4. International Eurasian Mycology Congress

3- 5 SEPTEMBER 2024 ÇANAKKALE

BOOK OF PROCEEDINGS

4th INTERNATIONAL EURASIAN MYCOLOGY CONGRESS (EMC'24)

4. ULUSLARARASI AVRASYA MİKOLOJİ KONGRESİ (EMC'24)

BOOK OF PROCEEDINGS

TAM METİN VE ÖZET KİTABI

September 03-05, 2024 Çanakkale-Türkiye

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4. ULUSLARARASI AVRASYA MİKOLOJİ KONGRESİ (EMC'24)

September 03-05, 2024

Tuesday, Wednesday, Thursday

in Faculty of Science at Çanakkale Onsekiz Mart University

Book of Proceedings

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Kongremize desteklerinden dolayı Çanakkale Onsekiz Mart Üniversitesi Rektörlüğü, TÜBİTAK Bilim İnsanı Destek Programları Başkanlığı, Çanakkale Onsekiz Mart Üniversitesi Üniversitesi Fen Fakültesi, Mush Mantar, Ezine Belediyesi, Kepez Belediyesi, Fujifilm Türkiye, World of Fungus from Mount Ida, Çanakkale Arı Yetiştiriciliği Birliği, GEMAR Çevre Ölçüm ve Analiz Laboratuvarı, Doğtaş Holding, Çanakkale Avec Hotel, Çanakkale Akol Hotel, 18 Mart Kitapevi, Çanakkale Aşkın Art Hotel, Cura Hotel, Anzac Hotel, Sunsan Hotel, Edirne Arslanzade, Çanakkale İl Kültür ve Turizm Müdürlüğü, Çanakkale İl Tarım ve Orman Müdürlüğü, Çanakkale Yalova Restaurant, Çanakkale English Time, Çanakkale Gastronomi Kültürü Eğitim Araştırma ve Tanıtım Derneği, Biop Biotech'e teşekkürlerimizi sunarız.

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PREFACE

Dear participants and colleagues,

This year, it was a great honour and pleasure for us to welcome you to the "4th International Eurasian Mycology Congress", which we organised from 3rd to 5th September 2024, hosted by Çanakkale Onsekiz Mart University, which is rapidly becoming a research university in Çanakkale, the land of martyrs, symbolising the Turkish nation's will to defend its homeland and protect its independence. EMC'24, which we organised in Çanakkale, which is a centre of attraction with its epic history, nature and unique view of the Bosphorus, was very valuable for us with the participation of you, precious scientists, especially in terms of guiding young scientists and exchanging information.

Our mycological family is getting bigger and stronger with the increase in the number of researchers who are devoted to mycology every day in the world and in our country. By coming together in such a scientific platform, valuable members of our community have found an environment where all scientific studies of mycology science are presented, innovations are put forward, experiences are shared, solutions to problems are produced, directions are given for what needs to be done for the future, joint projects can be made, and collaborations can be established. Especially with such mycological congresses, our primary goal is to encourage young mycologist researchers by including them among us, to increase their motivation and to instil the awareness that they can close the gaps in the field with their new research every day and to provide them with the highest level of gain. Especially with such mycological congresses, our primary goal is to encourage young mycologist researchers by including them among us, to increase their motivation and to instil in them the awareness that they can close the gaps in the field with their new research every day and to provide them with the highest level of gain.

Fungi, which make a great contribution to biodiversity, contain a large number and variety of organisms living in very different habitats. New studies are being done every day about fungi. We interact with fungi in many ways every day. Our hybrid congress covers a range of fungal topics, including aerobiology, mycology, biochemistry and fungal biotechnology. Topics include fungal physiology, lichenology, medical and veterinary mycology, medicinal fungi, fungal taxonomy, cultivation, mycorrhizal fungi, mycotourism, myxomycetes, parasitic fungi, and yeasts.

Finally, we would like to thank the organising committee, the scientific and advisory board, all the scientists who participated in our congress, our invited speakers, all the institutions and organisations that hosted us, and all our participant.

Best regards.

https://emc2024.comu.edu.tr

29 October 2024

Prof. Dr. Ahmet ASAN
Honorary President

Assist. Prof. Dr. Tülay BİCAN SÜERDEM
Congress President

ÖNSÖZ

Değerli Katılımcılar ve Kıymetli Meslektaşlarımız,

Sizleri bu yıl, Türk milletinin vatan topraklarını savunma, bağımsızlığını koruma iradesini simgeleyen, şehitler diyarı Çanakkale'mizde, araştırma üniversitesi olma yolunda hızla ilerleyen Çanakkale Onsekiz Mart Üniversitesi ev sahipliğinde, 3-5 Eylül 2024 tarihlerinde düzenlemiş olduğumuz "4. Uluslararası Avrasya Mikoloji Kongresi"nde ağırlamaktan büyük onur ve mutluluk duyduk. Çanakkale gibi destansı tarihiyle, doğası ve eşsiz boğaz manzarasıyla bir cazibe merkezi olan ilimizde düzenlediğimiz EMC'24, siz değerli bilim insanlarının katılımıyla, özellikle genç bilim insanlarına öncülük etmeniz ve bilgi paydaşlığı yapmanız açısından bizler için oldukça kıymetliydi.

Dünyada ve ülkemizde her geçen gün mikolojiye gönül veren araştırmacılarımızın artması ile mikoloji ailemiz daha da büyümekte ve güçlenmektedir. Camiamızın değerli üyeleri böyle bir bilimsel platformda biraraya gelerek, mikoloji bilimine ait tüm bilimsel çalışmaların sunulduğu, yeniliklerin ortaya konulduğu, tecrübelerin paylaşıldığı, sorunlara çözüm üretilirken, geleceğe yönelik yapılması gerekenlere yön verildiği, ortak projelerin üretilebildiği, işbirliklerinin kurulmasına katkı sağlayacak bir ortam imkanı bulmuşlardır. Özellikle bu tür mikoloji kongreleri ile genç mikolog araştırmacıları aramıza dahil ederek onları teşvik etmek, motivasyonlarını artırmak ve her geçen gün yeni araştırmalarıyla alandaki boşlukları kapatabilecekleri bilincini aşılamak ve onlara en yüksek düzeyde kazanım sağlamak öncelikli hedefimizdir.

Biyoçeşitliliğe büyük katkı sağlayan Fungi Alemi, çok farklı habitatlarda yaşayan çok sayıda ve çeşitlilikte organizmayı bünyesinde barındırmaktadır. Günlük hayatımızda çok farklı şekillerde maruz kaldığımız ve etkileşim içinde olduğumuz Fungi alemi üyeleri ile ilgili her geçen gün birçok yeni çalışma yapılmakta ve yeni gelişmeler yaşanmaktadır. Bu bilgiler ışığında hibrit (çevrimiçi ve yüz yüze) olarak gerçekleştirilen kongremizde aerobiyoloji, tarım ve gıda mikolojisi/ toksikolojisi, çevre mikolojisi, etnomikoloji, fungal çeşitlilik, fungal biyoteknoloji, fungal kimya ve biyokimya, fungal fizyoloji, likenoloji, tıbbi ve veteriner mikoloji, tıbbi mantarlar, moleküler fungal taksonomi, kültivasyon, mikorizal mantarlar, mikoturizm, miksomisetler, parazitik mantarlar, mayalar gibi başlıca konular ele alınmış ve tartışılmıştır.

Son olarak, bu duygularla kongrenin düzenlenmesi sürecinde birlikte yoğun bir özveriyle çalıştığımız düzenleme kuruluna, değerli görüş ve önerileriyle bizlere destek olan bilim ve danışma kurulu üyelerine, bilimsel çalışmaları ile kongremize katılım sağlayan tüm bilim insanlarına ve yurt içi ve yurt dışından davetimizi kabul edip aramızda olan davetli konuşmacı hocalarımıza, kongrenin düzenlenmesi sırasında bizleri büyük bir sabırla ağırlayan tüm kurum ve kuruluşlara ve katılımlarıyla kongremize değer katan tüm katılımcılarımıza en içten teşekkürlerimizi sunuyoruz.

Saygılarımızla.

https://emc2024.comu.edu.tr
29 Ekim 2024

Prof. Dr. Ahmet ASAN
Kongre Onursal Başkanı

Dr. Öğr. Üyesi Tülay BİCAN SÜERDEM
Kongre Başkanı

FACE TO FACE PROGRAMME

03.09.2024 - Tuesday		
09:00 - 10:00	**Registration**	***Troia Culture Center***
10:00 - 11:00	**Opening Cerenomy**	***Prof. Dr. Sevim Buluç Auditorium***
Plenary Session	**Chair: Prof. Dr. Ahmet ASAN** **Assist. Prof. Dr. Tülay BİCAN SÜERDEM**	
Invited Speaker ***(Prof. Dr. Sevim Buluç Auditorium)***		
11:00 - 11:45	***Prof. Dr. Ilgaz AKATA***, Ankara University – TR ***Title:*** Truffles and Truffle-like Fungi Reported in the European Part of Türkiye	
11:45 – 13:30 O P E N I N G C O C K T A I L		
Plenary Session	**Chair: Prof. Dr. Yusuf UZUN** **Prof. Dr. Rasime DEMİREL**	
Invited Speakers ***(Prof. Dr. Sevim Buluç Auditorium)***		
13:30 - 14:15	***Assoc. Prof. Dr. Beata ZIMOWSKA***, University of Life Sciences – PL ***Title:*** Biotechnological Potential of Endophytic Fungi in Nanotechnology and Sustainable Agriculture	
14:15 - 14:45	***Tuğberk Ağırman - FUJIFILM*** ***Title:*** Beta Glucan: New Horizons in Early Detection of Infection Risk	
14:45 - 15:15	***Assist. Prof. Dr. İskender KARALTI,*** Azerbaijan Medical University – AZ ***Title:*** Role of Serological Tests in the Diagnosis of Fungal Infections	
15:15 – 15:30 C O F F E E B R E A K		
15:30 - 16:00	**Fujifilm Workshop 1 (Application of ß-Glucan Test Kit) (Floor: -1)**	
	Session 1 (*Hall A*) **Medical and Veterinary Mycology** **Chair: Prof. Dr. Emel TÜMBAY** **Assist. Prof. Dr. İskender KARALTI**	**Session 2 (*Prof. Dr. Ümit Serdaroğlu Hall)*** **Agricultural and Food Mycology / Toxicology** **Chair: Prof. Dr. Ahmet ASAN** **Assoc. Prof. Dr. Halide KARABIYIK**
16:00 - 16:15	Uncovering New Mycoviruses in *Lecanicillium aphanocladii*: First Report of Dermatophytosis and Complete Genomic Characterization of LaPMV1 and LaNSRV1 *Gülce Ediş, Ilgaz Akata, Ertuğrul Kaya, Nuray Gündoğdu, Selçuk Kaya, Ergin Şahin*	Heavy Metal Content in the Mushroom *Dissingia leucomelaena*: Carcinogenic and Non-carcinogenic Risk Assessment *Fadime Canbolat, İsmail Acar*
16:15 - 16:30	The Role of Molecular Methods in Dermatophyte Diagnosis *Aras Fahrettin Korkmaz*	Heat Resistant Molds on Fruits and Fruit-Containing Products *Elif Doğan, Nükhet Nilüfer Zorba*
16:30 – 16:45	Investigation of The Presence of *Candida auris* in Blood Cultures with The MALDI-TOF MS System *Melek Tikveşli, Sümeyye Akyüz, Ender Çetinkaya, Habibe Tülin Elmaslar Mert, Şaban Gürcan, Figen Kuloğlu, Hüseyin Güdücüoğlu*	Investigation of *Fusarium* spp. on *Humulus lupulus* L. (HOPs) and in the Soils in which it is Grown at Pazaryeri/Bilecik Region *Seda Öztaş, Rasime Demirel*
16:45 - 17:00	Determining the Drug Sensitivity Pattern of *Candida* Isolated from the Urine of Patients Hospitalized in Imam Reza Hospital, Ardabil-Iran; 2022-2023 *Solmaz Basiri, Hamed Mohsenirad, Yaser Nasirzadeh, Sina Nazer, Mehrab Kosartalab, Mehran Sakkaki*	Fungal Diseases Causing Drying in Protease Ornamental Plants in Hatay Province *Aysun Uysal, Şener Kurt, Tuğba Hanedan*
17:00-17:15	Rosmarinic Acid Exhibits Antifungal and Antibiofilm Activities Against *Candida* Species: Insights into Gene Expression and Morphological Changes *Merve Aydın, Nurhan Unusan, Esra Şumlu, Emine Nedime Korucu*	Airborne Fungi Diversity in Dust Transport in Çanakkale on May 17, 2024 *Gülçin Özcan Ateş, Tuğba Hanedan*

