, Vasilenko A, Lima N, Ohkuma M, Robert V, Zhou Y, Li J, Fan G, Ingsriswang S, Ozerskaya S, Ma J. WDCM: an information infrastructure for the exploration and utilization of microbial strains preserved worldwide. Nucleic Acids Research. 2017; 45 (D1): D611-D618. doi: 10.1093/nar/gkw903. PMCID: PMC5210620

5. WFCC Statutes. http://www.wfcc.info/index.php/about/statutes

6. WDCM. Reference Strain Catalogue. http://refs.wdcm.org/affiliatedcclists.jsp

7. WDCM. Culture Collections Information Wordlwide. http://www.wfcc.info/ccinfo/collection/col_by_country/u/380/

8. American Type Culture Collection. ATCC. https://www.atcc.org/en/Products/Collections/Microbiology_Collections.aspx

9. Clark WA, Geary DH. The Story of the American Type Culture Collection – Its History and Development (1899-1973). Advances in Applied Microbiology, 1974; 17:295-309. PubMed ID 4609142

10. Berns KI, Bond EC, Manning FJ. The American Type Culture Collection. Resource Sharing in Biomedical Research. Washington, D.C.: National Academies Press (US). 1996; 2: 23-32. Available from: https://www.ncbi.nlm.nih.gov/books/NBK209072

11. Kondratiuk TA, Kharkevych ES, Nakonechnaya LT., Zakharchenko VO, Roj AA. Biodeterioration of airplane fuel system and aviation fuel TS-1. Physico-chemical mechanics of materials. Special Issue. 2006; 2 (5): 937-940. Ukrainian.

12. Kondratiuk T, Korytnyanska V, Zacharchenko V, Artyshkova L, Nakonechna L. Mikobiota knyhosxovyshh Nacionalnoyi biblioteky Ukrayiny imeni V.I. Vernadskoho. Nauk. praci Nacionalnoyi biblioteky Ukrayiny imeni V.I. Vernadskoho. 2007; 17: 53-64.13.

13. Kondratyuk TO, Kharkevych OS, Nakonechna LT. Microscopic fungi found on damaged finishing coating materials indoors (plaster and paint). Ukr. Bot. J. 2011; 68 (3): 407– 419. Ukrainian.

14. Kondratiuk T, Nakonechna LT, Kharkevych OS. Microscopic fungi in the air of film documents depositories. Microbiolog. Zhurnal. 2012; 74 (3): 48-53. Ukrainian.

15. Kondratyuk T. Black yeast-like fungi Exophiala alcalophila Goto et Sugly from hermetic damaged in conditions of indoor high humidity. Modern Phytomorphology. 2013; V.3: 225-229. Ukrainian. doi: https://doi.org/10.5281/zenodo.166571

16. Kondratyuk TO, Myroshnyk OV. Osoblyvosti rozvytku mikroskopichnyh micelialny grybiv v aviacijnomu palyvi. Materialy XI Mizhnarodn. nauko-tehnichnoyi konferenciyi "AVIA-2013". Kyiv: NAU. 2013; V 5: 31.115–31.118.

17. Kondratyuk T, Kalinichenko A. Microscopic fungi in rooms of many storeyed residential building of Kiev city. Bulletin of Lviv University. Biology Series. 2013; 61: 144-153. Ukrainian.

18. Martynenko SV, Kondratyuk TO, Sukhomlin MM. A hyphomycete, Engyodontium album (Limber) de Hoog, attacking spiders in underground headings of Kyiv-city. Ukr. Bot. J. 2011; 69 (2): 423-432. Ukrainian.

19. Martynenko SV, Kondratyuk TO, Sukhomlin MM. Micobiota of natural and artificial underground object. Review. Ukr. Bot. J. 2016; 73 (6). Forthcoming 2017. Ukrainian.

20. Berezovska MA, Pavlovska MM, Karbovska VV, Karpenko NI, Abduloyeva OS, Kondratyuk TO, Sukhomlin MM, Kostikov IYu. Znachennya kolekcij u zberezhenni bioriznomanittya ta u suchasnij naukovij diyalnosti. Bulletin of Taras Shevchenko National University of Kyiv. Series: Problems of Physiological Functions Regulation. 2012; 15: 44-47.