FUJIFILM WORKSHOP (Application of ß-Glucan Test Kit)

04.09.2024 - Wednesday	
10:00 - 11:00	Fujifilm Workshop 2 (Application of ß-Glucan Test Kit) (Floor: -1)
11:00 – 12:00	Fujifilm Workshop 3 (Application of ß-Glucan Test Kit) (Floor: -1)
14:00 – 15:00	Fujifilm Workshop 4 (Application of ß-Glucan Test Kit) (Floor: -1)
15:00 – 16:00	Fujifilm Workshop 5 (Application of ß-Glucan Test Kit) (Floor: -1)

04.09.2024 - Wednesday		
	Session 3 (*Hall A*) **Fungal Biotechnology** **Chair: Prof. Dr. Alev UZTAN** **Assoc. Prof. Dr. Beata ZIMOWSKA**	**Session 4 (*Prof. Dr. Ümit Serdaroğlu Hall*)** **Fungal Biodiversity, Medicinal Mushrooms** **Chair: Prof. Dr. Gıyasettin KAŞIK** **Assoc. Prof. Dr. Hossein ZARRINFAR**
09:30-09:45	Enhancement of Laccase Activity in *Trametes versicolor* Through Solid-State Fermentation Using Phenolic-Rich Lingonberry Waste *Berker Çetintaş, Sait Sargın*	Rediscovery of *Schenella pityophila* in Türkiye: In-Depth Morphological and Molecular Analyses for Accurate Identification and Characterization *Eda Kumru, Gülce Ediş, İsmail Acar, Ergin Şahin, Hakan Allı, Ilgaz Akata*
09:45-10:00	Current Artificial Intelligence Applications in Mycology *Selma Vuruşaner*	Wild Edible Macrofungi Determined in Ayaş District (Ankara) *İnci Yorulmazlar, Abdullah Kaya*
10:00-10:15	Mycelium as a Next-Generation Green Building Material: Comparative Analysis with Conventional Environmentally Harmful Products *Onur Kırdök, Berker Çetintaş, Orkun Kıvrak, Tutku Didem Altun, Elif Esin Hameş*	A New Genus Record from Hakkâri, Türkiye; *Helicogloea lagerheimii* Pat. *Yusuf Uzun, Sedat Kesici, İsmail Acar*
10:15-10:30	Macrofungus Species Selection for Mycelial Composite Production *Aylin Akdere, Bahar Gülce Korkmaz Kahveci, Esin Poyrazoğlu, Senem Öztürk Köse, H. Halil Bıyık, Zeynep Basaran Bundur, H. Hüseyin Doğan, Mustafa Yamaç*	Comparative Analysis of Macrofungal Diversity in Morocco and Türkiye: Environmental Influences on Species Richness and Ecological Distribution *Amal Belaid, Sinan Alkan, Gıyasettin Kaşık*
10:30-10:45	Biotechnological Potential of Macrofungi Isolated from Bilecik Province, Türkiye *Bahar Gülce Korkmaz Kahveci, Aylin Akdere, Hakan Allı, Hasan Hüseyin Doğan, Nalan Yılmaz Sarıözlü, Mustafa Yamaç*	Hymenochaetoid Medicinal Macrofungi in Central Asia: A Comprehensive Study of Their Diversity, Distribution, Ethnomycological Importance, and Medicinal Properties *Yusufjon Gafforov, Milena Rašeta, Manzura Yarasheva, Kanaim Bavlankulova, Burkhon Munnavarov, Oksana Mykchaylova, Şule İnci, Ewald Langer, Young Woon Lim, Li-Wei Zhou, Arshad Mehmood Abbasi, Dian-Ming Hu, Soumya Ghosh, Jiajia Chen, Sylvie Rapior*
10:45- 11:00 C O F F E E B R E A K		
Plenary Session		**Chair: Prof. Dr. Mustafa YAMAÇ** **Prof. Dr. Nükhet Nilüfer ZORBA**
Invited Speakers (*Prof. Dr. Sevim Buluç Auditorium*)		
11:00 - 11:45	***Prof. Dr. Jos HOUBRAKEN,*** Westerdijk Fungal Biodiversity Institute – NL ***Title*:** Taxonomy and Variability of Food-Associated *Aspergillus* and *Penicillium*	
	Session 5 (*Hall A*) **Fungal Biotechnology** **Chair: Prof. Dr. Abdullah KAYA** **Assist. Prof. Dr. Gülçin ÖZCAN ATEŞ**	**Session 6 (*Prof. Dr. Ümit Serdaroğlu Hall*)** **Fungal Biodiversity** **Chair: Prof. Dr. Özlem ABACI GÜNYAR** **Assist. Prof. Dr. Aras Fahrettin KORKMAZ**
11:45 – 12:00	Screening of Fungi Isolated from Hypersaline Environments for Eps Production and Production Optimization with Selected Isolate *Penicillium allii* *Esma Ocak, Semra İlhan*	Isolation, Identification, and Comparison of Microfungi on Stored Commercial Wheat and Siyez Wheat in İhsangazi District of Kastamonu *Ruhşen Aydın Karaağaç, Gülay Giray, Abdullah Şimşek*
12:15 – 12:30	Partial Purification and Characterization of Beta-Galactosidase Enzyme Isolated from *Aspergillus brasiliensis* *Yüksel Gezgin, Ebru Kocadağ Kocazorbaz, Ayşegül Yoltaş*	Halotolerance and Alkalitolerance Properties of Microfungi from Lake Acıgöl/Türkiye *Lira Usakbek Kyzy, Semra İlhan, Rasime Demirel*
12:30 – 12:45	Total Phenolic Content and DPPH Antioxidant Activity of Lion's Mane Mushroom (*Hericium erinaceus*) *Selcen Çakır*	Microfungal Contamination in Barn Environments: Health Risks and Economic Effects for Animals and Veterinarians *Abdullah Şimşek, Gülay Giray, Mehmet Küçükoflaz*
12:45 – 13:00	Evaluation Secondary Metabolites Profiles of *Aspergillus brasiliensis* by Plug Extraction Method *Yüksel Gezgin, Hatice Cemre Ünver, İnci Uludağ, İ. Hakkı Akgün*	
13:00 – 14:00 L U N C H		
Plenary Session		**Chair: Prof. Dr. Ilgaz AKATA** **Assoc. Prof. Dr. Halide KARABIYIK**
Invited Speakers *(Prof. Dr. Sevim Buluç Auditorium)*		
14:00 – 14:45	***Prof. Dr. Uğur BATI,*** Nişantaşı University - TR ***Title:*** The Effect of Mushrooms on Naturalistic Intelligence	
14:45-	***Onur KIRDÖK – BIOP BIOTECH***	

15:00	***Title:*** From Nature to Structure: Mycelium-Based Biocomposites and Green Innovation with Biop Biotech
	15:00 – 15:30 C O F F E E B R E A K
15:30	**P A N E L MAJOR PROBLEMS RELATED to MYCOLOGICAL STUDIES in TÜRKİYE (*Prof. Dr. Sevim Buluç Autditorium*) Moderator: Prof. Dr. Ahmet ASAN Panelists: Prof. Dr. Yusuf UZUN Prof. Dr. Rasime DEMİREL Prof. Dr. Ilgaz AKATA**

05.09.2024 – Thursday		
	Session 7 (*Hall A*) Fungal Biodiversity, Molecular Fungal Taxonomy Chair: Prof. Dr. Rasime DEMİREL Assist. Prof. Dr. Gülay GİRAY	**Session 8 (*Prof. Dr. Ümit Serdaroğlu Hall*) Myxomycetes, Medical and Veterinary Mycology Chair: Prof. Dr. Serkan ÖRTÜCÜ Assist. Prof. Dr. Selime Semra EROL**
09:30 - 09:45	Examination of the Distribution of *Candida* Species Isolated from Blood Cultures in a University Hospital *Salih Maçin, Senanur Yılmaz, Rugiyya Samadzade, Hatice Türk Dağı, Duygu Fındık*	Biodiversity and Ecology of Myxomycetes of Kırka Forest, Eskişehir *İjlal Ocak, Elif Korcan, Seval Sarıoğlu Yalın*
09:45 - 10:00	Polyphasic Taxonomy of Heat Resistant *Hamigera* Isolates from Soil Samples Taken from Some Locations in Different Provinces of Türkiye *Goulsoum Ouzeir, Burhan Şen, Rasime Demirel, Ahmet Asan*	Climate Change and Myxomycetes *İjlal Ocak, Tülay Bican Süerdem*
10:00 - 10:15	Green Synthesis of Copper Oxide Nanoparticles Using Okra Fruit Extract and Doped Shapes and Assessment of Their Antifungal Applications *Mohammad Javad Javid-Naderi, Majid Darroudi, Hossein Zarrinfar, Amin Jalili, Zahra Sabouri, Khalil Talebi*	Examination of Galactomannan Antigen Test Results in the Diagnosis of Patients with Suspect of Invasive Aspergillosis *Salih Maçin, Rugiyya Samadzade, Senanur Yılmaz, Duygu Fındık*
10:15 - 10:30	The Discovery of Polyphasic Taxonomy of Isolates of Heat-Resistant *Paecilomyces* and Its Close Genera Found in Soil Samples Taken from Some Locations in Different Provinces of Türkiye *Goulsoum Ouzeir, Burhan Şen, Rasime Demirel, Ahmet Asan*	
	10:30 – 11:00 C O F F E E B R E A K	
	Plenary Session	**Chair: Prof. Dr. İjlal OCAK Assoc. Prof. Dr. İsmail ACAR**
	Invited Speakers *(Prof. Dr. Sevim Buluç Auditorium)*	
11:15 – 12:00	***Prof. Dr. Özlem ABACI GÜNYAR,*** Ege University – TR ***Title:*** Bacteriome of the Clinically Important Fungi	
	12:00 – 12:15 C O F F E E B R E A K	
	Session 9 (*Hall A*) Mycotourism, General Mycology Chair: Prof. Dr. Tülay GÜZEL Assist. Prof. Dr. Ebru Özlem KORKUTATA	**Session 10 (*Prof. Dr. Ümit Serdaroğlu Hall*) Medicinal Mushrooms, Medical and Veterinary Mycology Chair: Prof. Dr. Prof. Dr. Jos HOUBRAKEN Prof. Dr. Burhan ŞEN**
12:15 - 12:30	Experiences Offered by Mushroom Gastronomy and Mushroom Tourism *Zührem Yaman*	Some Important Species of Mushrooms Known for Medical Purposes *Özge Nur Türkeri*
12:30 - 12:45	Production of Composite Materials from Mycelium: Potential and Applications in Türkiye *Süleyman Bayramoğlu, Zehra Ağırtmış, Selime Semra Erol*	In Silico Evaluation of Antimicrobial Activity of Luteon Terpenoid against *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Candida albicans* *Eray Korkmaz Yalçın, Gülçin Özcan Ateş*
12:45 - 13:00	A Comparison of Total Phenolic, Antioxidant, and Flavonoid Contents in Natural and Cultured Mycelia of *Morchella importuna* M. Kuo, O'Donnell & T.J. Volk. *Selime Semra Erol*	In Silico Evaluation of Anticandidal Activity of Main Constituents of *Melaleuca quinquenervia* (Niaouli Oil) against *Candida albicans* *Berk Eray Esen, Gülçin Özcan Ateş*
	13:00 – 14:00 L U N C H	
	Plenary Session	**Chair: Prof. Dr. Ahmet ASAN Assist. Prof. Dr. Tülay BİCAN SÜERDEM**
	Invited Speakers *(Prof. Dr. Sevim Buluç Auditorium)*	

14:00 – 14:45	***Uzm. Dr. Elif GÜVELOĞLU,*** İstanbul – TR ***Title:*** Mushroom and Cancer	
	14:45– 15:00 C O F F E E B R E A K	
15:00- 15.45	**Closing Ceremony**	***Prof. Dr. Sevim Buluç Auditorium***

POSTER PRESENTATION PROGRAMME

No	Section	03-05 September 2024 (*EVERY DAY AT 15:00 - 15:30 AND DURING COFFEE BREAKS*)
P1	Aerobiology	*Alternaria* Spores in Aerobiological Studies in Türkiye *Hanife Akyalçın, Yağmur Özkan*
P2	Agricultural and Food Mycology / Toxicology	Mold Risk in Cacao and Chocolate *Elif Doğan, Nükhet Nilüfer Zorba*
P3	Agricultural and Food Mycology / Toxicology	An Overview on Genotoxicity of Ochratoxins *Nihan Akıncı Kenanoğlu, Ahmet Ali Berber*
P4	Environmental Mycology	Fungal Biomaterials for a Sustainable Future *Gamze Çatal, Tülay Bican Süerdem*
P5	Fungal Biodiversity	*Mycena chlorantha* (Fr.) P. Kumm., a New Record for Türkiye *İnci Yorulmazlar, Abdullah Kaya*
P6	Fungal Biodiversity	New Macrofungal Records from Dokuz Eylül University Tınaztepe Campus Area: Morphological and Phylogenetic Insights *Eda Kumru, Gülce Ediş, Ergin Şahin, İsmail Acar, Ilgaz Akata*
P7	Fungal Biodiversity	Barcoding *Aspergillus*, *Penicillium* and *Talaromyces* strains from the CBS biobank *Jos Houbraken, Ya Bi Zhou*
P8	Fungal Biodiversity	Species Diversity of Puccinia Parasitic on Plant Family of Poaceae in Northeastern Uzbekistan *Islomjon Urinboev, Yusufjon Gafforov, Islambek Amaniyazov, Shikhnazar Khodjaev, Dilfuza Berdieva, Ikram Abdullaev*
P9	Fungal Biotechnology	Optimization of Substrate Pretreatment, Enzymatic Hydrolysis and Fermentation Conditions for Biomass Production with *Rhizopus oryzae* NRRL 395 from Stale Bread *Burcu Kaya, Özlem Şahiner, Gökçe Örüntaş, Onur Güneşer, Yonca Yüceer*
P10	Fungal Biotechnology	Production of Melanin by *Aspergillus terreus* and Analysis of its Structural Properties *Pervin Soyer, Semra İlhan, Yağmur Tunalı, Zerrin Cantürk*
P11	Fungal Biotechnology	Reseach of Laccase-Producing Microfungi in Agricultural Waste and by-Products in Thrace Region *Begüm Sıdal, Halide Karabıyık*
P12	Fungal Biotechnology	Investigation of the Gene Region Responsible for Ribotoxin Production in Entomopathogenic *Beauveria bassiana* *Bengi Aldı, Bahar Gökçen, Özlem Abacı Günyar*
P13	Fungal Biotechnology	The Screening of the Ribotoxin Production Potential in *Aspergillus* Species *Bahar Gökçen, Özlem Abacı Günyar*
P14	Fungal Biotechnology	Biodiesel Production from Fungi: Mycodiesel *Bilge Eskin, Tülay Bican Süerdem*
P15	Fungal Biotechnology	The Use of Filamentous Fungi as an Alternative Protein Source *Gülbeden Mutlu, Halide Karabıyık*
P16	Fungal Chemistry and Biochemistry	Exploring the Nutritional and Mycochemical Properties of Serbian *Cyclocybe aegerita*: Minerals and Polyphenolic Profiles *Milena Rašeta, Sanja Berežni, Marko Kebert, Yusufjon Gafforov*
P17	Fungal Chemistry and Biochemistry	Antagonistic Potential of an Endophytic *Pezicula* sp. against *Hymenoscyphus fraxineus* and its Impact on Secondary Metabolites Production *Özge Demir, Frank Surup, Barbara Schulz, Mıchael Steinert, Marc Stadler*
P18	Lichenology	Biomonitoring of Airborne Microplastics with Lichens in Urban and Rural Areas in Balıkesir Province *Handan Kurtulmuş Sancak, Gülşah Çobanoğlu, Ezgi Özen*
P19	Lichenology	Investigation of Airborne Microplastic Accumulation in Lichens in Some Urban Forests of İstanbul Using Fluorescent Techniques *Ezgi Özen, Handan Kurtulmuş Sancak, Gülşah Çobanoğlu*
P20	Medical and Veterinary Mycology	Effect of Henna- Apple Vinager Mixtures against *Trichophyton rubrum* *Suzan Ökten, Yankı Ökten, Kuzey Ada, Umay Ece Tosun, Serap Ergün*
P21	Medical and Veterinary Mycology	Antifungal Activity of Essential Oil and Ethanolic Propolis Extract Mixtures against Biofilm-Producing *Pichia manshurica* *Gülçin Özcan Ateş, Rumeysa Asude Gökalp*

P22	Medical and Veterinary Mycology	Anticandidal Activity of Ethanolic Propolis Extract and Essential Oil Mixtures Against Biofilm-Producing *Candida albicans* *Gülçin Özcan Ateş, Funda Elmacı*
P23	Medical and Veterinary Mycology	The Impact of COVID-19 Pandemic on the Prevalence, Predisposing Factors, and Outcomes of *Pneumocystis jirovecii* pneumonia Among Pediatric Inpatients *Neginsadat Hosseinikargar, Hossein Zarrinfar, Seyed Javad Seyedi, Mohammadjavad Najafzadeh, Mohsen Dashti, Mohammadreza Montazer Abadi, Hadi Farsiani, Maryam Hosseinipour, Narges Shekofteh Mehr*
P24	Medical and Veterinary Mycology	Antifungal Activity of Basil Oil on Radial Growth of *Aspergillus niger* *Müge Hayal Soyiç, Gülçin Özcan Ateş*
P25	Medical and Veterinary Mycology	Antifungal Activity of Taurus Mint Oil on Radial Growth of *Penicillium* sp. *Fatma Budak, Gülçin Özcan Ateş*
P26	Medical and Veterinary Mycology	Antifungal Activity of Garlic Oil on Radial Growth of *Fusarium sp.* *Rana Karlı, Gülçin Özcan Ateş*
P27	Medicinal Mushroom	Cultivation of *Ganoderma lucidum* (Curtis) P. Karst. (Immortality Mushroom) *İrem Nur Özdemir, İsmail Acar*
P28	Medicinal Mushroom	The Importance of *Grifola frondosa* (Dicks.) Gray in Cosmetics *İdil Aze Türkdoğan, Tülay Bican Süerdem*
P29	Medicinal Mushroom	Pharmaceutical Properties of *Hericium erinaceus* *Halise Şahin, İsmail Acar*
P30	Medicinal Mushroom	*Cordyceps*: A Mycological Marvel *Miray Özkılıç, Tülay Bican Süerdem*
P31	Molecular Fungal Taxonomy	First report of *Leucoagaricus viscidulus* in Türkiye:Documenting its Initial Presence on the Asian Continent *Gülce Ediş, Eda Kumru, Ergin Şahin, İsmail Acar, Ilgaz Akata*
P32	Mushroom Cultivation	Wild-Collected *Ganoderma lucidum* (Curtis) P. Karst. Mushroom on Hazelnut Waste Compost: A Sustainable Approach *Selime Semra Erol, Şemsettin Kulaç*

ONLINE PROGRAMME

04.09.2024 – Wednesday	
Session 11 Oral Presentation Chair: Assist. Prof. Dr. Onur Sinan TÜRKMEN	
11:00 – 11:15	Dimensional Analysis of Truffle Mushroom Usage in Restaurants within the Muğla Region *Sevgin Özderin, Ali Orhan, Murat Sakal*
11:15 – 11:30	Multigene Phylogeny and Morphological Identification of *Helvella capucina* from Türkiye *Şüheda Aldemir Terman, Ayten Dizkırıcı, Mustafa Emre Akçay*
11:30 – 11:45	Examination of the Aegean Region in Terms of Truffle Potential *Sevgin Özderin, Hakan Allı*
11:45 – 12:00	New Record and Molecular Identification of *Tricharina cretea* Collected from Nemrut Mountain, Türkiye *Şüheda Aldemir Terman, Mustafa Emre Akçay, Ayten Dizkırıcı*
Session 12 Oral Presentation Chair: Prof. Dr. Nükhet Nilüfer ZORBA	
13:00 – 13:15	Identification of *Neopestalotiopsis clavispora* Associated with Brown Leaf Spot on Avocado in Northern Thailand *Asieh Vasighzadeh, Ruvishika S. Jayawardena*
13:15 – 13:30	Atmospheric Nitrogen Pollution Effects on the Lichen *Xanthomendoza fulva* in Tehran Metropolis *Nasrin Hassanzadeh, Faezeh Jafari, Mohammad Sohrabi, Rouhollah Karimi, Silvana Munzi*
13:30 – 13:45	Where Taxonomy Meets Chemistry and Medicine: Medicinal Hymenochaetaceae brought into the Molecular Phylogeny *Masoomeh Ghobad-Nejhd, Li-Wei Zhou, Michal Tomšovský, Paola Angelini, Gaia Cusumano, Giancarlo Angeles Flores , Roberto Venanzoni, Xue-Wei Wang, Samaneh Chaharmiri-Dokhaharani, Mehdi Moridi Farimani, Kadri Pärtel, Yu-Cheng Dai, Fang Wu*
13:45 – 14:00	Biological monitoring of potentially toxic elements (Cr, Fe, Pb, Zn) with the method of lichen transplant in the southern part of the Tehran metropolis *Nasrin Hassanzadeh, Sara Abdollahi, Mohammad Sohrabi, Stefano Loppi*
Session 13 Oral Presentation Chair: Assist. Prof. Dr. Aras Fahrettin KORKMAZ	
14:30 – 14:45	A Rare Microfungus Record from Türkiye *Merve Ulukapı, Faruk Selçuk, Elşad Hüseyin, Ekrem Aktoklu*
14:45 – 15:00	Effects of Growth Media on the Diversity of Culturable Fungi from Lichens of Bursa, Türkiye *Gamze Kurtulus, Tunahan Irmak Başaran, Goulsoum Ouzeir, Birkan Açıkgöz, Barış Gökalsın, Burhan Şen, Nüzhet Cenk Sesal*
15:00 – 15:15	Comparison of Endolichenic Fungi Biodiversity of *Pseudevernia furfuracea* from Bursa-Türkiye, by Advanced Isolation Techniques and Metabarcoding Analysis

	Tunahan Irmak Başaran, Gamze Kurtuluş, Goulsoum Ouzeir, Birkan Açıkgöz, Barış Gökalsın, Burhan Şen, Nüzhet Cenk Sesal
15:15 – 15:30	Endolichenic Fungi from *Ramelina* sp. as Potential Quorum Sensing Inhibitors *Beste Şener, Orçun Toksöz, Birkan Açıkgöz, Jae-Seoun Hur, Barış Gökalsın, Nüzhet Cenk Sesal*
15:30 – 15:45	Genetic Structure of the Population of *Botrytis cinerea* and Molecular Diagnosis of the Fungal Contamination in Strawberry in Aydın Province *Hacı Bıyık, Zeynep Ün Yılmaz*
	Session 14 Oral Presentation **Chair: Assist. Prof. Dr. Fadime CANBOLAT**
16:00 – 16:15	A Research on the Production of Insulation Materials from Some Fungi Mycelia *Hacı Halil Bıyık, Aykan Özgür*
16:15 – 16:30	Antiviral Activity of *Fuscoporia torulosa* (Pers.) T.Wagner & M. Fisch. against HSV-1 and HSV-2 *Ümmühan Ünlü, Hasan Hüseyin Doğan, Rüstem Duman*
16:30 – 16:45	A Major Clinical Challenge: Development of Resistance to Antifungal Drugs in *Candida parapsilosis* Complex Isolates! *Zeynep Yazgan, Gökhan Aygün*
16:45 - 17:00	Inhibitory Effect of Methylene Blue on *Candida albicans* Clinical Isolates *Deniz Gazel, Simge Demir, Ayşe Büyüktaş Manay*

INVITED SPEAKERS

Truffles and Truffle-like Fungi Reported in the European Part of Türkiye

Ilgaz AKATA[1*], Eda KUMRU[2], Gülce EDİŞ[2], Emre KESKİN[3-4], Ergin ŞAHİN[5-6]

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The current study, conducted between 2022 and 2024, thoroughly investigated the diversity of truffle and truffle-like fungi in the European region of Türkiye. This research entailed systematically collecting and identifying fungal specimens, which were then subjected to rigorous analyses. A multi-faceted approach was employed, encompassing both morphological and detailed evaluations of their microscopic and macroscopic characteristics. This comprehensive methodology enabled a robust phylogenetic framework, identifying 30 distinct species of truffle and truffle-like fungi. These species were taxonomically classified into two principal divisions, with further categorization into eight families and ten genera. Notably, 24 species were classified under the Ascomycota division, while the remaining six were categorized under Basidiomycota.