21. Kondratyuk TO, Bardeau J-F, Sobko VM, Tarasyuk OP, Makhno SM, Sheludko EV, Kyselov YuV, Rogalsky SP. Antifungal activity of polyamide 12 films modified with polyhexamethylene guanidine dodecylbenzenesulfonate. Abstracts of Intern. Conf. Modern Problems of Surface Chemistry. 2014 May 19-23; Kyiv, Ukraine; 2014. p. 124.

22. Volodina OP, Zhdanova NM, Kanarjova LM, Kondratyuk TO, Sydorchenko PM. Doslidzhennya vplyvu biocydnyh preparativ na starinnya restavracijnyh paperiv. Metodychni rekomendaciyi. Kyiv: Derzhkomarhiv Ukrainy, UNDIASD. 2005.

23. Kondratyuk T, Kalinichenko A. Influence of essential oils and polyhexamethyleneguanidine on black yeast-like fungi Exophiala alcalophila. Bulletin of Taras Shevchenko National University of Kyiv. Series: Biology. 2014; 68 (3): 75-79. Ukrainian.

24. Kondratiuk TO, Morgaienko OO, Zheltonozhskaya TB, Permyakova NM. Antibacterial and antifungal effect of silver nanoparticles in compositions with polymer/inorganic hybrids. Abstracts of Intern. research and practice conf. Nanotechnology and Nanomaterials (Nano-2015). 2015 Aug 26-29. Lviv, Ukraine; 2015. p. 449.

25. Kondratyuk T. Microscopic fungi destructors in conditions of restricted carbon source: morphology and accumulation of inorganic polyphosphates. Modern Phytomorphology. 2014; 5: 267-273. Ukrainian.

26. Kondratiuk T, Kalinichenko A. Structural-functional reorganization of dimorphous black yeast-like fungi Exophiala alcalophila under influence of plant essential oils. Bulletin of Taras Shevchenko National University of Kyiv. Series: Biology. 2015; 70 (2): 42 – 46. Ukrainian.

27. Kuhad RC, Gupta R, Singh A. Microbial Cellulases and Their Industrial Applications. Enzyme Research. 2011; 10 pages. Article ID 280696. doi:10.4061/2011/280696.

28. Kondratyuk TO, Jeoung M-H, Hur J-S, Kondratyuk SY, editors. Phylogenetic analysis of microscopic fungi of the genera Cladosporium and Exophiala after nuclear DNA. In: Molecular phylogeny and recent taxonomy of terrestrial sporen plants. Kyiv: Naukova dumka, 2013.

29. Kondratyuk TO, Kondratyuk SY, Morgaienko OO, Beregova TV, Ostapchenko LI. Pseudonadsoniella brunnea (Meripilaceae, Agaricomycotina), a new brown yeast-like fungus producing melanin from the Antarctic; with notes on nomenclature and type confusion of Nadsoniella nigra. Acta Botanica Hungarica. 2015; 57(3–4): 291–320. doi: 10.1556/034.57.2015.3-4.5

30. Kondratiuk TO, Kondratyuk SY, Khimich MV, Beregova TV, Ostapchenko LI. Confirmation of taxonomic status of black yeast-like fungus by three gene phylogeny. Acta Botanica Hungarica. 2016; 58(3–4): 287–302. doi: 10.1556/ABot.58.2016.3-4.5

31. Taburets OV, Morgaienko OO, Kondratiuk TO, Beregova TV, Ostapchenko LI. The effect of "Melanin-Gel" on the wound healing. Res. J. Pharm., Biol. Chem. Sci. 2016; 7 (3): 2031-2038.

32. Kondratiuk T, Beregova T, Ostapchenko L. Antifungal influence of culture fluid of melanin producer Pseudonadsoniella brunnea. ScienceRise: Biological Science. 2016; 3 (3): 74-78. Ukrainian.

33. Kondratiuk T, Beregova T, Ostapchenko L. Antifungal influence of a melanin producer Pseudonadsoniella brunnea culture fluid on Gibberella fujikuroi (anamorph: Fusarium verticilloides). Acta Botanica Hungarica. 2017; 59(1–2). doi: 10.1556/ABot.59.2017.1-2.X. Forthcoming 2017.