A significant outcome of this study is the documentation of ten species new to the mycobiota of Türkiye. These include *Elaphomyces aculeatus* Vittad., *E. papillatus* Vittad., *E. virgatosporus* Hollós, *Genea fragrans* (Wallr.) Sacc., *G. pseudobalsleyi* Agnello, Bratek & Cabero, *G. pseudoverrucosa* Bratek, Konstantin. & Van Vooren, *G. vagans* Mattir., *Tuber lusitanicum* Ant. Rodr. & Muñoz-Mohedano, *Hymenogaster huthii* Stielow, Bratek & Hensel, and *Statesia pompholyx* (Tul. & C.Tul.) Castellano, T.Lebel, Davoodian & K.Hosaka. Additionally, the study documented 14 species previously unreported in the European part of Türkiye.

Moreover, this research provides a thorough and systematic documentation of the collection sites, including precise geographical coordinates, detailed habitat descriptions, and specific collection dates. Each species was rigorously characterized, incorporating comprehensive macro- and micromorphological descriptions, alongside high-resolution spore images captured through scanning electron microscopy (SEM).

Keywords: Novel records, truffle fungi, molecular phylogeny, morphological assessment, Türkiye

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Biotechnological Potential of Endophytic Fungi in Nanotechnology and Sustainable Agriculture

Beata ZIMOWSKA[1*], Gabrela KRATOŠOVÁ[2], Monka BELECKA[3], Magdalena ANTONOWCZ[4], Bartosz PENCAKOWSK[3]

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Biodiversity loss, ecosystem collapse and food security are some of the biggest threats facing humanity currently and in the next decade. As a milestone of European Union's priority is to reverse biodiversity loss, achieve food security and engender agricultural sustainability, to ensure that by 2030 all the ecosystems are intended to be resilient, restored, and adequately protected. Pollution, including hazardous pesticides, is a core driver of biodiversity loss and has a harmful impact on our health and environment. Thus, biological control of pests and pathogens is a promising approach as a strategy supporting environmentally friendly line with limited health hazards. Endophytic fungal associations with crops show considerable promises in this respect, because of their effectiveness, habit-specific mode of action and capacity to provide multiple benefits These economically viable microorganisms have the ability to take part in plant fitness and growth development, with beneficial advantages which can be explored for sustainable agriculture. The great ability of adaptation to different environments, an aptitude to colonize a majority number of hosts and the expression of high amounts of biological compounds make endophytes to be considered for biotechnological applications. Their properties apply to different areas and are highly useful in different sectors of industries, environment and recently also in nanotechnology. There are many reports concerning biological synthesis of nanoparticles, but the potential of endophytic fungi in this respect has not yet been fully investigated. The main goals of this studies were mycosynthesis of AgNPs using *Arcopilus aureus*, *Boeremia exigua* var. *exigua* and *Fusarium* sp. as an endophytic fungi, characterization of synthetized AgNPs and their antifungal assay towards *Colletotrichum fuscum*, *Boeremia strasseri*, and *Sclerotinia sclerotiorum*. Morphological features of endophytes were confirmed by molecular analysis with sequencing of relevant DNA

markers, namely ITS, β-tubulin (*tub*), *tef-1*, and the RNA polymerase II (*rpb2*) genes. Fresh mycelium cell-free filtrate was mixed with 30 mM $AgNO_3$ Subsequently, the reaction mixture was vigorously shaken in a shaker incubator at 27°C for 96 hrs. The primary detection of AgNPs was carried out by visual observation of color change after treatment of fungal extract with $AgNO_3$. X-ray diffraction and scanning electron microscope (SEM) with detector for transmission revealed the synthesis of different shapes AgNPs, particularly, hexagonal and triangular with sizes in the range of 10–100 nm. The antifungal properties of the synthesized AgNPs were investigated by the well-diffusion practice against plant disease agents. Diffusion of AgNPs caused the inhibition zones around the disks of tested pathogens which obviously indicate the antifungal activity.

Keywords: Endophytes, mycosynthesis, silver nanoparticles, biological control, plant pathogens.

Taxonomy and Variability of food associated *Aspergillus* and *Penicillium*

Jos HOUBRAKEN[1*]

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Mild preservation protocols, often in combination with controlling fungal contamination, are utilized to combat fungal spoilage. Ideally, a preservation system should be effective against all spoilage fungi, but most (novel) preservation protocols tend to be species specific. Besides this interspecific variation, also intraspecific variation occurs, and food preservation becomes even more challenging when considering intra-strain variation, *e.g*., the heterogeneous character of conidia in their stress resistance and germination capacity. This inter- and intraspecific variation also impacts taxonomic studies. Accurate identification remains important for effective communication and recognition of unique properties and traits associated with specific fungal species. While species delimitation appears to be clear-cut, studies in *Aspergillus* reveal that species boundaries become more robust and accurate with an increased understanding of variability. When including this variability in taxonomic studies, new species are discovered, but also known food spoilage species changed name. In this presentation, the extent of heterogeneity at the inter- and intraspecific level, in relation of food spoilage and taxonomy, will be discussed. Needlessly to say, strain collections play a crucial role in these studies.

Keywords: Identification, biodiversity, spoilage, barcoding.

The Effect of Mushrooms on Naturalistic Intelligence

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Bacteriome of Clinically Important Fungi

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Communities of microorganisms that exist in a particular environment, often referred to as the microbiome, have been universally observed across diverse ecosystems and biological niches including food products, soils, humans, and animals. Advancements in this field have shown that large microbiomes can harbour their own microbiomes and have proposed the concept of 'microbiome within microbiome.'

Bacteria living inside fungi are called endofungal or endohyphal bacteria (EFBs or EHBs), which cause the most complex relationships between bacteria and fungi. EHB has been found to regulate key components of the host reproductive machinery, induce the phytohormone production, and enhance stress tolerance of the host fungi.

Endofungal bacteria have been known for a long time and there have been many studies on the diversity of endofungal bacteria living inside fungi, especially isolated from environmental samples, and on the secondary metabolites produced by endofungal bacteria. However, there have been very limited number of studies on clinical fungi and their endofungal bacteria.

Opportunistic infections caused by fungi of environmental origin have become a growing clinical problem, especially due to the increasing number of immunocompromised individuals. For example, spores of the most studied order Mucorales, known to harbour endofungal bacteria, are ubiquitous in the environment but can also cause acute invasive infections.

Soil-dwelling fungi must evade attack by phagocytic amoebae, and similarly pathogenic fungi evade host phagocytic cells that defend against infection. Studies using soil amoebas *Protostelium aurantium* and *Dictyostelium discoideum*, which feed on yeast and fungi, have shown that endosymbionts protect the fungal host from amoebic attack. It is also emphasized that the endosymbiont is necessary for virulence in both zebrafish and mice.

Considering that endofungal bacteria living in fungi can be pathogenic species, the releasing of bacteria from fungal cells or the secondary metabolites that they produce are very important for

human health. Because there is a possibility that an endofungal bacterium in the fungus may increase the virulence of the fungus and there is a possibility that the endofungal bacterium may come out of the fungal cell during fungal infection and cause infection.

Mushroom and Cancer

Elif GÜVELOĞLU

FULL TEXTS

A Major Clinical Challenge: Development of Resistance to Antifungal Drugs in *Candida parapsilosis* Complex Isolates!

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Abstract

Invasive fungal infections are a serious threat in terms of morbidity and mortality especially in immunocompromised patients. The most frequently isolated agents are fungi of the genus *Candida*, and bloodstream infections due to *Candida* species are common worldwide. It has been observed that the sensitivity of *Candida parapsilosis* complex isolates, the causative agent of candidemia, to azole and echinocandin group antifungal drugs, which are preferred in treatment, decreases and resistant isolates increase.

C. parapsilosis complex isolates isolated from blood cultures in the Medical Mycology Laboratory of Cerrahpaşa Medical Faculty in a 9-year period between 2015 and 2023, minimum inhibitory concentration values of azole group antifungals (fluconazole, voriconazole), echinocandin group antifungals (anidulafungin, micafungin) and Amphotercin B were determined and evaluated according to the recommendations of 'European Committee on Antimicrobial Susceptibility Testing'.

In the study, antifungal susceptibility tests were performed by Gradient test (E-test) method and MIC range and MIC50-MIC90 values were determined. MIC range for Fluconazole, Voriconazole, Anidulafungin, Micafungin and Amphotercin B in *Candida parapsilosis* complex species were 0.032->256, 0.004->32, <0.002->32, 0.016->32 and <0.002->32 µg/ml; MIC50 values were 3, 0.064, 1.5, 0.75 and 0.25; MIC90 values were >256, 2, 4, 2 and 1.5 µg/ml.

Considering the changing range of minimum inhibitory concentration values and the increase in these values, especially in *Candida parapsilosis* complex species, in vitro antifungal susceptibility tests seem to be a necessity in the selection of antifungal drugs that can be used in the treatment of infections. Identification of *Candida parapsilosis* complex species with significant differences in resistance to antifungal drugs and determination of resistance will be useful in the proper evaluation of risky patients and in the correct and effective treatment.

Keywords: *Candida parapsilosis* complex, antifungal, azole, echinocandin.

Önemli Bir Klinik Zorluk: *Candida parapsilosis* Kompleks Izolatlarında Antifungal İlaçlara Karşı Direnç Gelişimi

Özet

İnvazif mantar enfeksiyonları, özellikle bağışıklık sistemi baskılanmış hastalarda morbidite ve mortalite açısından ciddi bir tehdittir. En sık izole edilen etkenler *Candida* cinsi mantarlardır ve *Candida* türlerine bağlı kan dolaşımı enfeksiyonları dünya çapında yaygındır. Kandidemi etkeni olan *Candida parapsilosis* kompleks izolatlarının tedavide tercih edilen azol ve ekinokandin grubu antifungal ilaçlara duyarlılığının azaldığı ve dirençli izolatların arttığı gözlenmiştir.

2015-2023 yılları arasındaki 9 yıllık dönemde Cerrahpaşa Tıp Fakültesi Tıbbi Mikoloji Laboratuvarında kan kültürlerinden izole edilen *C. parapsilosis* kompleks izolatları, azol grubu antifungaller (flukonazol, vorikonazol), ekinokandin grubu antifungaller (anidulafungin, mikafungin) ve Amphotercin B'nin minimum inhibitör konsantrasyon değerleri belirlenmiş ve 'European Committee on Antimicrobial Susceptibility Testing' önerilerine göre değerlendirilmiştir.