34. Kondratiuk T, Sobko V, Beregova T, Ostapchenko L. Features of melanin producer Pseudonadsoniella brunnea under the influence of nitrate lead. Bulletin of Taras Shevchenko National University of Kyiv. Series: Problems of Physiological Functions Regulation. 2016; 21 (2): 8-14. Ukrainian

37. Kondratiuk TO, Beregova TV, Ostapchenko LI. Diversity of Antarctic microorganisms – potential producers of biologically active substances. Ukrainian Antarctic Journal. 2016; 15: 153-159.

38. Dixit R, Wasiullah, Malaviya D, Pandiyan K, Singh UB, Sahu A, Shukla R, Singh BP, Rai JP, Sharma PK, Lade H, Paul D. Review Bioremediation of Heavy Metals from Soil and Aquatic Environment: An Overview of Principles and Criteria of Fundamental Processes. Sustainability 2015; 7: 2189-2212. doi:10.3390/su7022189

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МІКРООРГАНІЗМИ, ПЕРСПЕКТИВНІ ДЛЯ БІОТЕХНОЛОГІЇ, МЕДИЦИНИ, ПРИРОДООХОРОННИХ ТЕХНОЛОГІЙ, У КОЛЕКЦІЇ МІКРОСКОПІЧНИХ ГРИБІВ ННЦ "ІНСТИТУТ БІОЛОГІІ ТА МЕДИЦИНИ" КИЇВСЬКОГО НАЦІОНАЛЬНОГО УНІВЕРСИТЕТУ ІМЕНІ ТАРАСА ШЕВЧЕНКА

Проаналізовано сучасний стан (склад) колекції живих культур мікроскопічних грибів, яка є частиною колекції "Culture Collection of Fungi at Taras Shevchenko National University of Kyiv" (WDCM 1000). Колекція містить 530 ізолятів мікроскопічних (міцеліальних та дріжджоподібних) грибів, які належать до відділів Zygomycota, Basidiomycota (дріжджоподібні гриби роду Rhodotorula), Ascomycota та групи Anamorphic fungi, яка є найбільшою за кількістю родів та видів мікроскопічних грибів. У 2014–2016 рр. колекцію поповнено ізолятами різних мікроорганізмів, спроможних до синтезу біологічно активних сполук (у тому числі меланіну) і стійких до впливу токсичних металів. Охарактеризовано основні напрями та результати використання колекційних ізолятів мікроорганізмів, зокрема тих, що здатні синтезувати меланін.

Ключові слова: WDCM 1000, біологічно активні сполуки, продуценти меланіну, металорезистентні мікроорганізми.

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МИКРООРГАНИЗМЫ, ПЕРСПЕКТИВНЫЕ ДЛЯ БИОТЕХНОЛОГИИ, МЕДИЦИНЫ, ПРИРОДООХРАННЫХ ТЕХНОЛОГИЙ В КОЛЛЕКЦИИ МИКРОСКОПИЧЕСКИХ ГРИБОВ УНЦ "ИНСТИТУТ БИОЛОГИИ И МЕДИЦИНЫ" КИЕВСКОГО НАЦИОНАЛЬНОГО УНИВЕРСИТЕТА ИМЕНИ ТАРАСА ШЕВЧЕНКО

Проанализированы современное состояние (состав) коллекции живых культур микроскопических грибов, которая является составной частью коллекции "Culture Collection of Fungi at Taras Shevchenko National University of Kyiv" (WDCM 1000). Коллекция содержит 530 изолятов микроскопических (мицелиальных и дрожжевидных) грибов, принадлежащих к отделам Zygomycota, Basidiomycota (дрожжевые грибы рода Rhodotorula), Ascomycota и группе Anamorphic fungi, которая является наибольшей по количеству родов и видов микроскопических грибов. В 2014–2016 гг. коллекция была пополнена изолятами микроорганизмов, способных синтезировать биологически активные соединения (в том числе меланин) и устойчивых к влиянию токсических металлов. Охарактеризованы основные направления и результаты использования коллекционных изолятов микроорганизмов, в частности тех, которые способны синтезировать меланин.

Ключевые слова: WDCM 1000, биологически активные соединения, продуценты меланина, металорезистентные микроорганизмы.