Çalışmada antifungal duyarlılık testleri Gradient test (E-test) yöntemi ile yapılmış ve MİK aralığı ile MİK50-MİK90 değerleri belirlenmiştir. *Candida parapsilosis* kompleks türlerinde Flukonazol, Vorikonazol, Anidulafungin, Mikafungin ve Amphotercin B için MİK aralığı 0.032->256, 0.004->32, <0.002->32, 0.016->32 ve <0.002->32 µg/ml; MİK50 değerleri 3, 0.064, 1.5, 0.75 ve 0.25; MİK90 değerleri >256, 2, 4, 2 ve 1.5 µg/ml olarak bulunmuştur.

Özellikle *Candida parapsilosis* kompleks türlerinde minimum inhibitör konsantrasyon değerlerinin değişen aralığı ve bu değerlerdeki artış göz önüne alındığında, enfeksiyonların tedavisinde kullanılabilecek antifungal ilaçların seçiminde in vitro antifungal duyarlılık testleri bir gereklilik olarak görünmektedir. Antifungal ilaçlara karşı dirençte önemli farklılıklar gösteren *Candida parapsilosis* kompleks türlerinin tanımlanması ve direncin belirlenmesi, riskli hastaların doğru değerlendirilmesinde, doğru ve etkin tedavide yararlı olacaktır.

Anahtar kelimeler: *Candida parapsilosis* complex kompleksi, antifungal, azol, ekinokandin.

Introduction

In recent years, a significant increase in the incidence of fungal infections has been reported. Among fungal agents, infections due to *Candida* species are becoming more important as the

organism group that plays a major role in this increase. Candidaemia is a serious bloodstream infection with a high mortality rate and difficult early diagnosis and treatment. Bloodstream infections due to *Candida* species are common all over the world (Pappas et al., 2018).

Nosocomial infections with resistant *Candida* species are increasing and candidemia is becoming a public health problem. This is associated with an increase in the number of immunocompromised individuals (such as long-term inpatients in intensive care units, haematology patients, patients receiving chemotherapy and organ transplant patients), the widespread empirical use of broad-spectrum antibiotics and antifungals for prolonged periods, and the widespread use of central venous catheters and invasive therapeutic procedures (Pappas et al., 2018).

Candida species are the most common cause of fungal infections, accounting for 70-90% of all invasive mycoses. (Pappas et al., 2018, Arendrup, 2013). Although the frequency of isolation in candidemia, which is an important part of systemic mycoses, varies between countries and even between centres, the most common pathogenic species encountered in 95% of infections are *C. albicans, C. parapsilosis* complex, *C. glabrata, C. tropicalis* and *Pichia kudriavzevii (C. krusei)* (Arendrup et al., 2023; Murray, 2016). *C. parapsilosis* is common among newborns. As a skin coloniser, *C. parapsilosis* is a common pathogen in intravascular catheter-related infections (Arendrup, 2013; Tóth et al., 2019).

There are a limited number of antifungal groups with limited efficacy developed for the treatment of fungal infections and they have toxic side effects that adversely affect their clinical use. Early and effective initiation of antifungal treatment has a positive effect in significantly reducing the mortality rates of candidemia (Pappas et al., 2018; Arendrup, 2013). Sensitivity to azoles, which are frequently used in treatment, is decreasing. Therefore, the need for treatment options is increasing day by day.

It has been observed that the susceptibility of *C. parapsilosis* complex isolates, the causative agent of candidemia, to azole and echinocandin group antifungal drugs, which are frequently used in treatment, has decreased over the years and resistant isolates have increased (Tóth et al., 2019).

In this study, it was aimed to provide data on azole resistance in *C. parapsilosis* complex isolates, which are the causative agents of candidemia in our hospital where a large number of high-risk patients are followed up, to help in guiding the choice of treatment in the relevant patient group and to contribute to the data in this field in Türkiye by determining the resistance rate.

Methods

The present study was conducted retrospectively on *C. parapsilosis* complex isolates obtained from blood cultures between 2015 and 2023 at the Medical Mycology Laboratory of the Cerrahpaşa Medical Faculty. Antifungal susceptibility tests of these isolates to azole group antifungals fluconazole, voriconazole; echinocandin group antifungals anidulafungin, micafungin and Amphotercin B were performed by Gradient test method. The protocol of the study was approved by İstanbul University- Cerrahpaşa Clinical Research Ethics Committee with the decision numbered 2024/1014569.

Blood culture was evaluated using the BACTEC™ haemoculture (Becton Dickinson, Franklin Lakes, NJ, USA) automated system. When yeast cells and pseudohyphae structures were observed on Gram staining in bottles containing growth signals, Sabouraud dextrose agar (SDA; Oxoid, UK) medium and CHROMagar Candida (Becton Dickinson GmbH, Germany) medium were inoculated in addition to routine bacterial media. In the identification of yeast colonies isolated in primary culture by conventional methods; colony morphology, germ tube formation and urease enzyme activity were negative. Yeast colonies grown on Corn Meal-Tween 80 agar (Oxoid, Thermo Fisher, UK) were microscopically examined for pseudohyphae structures and identified by using API 20C AUX (bioMerieux, France) kit for carbohydrate assimilation tests and confirmed by BD Phoenix YEAST ID (Becton, Dickinson and Co., Sparks, USA) or MALDI-TOF MS (MALDI Biotyper, Bruker Daltonics GmbH). Antifungal susceptibility tests of the identified *C. parapsilosis* complex species were performed by Gradient test (E-test) (bioMérieux, France) (Figure-1) after 24-48 hours incubation.

Figure 1: In *C. parapsilosis* complex isolates; high MIC value to Micafungin from Echinocandin group of antifungals and resistance to Fluconazole from Azole group.

RPMI 1640 (Sigma Chemical Co, St Louis, Mo, USA) agar medium was used for antifungal susceptibility testing of *C. parapsilosis* isolates. Minimum inhibitory concentration (MIC) values

were determined and evaluated according to the European Committee on Antimicrobial Susceptibility Testing (EUCAST) recommendations. The results of MIC values determined in antifungal susceptibility tests were based on antifungal ECOFFs for C. parapsilosis complex isolates using EUCAST E.Def 7.4, E.Def 9.4 and E.Def 11.0 procedures and susceptibility cut-off values including clinical breakpoints (Version 4.0, valid from 2023-08-14) (EUCAST, 2023).

MIC50 and MIC90 values were calculated for each antifungal in the isolates analysed. The lowest antifungal concentration inhibiting 50% of the isolates was defined as MIC50 and the lowest concentration inhibiting 90% of the isolates was defined as MIC90. *C. parapsilosis* ATCC 22019 control strains with known MIC ranges were used in the antifungal susceptibility tests.

When consecutive isolates belonging to the same patient were found, antifungal susceptibility tests were performed on all of them and isolates that developed resistance during treatment were included in the study. In consecutive isolates, the first isolate that grew was included in the study. If any azole MIC value was found at or above the resistance limit value, the antifungal susceptibility test was repeated for confirmation.

Results

A total of 154 *C. parapsilosis* complex isolates were identified and 69 of the patients were male (45%) and 85 were female (55%). The age range was 0-88 years and the mean age was 22 years. Of the isolates, 98 belonged to paediatric patients (64%) and 56 belonged to adult patients (36%).

The MIC 50 and MIC90 values determined by antifungal susceptibility tests to drugs such as azole group, echinocandin group and Amphotericin B in isolates identified as *C. parapsilosis* complex are shown in the table (Table-1).

Table 1. MIC50 and MIC90 values of *C.parapsilosis* complex isolates

***Candida parapsilosis* kompleks**			
Antifungal	**MIC range** (µg/mL)	**MIC50** (µg/mL)	**MIC90** (µg/mL)
FLU (n=150)	0,032 - >256	**3 µg/ml**	**>256 µg/ml**
VOR (n=144)	0,004 – >32	**0,064 µg/ml**	**2 µg/ml**
Amp. B (n=144)	<0,002 – >32	**0,25 µg/ml**	**1,5 µg/ml**
AND (n=81)	<0,002 – >32	**1,5 µg/ml**	**4 µg/ml**
MYC (n=111)	0,016 - >32	**0,75 µg/ml**	**2 µg/ml**

When MIC50 and MIC90 values were compared for *C. parapsilosis* complex isolates, a significant increase was found in MIC values against azole group antifungals, especially Fluconazole. In isolates resistant to fluconazole, decreased susceptibility to other azole groups (Voriconazole and Itraconazole) was detected as cross-resistance.

According to EUCAST MIC cut-off values for *C. parapsilosis* complex isolates; Fluconazole (n=154) resistance rate was 40% (n=61), Voriconazole (n=148) resistance rate was 28% (n=42), Amphotericin B (n=148) resistance rate was 9% (n=13), Anidulafungin (n=84) resistance rate was 8% (n=7) and Micafungin (n=115) resistance rate was 7% (n=8) (Figure 1).

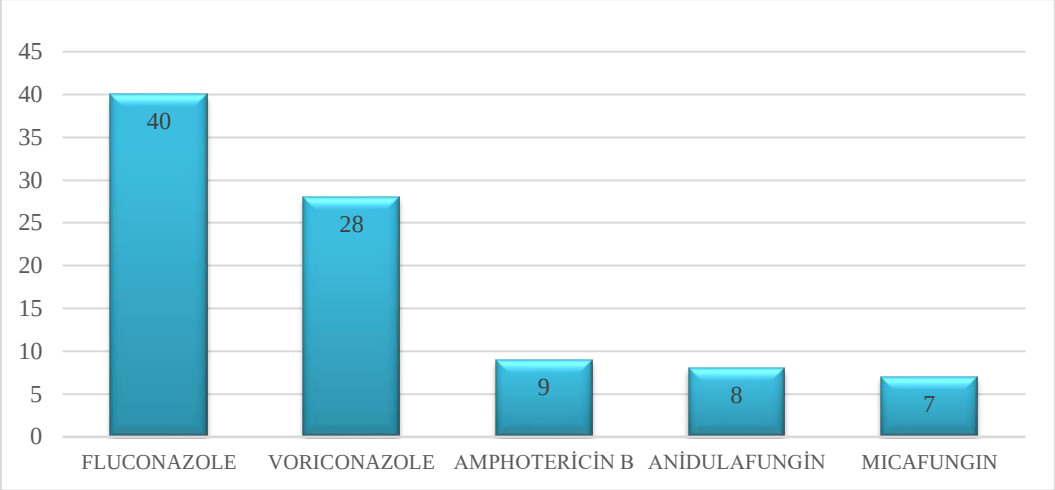

Figure 1. Antifungal drug resistance in *C. parapsilosis* complex isolates (%)

C. parapsilosis complex group isolates were divided into 3 time periods (2015-2017, 2018-2020 and 2021-2023), each including a 3-year period to evaluate the COVID-19 outbreak, changes related to the relocation of our hospital and the change in resistance profile to azole group antifungals. The number of patients resistant to fluconazole, one of the azole antifungals, was 18, 22 and 21 in the first 3 years. The fluconazole resistance rate was 37% in paediatric patients and 45% in adult patients. A 9-year period between 2015 and 2023 was evaluated.

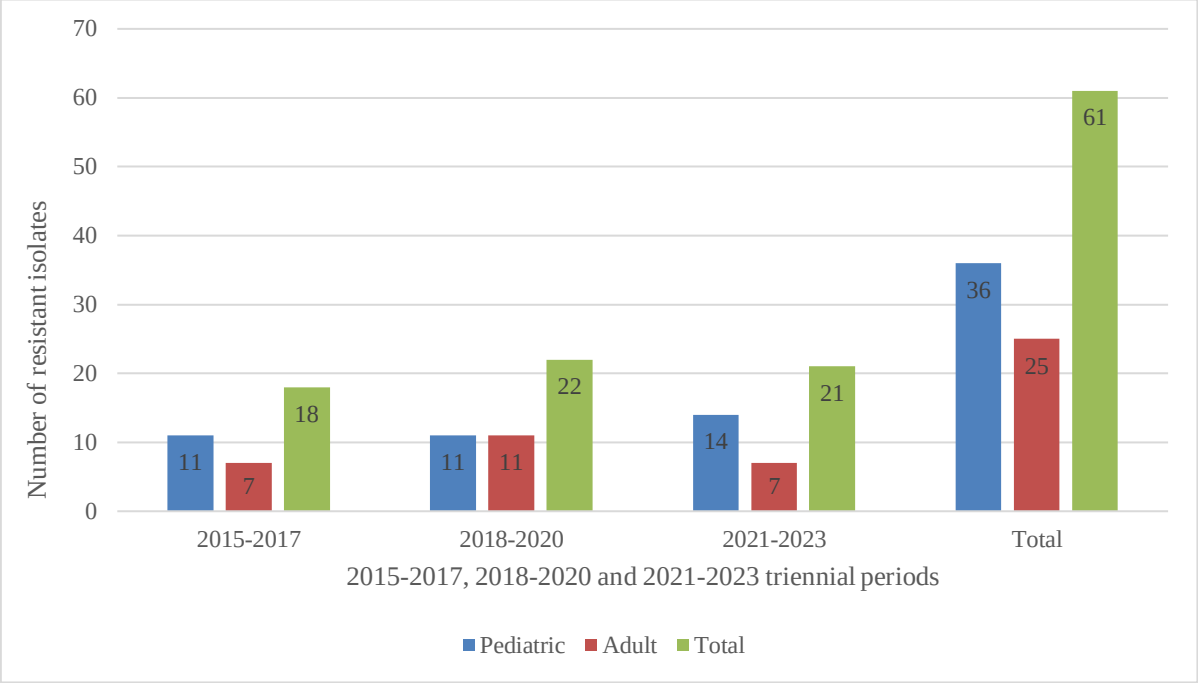

Figure 2. Distribution of resistant isolates in the *C. parapsilosis* complex group

Discussion

Fungal pathogens and the diseases caused by them, which are increasingly becoming a global public health problem today, were described as a priority problem by WHO in 2022 and a list of priority pathogens was published and *C. albicans* was included in the critical priority threat list. In the high priority threat list, *C. parapsilosis* was added to the priority threat watch lists (WHO, 2022).

Infections caused by *Candida* species occupy an important place among fungal infections. The incidence of bloodstream infections caused by *Candida* species is increasing daily and represents a serious threat, especially in immunocompromised patients. Although *C. albicans* is usually the most frequently isolated pathogen in these infections, *Candida* species other than *C. albicans* have been frequently isolated in recent years (Tóth et al., 2019, Arendrup et al., 2023). Among *Candida* species other than *C. albicans*, species belonging to the *C. parapsilosis* complex are very important as frequently observed species.

Although there are noticeable differences in species distribution at the country level, factors such as isolation rates of species other than *C. albicans*, characteristics of the patient population (age, previous antifungal exposure, underlying diseases, hospitalisation, etc.) are thought to affect the species distribution of candidemia, the underlying causes of this difference are not fully known.

C. parapsilosis causes 30% of candidemia cases among neonates and paediatric patients (< 18 years of age), while this rate is 10-15% in adults (Murray, 2016).

When the studies in paediatric patients are examined; In the study in which the change in the epidemiology of invasive candidiasis in children was monitored over a 10-year period, *C. albicans* (47.8%) and *C. parapsilosis* (28.7%) were found to be the most frequently isolated species (Noni et al., 2019). In the study stating that *Candida* bloodstream infections have decreased in paediatric populations in the USA, but continue to be an important cause of morbidity and mortality; *C. parapsilosis* was the dominant species (35.6%) and *C. albicans* (29.8%) between 2006-2016 (Piqueras et al., 2021).

In Önal's study, which examined paediatric patients in our centre, *C. parapsilosis* was found to be the dominant isolated species (44%) between 2014 and 2021 (*C. albicans*; 34.4%) and the median age was 17 months (Önal et al., 2024). In Mete's study in which adult patients in our centre were examined, the frequency of *Candida* infections in Cerrahpaşa Medical Faculty intensive care units in a 10-year period was determined as *C. albicans* (32%) and *C. parapsilosis* (28%) (Mete et al., 2021).

The update on treatment approaches for invasive fungal infections in adults reports that mortality remains high when antifungal susceptibility testing results are often unavailable or delayed (Boutin et al., 2024). The incidence of invasive mycoses is increasing with the growing number of patients on potent immunosuppressive therapy (Wickes et al., 2018).

In our study, although 64% of isolates belonged to paediatric patients (n=98) and 36% to adult patients (n=56), the rates of resistance to fluconazole were 37% in paediatric patients and 45% in adult patients. In accordance with the literature, *C. parapsilosis* complex isolates are common in paediatric patients. The rate of resistance was higher in adult patients.

C. parapsilosis is a common cause of candidaemia in Europe, especially in Mediterranean countries (Pappas et al., 2018). A continuous shift in species distribution from *C. albicans* to *C. glabrata* and *C. parapsilosis* is shown. This confirms a high but stable rate of fluconazole resistance in *C. glabrata* and an alarming emergence of fluconazole resistance in *C. parapsilosis* in southern Europe.

Various molecular studies revealed that this species is actually a species complex containing *C. parapsilosis*, *C. orthopsilosis* and *C. metapsilosis* species (Larone, 2023). The dominant species in *C. parapsilosis* complex isolates is *C. parapsilosis*. The frequencies of *C. orthopsilosis* and *C.*

metapsilosis are rare. The virulence, infection prognosis and antifungal susceptibility of these phenotypically indistinguishable species differ.

C. parapsilosis is an important hospital-associated infectious agent with an increasing frequency worldwide (Pappas et al., 2018). This species plays a role in gastrointestinal disorders and metabolic diseases, total parenteral nutrition and infections that develop during widespread use of central venous catheters. Unlike other *Candida* species, *C. parapsilosis* colonises the skin rather than mucosa in humans and animals. Since *C. parapsilosis* colonises the skin, it is frequently seen in catheter-related infections and may cause hospital outbreaks that may occur with fluconazole-resistant isolates that develop in this species.

Azoles are the first and most commonly used antifungals in the treatment of life-threatening *Candida* infections (Murray, 2016). In vitro antifungal susceptibility tests are recommended for the selection of antifungal drugs for the treatment of *Candida* infections ((Arendrup et al., 2013; Tóth et al., 2019). When fluconazole and amphotericin-B susceptibilities were compared with the gold standard reference broth microdilution and gradient test (E-test) methods recommended by EUCAST; fluconazole and amphotericin-B were found to be 98.5% and 90% compatible, respectively (Van Eldere et al., 1996).

Although azole resistance rates are generally low in *C. parapsilosis* complex isolates, an increase has been reported in recent studies. As the exposure of a susceptible population to azoles increases, there is an increase in the mutations that lead to the emergence of resistance (Toth et al., 2019) In the European Confederation of Medical Mycology (ECMM) Candida III multicentre observational study, which included 632 patients with candidemia from 20 European countries and 60 centres in total, acquired fluconazole resistance was observed in *C. parapsilosis* in Southern Europe (Arendrup et al., 2023). *C. parapsilosis* was identified as the most prevalent species in the UK and Türkiye, with an incidence rate of 24% in Greece and Italy, and a notably higher rate of 26% in Türkiye.

In recent years, reports of resistance to fluconazole have increased in Europe, South America and some Asian countries where infections with *C. parapsilosis* complex are common. Compared to other countries in the distribution of species among countries, especially in Türkiye, fluconazole-resistant *C. parapsilosis* isolates, as well as extremely rare echinocandin resistance, which is an intrinsic mutation in the Fks target gene, have been detected in *C. parapsilosis* isolates (Arendrup et al., 2023). New resistance mechanisms can directly affect clinical outcomes by jeopardising the role of azoles in the treatment of candidosis.

Considering the literature on antifungal susceptibility of *C. parapsilosis* complex, the decreased susceptibility rates to azoles and echinocandins seem to be alarming. Fluconazole resistance rates in *C. parapsilosis* complex are generally between 2% and 5% (Pappas et al., 2018). In a multicentre study from South Africa, 38% fluconazole susceptibility was reported. Govender et al, 2016). There are also studies reporting much higher rates. In our study, according to EUCAST MIC cut-off values for C. parapsilosis complex isolates; Fluconazole (n=154) resistance rate was found to be 40% (n=61). Anidulafungin (n=84) resistance rate was 8% (n=7) and Micafungin (n=115) resistance rate was 7% (n=8).

In Dalyan 2019 study, fluconazole resistance in *C. parapsilosis* complex isolates (n=118) was determined as 26.3%. In the Dalyan study in 2023, fluconazole resistance in *C. parapsilosis* complex isolates was reported as 7.5%. The difference in fluconazole resistance rates of *C. parapsilosis* isolates isolated from different centres between regions may be related to the clonal distribution of *C. parapsilosis*, in which nosocomial transmission plays an important role (Dalyan, 2023).

The emerging resistance to fluconazole is particularly important as it is frequently used as a cheap and safe antifungal group in developing countries (Thomaz et al., 2018). Candidiasis has become a global health threat, with antifungal resistance increasing rapidly and limited access to quality diagnosis and treatment in many settings (WHO, 2022). In *C. parapsilosis* complex, the increase in azole resistance is greater than in other common invasive infectious *Candida* species such as *C. albicans* and *C. glabrata.* (Pappas et al., 2018; Toth et al., 2019; Pristov et al., 2019).

A multicentre study from our country (n=12) reported 7.7% fluconazole resistance in *C. parapsilosis* complex (n=575) isolates from 1991 *Candida spp* isolates (n=91) and pointed out that fluconazole resistance showed great variability between centres (0%-47.1%). The MIC50 value for FLU was reported as 1 µg/ml and the MIC90 value as 4 µg/ml (Arikan-Akdagli et al., 2019). In our study, MIC50 value was 3 µg/ml and MIC90 value was >256 µg/ml.

In our study in which antifungal resistance profiles of *C. parapsilosis* isolates grown in blood culture were determined and their resistance to azole group antifungals was evaluated; MIC50 and MIC90 values for FLU, which were determined in-vitro for antifungals, were 3 and >256 µg/ml. When the MIC50 and MIC90 values for *C. parapsilosis* isolates were compared, a significant increase in the MIC values for azole group antifungals, especially against FLU, was found. The detection of 40% fluconazole resistance is an important concern.

As a result of this; Due to the ability to acquire azole and echinocandin resistance in *C. parapsilosis* complex isolates, in vitro antifungal susceptibility tests are essential in the selection of antifungal drugs for the treatment of infections. Identification of *C. parapsilosis* complex species showing significant differences in resistance to antifungal drugs and determination of resistance will be useful in the appropriate evaluation of risky patients and in the correct and effective treatment.

The rising prevalence of invasive infections caused by species belonging to the *C. parapsilosis* complex has coincided with a notable surge in the development of resistance to azole antifungal agents in these species over recent years. Given the increase in these values in *C. parapsilosis* complex species, monitoring the emergence of acquired resistance and predicting future challenges is critical for antifungal management and epidemiological data.

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Cultivation of *Ganoderma lucidum* (Curtis) P. Karst. (Immortality Mushroom)

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Abstract

Ganoderma lucidum is a type of mushroom known as 'reishi', which has a long history in traditional medicine. Morphologically, it is usually shiny, brown and characterised by a half-moon-shaped hat. Its natural habitat is temperate forests and dead trees. Economically, this mushroom, which is in high demand due to its health benefits, occupies an important place in the supplementary foods and pharmaceutical sector. In terms of cultivation, the successful production of *Ganoderma lucidum* requires appropriate temperature, humidity and substrate selection. Different methods, such as using wood chips or rice straw, have been developed to improve productivity and quality. Optimising cultivation practices is critical to maximise the economic potential of this mushroom. This review presents studies related to different cultivations of *Ganoderma lucidum* and the improvement of composts.

Keywords: Basidiomycota, Cultivation, *Ganoderma lucidum*, Reishi.

Ganoderma lucidum (Curtis) P. Karst'ın yetiştirilmesi. (Ölümsüzlük Mantarı)

Ganoderma lucidum, geleneksel tıpta uzun bir geçmişe sahip olan ve 'reishi' olarak bilinen bir mantar türüdür. Morfolojik olarak genellikle parlak, kahverengi ve yarım ay şeklinde bir şapka ile karakterize edilir. Doğal yaşam alanı ılıman ormanlar ve ölü ağaçlardır. Sağlığa olan faydalarından dolayı yoğun talep gören bu mantar, takviye edici gıda ve ilaç sektöründe ekonomik açıdan önemli bir yer tutmaktadır. Yetiştirme açısından *Ganoderma lucidum*'un başarılı üretimi uygun sıcaklık, nem ve substrat seçimini gerektirir. Farklı yöntemler, örneğin verimliliği ve kaliteyi artırmak için talaş veya pirinç samanı kullanan sistemler geliştirilmiştir. Yetiştirme uygulamalarını optimize etmek, bu mantarın ekonomik potansiyelini en üst düzeye çıkarmak için kritik öneme sahiptir. Bu derlemede *Ganoderma lucidum*'un farklı kültür yöntemleri ve kompostlarının iyileştirilmesi üzerine yapılan çalışmalar sunulmaktadır.

Anahtar Kelimeler: Basidiomycota, Yetiştirme, *Ganoderma lucidum*, Reishi.

Introduction

Ganoderma lucidum (Curtis) P. Karst. is a species of fungus belonging to the genus *Ganoderma* in the class *Agaricomycetes* of the Basidiomycota, the second largest identified division of the fungal kingdom. It has a long history of two thousand years in Asian history (Jong and Birmingham, 1992) and has been used for many years in China, Japan and Korea for its medicinal potential. Often called reishi (in Japan) or lingzhi (in China) (Stamets, 1993; Yang et al., 2003), Karsten proposed the name of the genus *Ganoderma* (Karsten, 1881). This mushroom, which has a very important position in China with names such as "Elixir of Immortality" or "Plant of Spiritual Power", has been frequently used as a symbol not only in the medical field but also in Chinese history as a symbol of immortality and energy (Kumar and Kumar, 2019). In earlier years, when it was not cultivated, was rare and accessible only to the nobility, beliefs also emerged that this precious mushroom grew only in the homes of the immortals (Yetts, 1912).

Morphology and Habitat

The word "*lucidum"*, which means 'shiny' in Latin, gives us an important clue about the morphology of the mushroom. Its shiny appearance thanks to its red polished cap is of great benefit in attracting attention and distinguishing it from other mushrooms (Yakupoğlu and Pekşen, 2011). The presence of a stalk in its basidiocarp and the presence of pores are some of its morphological features. The lower parts of this mushroom, which takes the shape of a kidney as a result of growth and maturation, change to different shades of brown (Yakupoğlu and Pekşen, 2011; Hal et al., 2021). Today, thanks to the suitable conditions of our country, the Reishi mushroom, which has a very durable, hard and woody structure that we often encounter on tree trunks in our forests, is an exotic mushroom species that can grow in both temperate and tropical regions (Yakupoğlu and Pekşen, 2011). Reishi, also known as a wood-rotting fungus, is usually seen on old logs rather than living trees and feeds as a parasite, and can usually be found on decaying branches and stumps of parts where decay is more advanced. It can be found in many regions of Asia and North America. It grows frequently in the Southeastern regions of China (Herder, 2022).

Effects on Health

Mushrooms, which we encounter in different habitats, have been accepted as a rich food source due to their high protein and mineral content and have been preferred for years. Mushrooms are not only a food source in our lives but also play a role as a medicine used in the treatment of

many diseases (Öztürk and Çopur, 2009). *Ganoderma lucidum* has a unique importance in terms of its high medical potential compared to its nutritional value. It has been revealed that there are some compounds in Reishi mushroom that protect cellular DNA from oxidative damage (Shi et al., 2002). It has the ability to heal various diseases, especially hypertension (İrkin, 2024) and liver diseases (Liu et al., 2002), as well as bronchitis, asthma, ulcers (Batra et al., 2013) with the pharmaceutical compounds it contains. These compounds include immune-boosting, antitumor (Yuen and Gohel, 2005), antiviral (Wachtel-Galor, 2011), antioxidant (İrkin, 2024) and antimicrobial (Cör et al., 2018) activities. It has made a breakthrough in medical terms with its therapeutic properties even in cancer, one of the most dangerous and deadly diseases of our day. According to scientific research, the cancer-treating properties of *G. lucidum* are based on glucans and triterpenes. Thanks to beta glucans, the immune system is activated and triterpenes have a cytotoxic effect against cancer cells, thus minimizing the damage (Unlu et al., 2016). Thanks to these properties, it has become the only mushroom species accepted by the Japanese Ministry of Health as an auxiliary herbal medicine that can be used in cancer treatment (Anonymous, 2024a). In a scientific study, the antitumor and immune effects were studied in mice fed with supplemental food containing *Ganoderma lucidum* and *Aspergillus brasiliensis* mice. S180, also known as mouse sarcoma, is known as a cancer cell line that proliferates rapidly in mice. It was observed that S180 inhibited tumor growth and caused significant improvements in the immune system in mice fed in this way for approximately 3.5 months. *Ganoderma lucidum* is a very important resource used in the pharmaceutical industry today and is a promising species in the world of natural medicine (Rubel, 2018).

Production

A better understanding of the importance of mushrooms in areas such as food and health has increased the need and demand for consumption of the rapidly growing world population. The fact that *Ganoderma lucidum* is a rare mushroom has caused the amount collected and supplied to fall short of commercial demand expectations. This has made it necessary to produce it commercially. With the Chinese government issuing certificates to more than 1000 *Ganoderma*-containing products that it deems appropriate for consumption for health reasons, and the emergence of Krestin, obtained from the *G. lucidum* mushroom, as an important drug raw material that prevents cancer, it covered 25% of the cancer drug market in 1999 (Chen et al. 2016; Mizuno, 1999). This has been an important factor in the rapid increase in mushroom cultivation and its significant share in the world market. Today, China has become the leader by producing approximately 42% of the world's mushroom. China is followed by the USA, the Netherlands and France. According to the

studies, China has 13,094,970 tons of mushroom production, the USA 3,910,000 tons, the Netherlands 2,800,000 tons and France 2,000,000 tons (Uzun, 2004). Although there is no definitive data on the current production of *G. lucidum*, when we look at the 2005 data, China's share in mushroom production is increasing, while America's share is decreasing every year (Chang, 2005). More than 30 million people in the world are engaged in mushroom production and mushroom cultivation. In Türkiye, in recent years, it has been observed that there has been an increase in the production of medicinal macrofungi and species with high economic value such as *G. lucidum*. In our country, *Ganoderma lucidum* production started in Denizli in 2000 and its production is still continuing to be widespread (Anonymous, 2024a).

Economic Value of Reishi

With the increasing popularity of medicinal mushrooms, the consumption rate has continued to increase rapidly in many parts of the world. *Ganoderma lucidum* cannot be consumed fresh due to its woody structure. Dietary supplements made from its extract, tea and powdered products in various forms are suitable for consumption (Salihoğlu and Akkıran, 2024). It has been revealed that there is a growing important market of approximately 109 billion dollars in the dietary supplement industry for consumption in these forms. It is predicted that this sales amount will double in three years (Binns et al., 2017). Although no definitive figure has been published regarding the economic value of Reishi products worldwide, the market value of *Ganoderma*-based products in Taiwan was estimated to be 215 million dollars in 1995. In different studies conducted in the same year, it was revealed that the market value of *Ganoderma* was $350 million in China, $600 million in Korea, $300 million in Japan, $91.2 million in Malaysia, $30 million in Hong Kong, $2.2 million in Singapore and $10 million in other countries (Chang et al., 1999).

Culture and Cultivation

It is possible to find products produced from various structures of the mushroom in today's market. Nearly 100 Reishi mushroom products have been approved and continue to be marketed in the international market (Lin, 2000). The most popular products in the market are capsule and tablet shaped products consisting of the fruit body of the mushroom. Since the culture of the fruit body will take months, the cultivation method has emerged in order to meet the increasing demand over time. Substrates such as mushroom residues, wood, sawdust, and grains are used in the cultivation of Reishi mushroom (Boh et al., 2007). The artificial culture and cultivation of Reishi was first studied by T. Henmi and his friends in 1937. The artificial culture was made in the early 1970s

(Mizuno et al., 1996). In 1971, spawn was inoculated into jars filled with sawdust by Y. Naoi and the production of caps was successfully completed (Mizuno, 2003). This cultivation method, which gave successful results, was developed and showed that it can be grown in any desired environment. Bottles or bags are the most preferred for the culture medium. One of the two types of cultivation methods of *G. lucidum* mushroom is Plant waste (sawdust) culture and the other is Log cultivation (Anonymous, 2024a). The first of the nutrient sources that should be added to the medium is carbon sources. Carbon sources provide the energy necessary for the growth of the mycelium and the development of the hat. Nitrogen sources help in the necessary protein synthesis. Finally, inorganic salts are used to moisten the substrate. Too much moisture in the compost slows down the growth of the mycelium. Therefore, this moisture rate is ideal to be 60-65%. Adding 1% calcium sulfate to compost ensures that the pH value remains balanced and the content remains alive and does not become muddy (Anonymous, 2024b). First of all, it is very important to use hardwood (oak, poplar, beech, hornbeam) sawdust in the growing medium of the sawdust culture method. The necessary growth media prepared will be filled into heat-resistant bags (polypropylene) by 1-2 kg and the mouths of the bags will be covered with cotton. Then, the bags will be sterilized by keeping them in the autoclave at 121 °C for 1.5 hours and the temperature of the bags will be adjusted to 20-25 °C and mycelium inoculation will be carried out in sterile rooms. The bags with mycelium inoculation will be placed in the production room and the necessary conditions for mycelium formation will be provided at 25-30 °C in a dark environment. In order to ensure the formation of carpophores in the bags that have completed mycelium growth, the room should be illuminated with 100-200 lux light (Chen, 2004). The mouths of the bags where we observe that the primordium structure has started to form will be opened, the room will be regularly humidified and ventilated to provide the necessary conditions and the room temperature will be adjusted to 20-25°C. With the provision of suitable environments, the number of primordiums increased and then the upper parts of the bags were cut open to facilitate their emergence in order to support mushroom growth. The mushrooms will be carefully observed throughout the growth process and will be harvested at the most appropriate harvest time. For *Ganoderma lucidum* cultivation, the use of artificial sawdust logs and closed environments with adjustable air and conditions gives successful results (Anonymous, 2024a). In production with the grafting method on logs, tree logs with a hard structure should be used. The branches around the log should be cut and cleaned and the newly cut logs with high moisture content should be waited to dry for use. Dry logs that are not wet should be kept in water for a few hours to moisten them. Holes with a diameter of 3 cm should be opened in the oak log cut to 15 cm in length and 15 cm in diameter for the placement of mycelia (planting of spawn). Logs with

mycelia inoculation should be stored for 6 months in a room set at 25 ° C and 70% humidity. After the mycelia have wrapped the logs, the logs will be buried in soil enriched with organic matter and suitable conditions will be provided. The temperature should be set at 25-30 ° C and humidity at 70-90%. Log cultivation is not preferred in our country due to climate reasons (Anonymous, 2024a; Anonymous, 2024b).

There are some tricks to consider in order to produce a quality *G. lucidum*. Some of these are; selecting the highest yielding strain, using the right cultivation method, harvesting the product at the right time and treating the product appropriately after harvest. Attention should be paid to ventilation; if ventilation is not done well, carbon dioxide concentration may increase and more than 0.1% may cause fruit deterioration (Anonymous, 2024a). Light has a great effect on *Ganoderma lucidum*. No lighting is required while the mushroom is developing in mycelial form, but later on, whether the lighting is low or high is important for the pigmentation and shape of the mushroom. The environment must be completely dark for mycelial development. If the light intensity is high, the cap may form early and the stem may remain short. High light, especially yellow light, causes development to slow down. For this reason, direct sunlight in the greenhouse should be prevented. Some light is needed for fruit development (Lee, 2003). This is because the fruit body has phototropism. The growth points of the cap and fruit develop by turning towards the light (Anonymous, 2024a). One of the most important factors for quality production is temperature. High temperatures are required for the production of fruit. The most suitable temperature for the development of mycelium is 27-32 ° C. When the temperature drops below these degrees, mycelium development will begin to slow down. At the same time, failure to maintain the temperature causes shape deformations. Another important point is humidity, which is a must for the formation of the cell. The humidity rate should be between 80-90% during the primitive formation. Growth will start to decrease and stop at low humidity (Lee, 2003). Lee (2003) stated in a scientific study that the optimum humidity rate should be 65-70%. Chen (2004) determined this humidity rate as 67-70% in his study. When we look at the results, it is seen that the humidity rates mentioned are close to each other. When we look at the pH criterion, we can say that *G. lucidum* is most productive in low acid environments. It has been revealed that the pH range required for its growth is 3.0-7.5, but the most suitable values are generally 4.0-6.0. Many scientific studies have been published on the preparation of the substrates required for Ganoderma lucidum culture, the methods of use when it has completed its maturation (Okhuoya et al., 2010) and the determination of its quality. Ihayere et al. According to the study conducted by (2017), mycelium was reached at the end of the 5th day of inoculation in all media prepared with different isolates. According to this

study, it was recorded that the sawdust substrate prepared using *Brachystegia nigerica* reached mycelium on the 19th day after inoculation and that all isolates studied had full mycelial mass on the 62nd day. It was observed that all these production stages were completed in a total of 110 days. Similarly, in another study, it was stated that this production stage was completed in approximately 150 days (Ueitele et al. 2014). Similarly, Azizi et al. (2012), who studied the production of *Ganoderma lucidum*, stated that they completed this process in 90 days. It was stated that this change in the process could be based on genetic differences, geographical conditions, different substrate uses and various cultivation methods (Ihayere et al., 2017). In addition, studies have shown that the most productive mushrooms are found in the longest spawn development period (Royse and Bahler, 1986). Biological productivity is found by calculating the percentage measurement of fresh mushroom weight to the dry weight of the substrate. This ratio gives us biological productivity (Stamets, 2000). Most of the scientific researches carried out on cultivation are studies aimed at increasing the quality and yield in production. Roy (2015) conducted a study on increasing the yield of *G. lucidum* using different sawdust and supplements. He stated that the use of wheat bran and S. mahagoni sawdust provided higher yield compared to the use of rice bran. He stated that the use of wheat bran and *S. mahagoni* in productivity could be suitable for production due to its low cost in economic terms. Gonzalez-Matute et al. (2002) argued that sunflower seed shells can be used as the main energy source and that adding 5% malt to this main energy source will increase quality and yield. Erkel (2009) used molasses, which contains high glucose and fructose, as a carbon source, and gluten flour, which has a rich protein content and low starch content, as a protein source. As a result of this research, it was revealed that molasses improved mycelium growth and provided efficiency more than gluten. According to Erkel, carbon is more important than protein for fruit formation. Molasses clearly stated that it could be an excellent supplement as a carbon source when compared to gluten, which is rich in protein content. The fact that the productivity in mushrooms decreases with the increase in the amount of gluten flour showed that there is an inverse proportion and that there is no need for high dosages of protein. Yang et al. (2003) have the opinion that there is a direct proportion between the amount of reinforcement added to the medium and efficiency. According to this opinion, as the amount of reinforcement increases, the productivity increases.

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Enhancement of Laccase Activity in *Trametes versicolor* Through Solid-State Fermentation Using Phenolic-Rich Lingonberry Waste

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Abstract

This study investigates the enhancement of laccase production in the white-rot fungus *Trametes versicolor* through solid-state fermentation by utilizing phenolic-rich organic waste. Wheat bran was used as the primary substrate, supplemented with lingonberry waste at concentrations of 0%, 5%, 10%, 15%, and 20%. The total phenolic content of the lingonberry waste was measured using the Folin-Ciocalteu method, and laccase activity was determined spectrophotometrically at 420 nm using ABTS as the substrate. The results indicated that increasing the phenolic content not only enhanced laccase activity but also potentially accelerated mycelial growth. Specifically, the laccase activity values obtained for the different fractions of lingonberry waste (0%, 5%, 10%, 15%, 20%, and 25%) were 287.49, 328.52, 350.52, 431.15, 473.93, and 422.402 U/L, respectively. These findings suggest that phenolic-rich organic wastes can be a valuable resource for optimizing laccase production and promoting mycelial growth in solid-state fermentation. Consequently, this study underscores the significance of phenolic compounds in biotechnological processes and presents alternative substrates for enhancing both laccase production and mycelial growth.

Keywords: Laccase, *Trametes versicolor*, solid-state fermentation, phenolic compounds, lingonberry waste.

Fenolik Zengin Kekreyemiş Atığı Kullanılarak Katı Kültür Fermentasyonu Yoluyla *Trametes versicolor* Lakkaz Aktivitesinin Artırılması

Bu çalışma, fenolik açıdan zengin organik atıkların kullanımıyla katı hal fermantasyonu yoluyla beyaz çürüklük mantarı Trametes versicolor'da lakkaz üretiminin artırılmasını araştırmaktadır. Birincil substrat olarak buğday kepeği kullanılmış ve %0, %5, %10, %15 ve %20

konsantrasyonlarında kızılcık atığı eklenmiştir. Kızılcık atığının toplam fenolik içeriği Folin-Ciocalteu yöntemi kullanılarak ölçülmüş ve lakkaz aktivitesi ABTS'yi substrat olarak kullanarak 420 nm'de spektrofotometrik olarak belirlenmiştir. Sonuçlar, fenolik içeriğin artırılmasının sadece lakkaz aktivitesini artırmakla kalmayıp aynı zamanda misel büyümesini de hızlandırabileceğini göstermiştir. Özellikle, yaban mersini atığının farklı fraksiyonları için elde edilen lakkaz aktivite değerleri (%0, %5, %10, %15, %20 ve %25) sırasıyla 287,49, 328,52, 350,52, 431,15, 473,93 ve 422,402 U/L'dir. Bu bulgular, fenolik açıdan zengin organik atıkların, lakkaz üretimini optimize etmek ve katı hal fermantasyonunda miselyal büyümeyi teşvik etmek için değerli bir kaynak olabileceğini düşündürmektedir. Sonuç olarak, bu çalışma fenolik bileşiklerin biyoteknolojik süreçlerdeki önemini vurgulamakta ve hem lakkaz üretimini hem de miselyal büyümeyi artırmak için alternatif substratlar sunmaktadır.

Anahtar kelimeler: Lakkaz, *Trametes versicolor*, katı kültür fermentasyonu, fenolik bileşikler, kekreyemiş atığı.

Introduction

Laccase enzyme (p-diphenol oxidase E.C. 1.10.3.2) is a polyphenol oxidase that contains multiple copper atoms (Madhavi and Lele, 2009; Debnath and Saha, 2020). This enzyme, part of the oxidoreductase family, facilitates the oxidation of phenolic substrates, aromatic amines, and other related compounds. It incorporates both monomeric and multimeric copper forms within its structure. Laccase plays a critical role in the oxidation of phenolic and polyphenolic compounds, particularly those found in lignin (Kunnameni et al., 2008; Giardina et al., 2010). While certain bacteria, insects, higher plants, and fungi can synthesize laccase, white-rot fungi are recognized as the most efficient producers (Birhanlı and Yeşilada, 2016). Well-known laccase-producing species include *Trametes versicolor*, *Thermochaetoides thermophila*, *(Chaetomium thermophilum*) and *Pleurotus eryngii* (Revankar and Lele, 2006). Due to its broad substrate specificity, laccase is utilized in various industries, such as paper for delignification and bleaching, food for wine and juice clarification, textiles for bleaching, chemicals for paint decolorization, industrial waste detoxification, and biosensor development (Imran et al., 2012; Dana et al., 2017). Fungi-based laccase production can be accomplished through both submerged and solid-state fermentation. Compared to submerged fermentation, solid-state fermentation offers benefits like lower water usage, cost efficiency, waste valorization, high productivity, and reduced energy consumption (Chmelová et al., 2022). Nevertheless, achieving optimal laccase production in solid-state

fermentation requires precise control of several parameters, including substrate type, moisture content, pH, temperature, aeration, incubation time, inoculum level, and particle size.

The primary factor to focus on when selecting a substrate for solid-state fermentation is the carbon-to-nitrogen ratio. Carbon is the main energy source for microorganisms in SSF. These substrates not only provide the energy needed for microbial metabolism but also act as structural components that support fungal development. The degradation of complex carbohydrates into simpler sugars powers the synthesis of enzymes and other metabolites. The type of carbon source chosen can greatly influence both the amount and activity of the enzymes produced, making it crucial to select substrates that match the desired fermentation outcomes. Nitrogen, on the other hand, is a vital nutrient required for the synthesis of proteins, nucleic acids, and other essential cellular elements. The balance between carbon and nitrogen is critical for controlling microbial growth and enzyme production. While sufficient nitrogen levels encourage growth and enzyme synthesis, an excess amount can inhibit enzyme production, particularly for enzymes like laccase. Therefore, carefully regulating nitrogen levels is essential for maximizing enzyme yields (Reddy and Kanwal, 2022; Colla et al., 2023). Besides carbon and nitrogen, the presence of phenolic compounds in the substrate may also enhance laccase enzyme production. Studies have demonstrated that phenolic compounds in the medium can trigger increased laccase production, especially by white-rot fungi (Ergul et al., 2009; Imran et al., 2012).

This research explored the more efficient production of laccase using phenolic-rich lingonberry powder waste (Kostka et al., 2022; Urbonaviciene et al., 2023) as a nutrient supplement in solid-state fermentation.

Materials and Methods

Microorganisms and substrates

In this study, the white-rot fungi *Trametes versicolor* (FPRL 28A INI Egham, Surrey strain) and *Ganoderma lucidum*, known for their laccase-producing capabilities, were utilized. The microorganisms were cultured on Potato Dextrose Agar (PDA) plates at 26ºC for 7 days and subsequently stored at +4ºC to preserve viability following the incubation period. Liquid spawn used in the experimental procedures was prepared in Potato Dextrose Broth (PDB) medium. To prepare the inoculum, 20 g/L of pre-formulated Potato Dextrose nutrient medium was dissolved in 50 ml of distilled water and placed into a 250 ml Erlenmeyer flask. The solution was sterilized at

121ºC and 1 bar pressure for 15 minutes using an autoclave. Subsequently, three 1 cm diameter agar plugs, taken from the stock cultures grown on PDA, were aseptically transferred into the sterile liquid medium, and the Erlenmeyer flasks were incubated statically at 26ºC for 7 days. After incubation, the cultures were homogenized using a sterile homogenizer under aseptic conditions, and this homogenized culture was employed as the inoculum.

For solid-state fermentation, wheat bran was used as the primary substrate to evaluate the enhancement of laccase enzyme production with the addition of lingonberry waste. Both substrates were sourced commercially.

Folin-Ciocalteu method for total phenol content (TPC) assay

In this study, the Folin-Ciocalteu method was employed to quantify the total phenolic content present in lingonberry waste, which was used as a phenolic component additive. A standard calibration curve was first constructed using gallic acid to facilitate the determination of total phenolic content (Figure 1). For the analysis, 2 mg of lingonberry waste was placed into an Eppendorf tube, and 1.3 ml of 1.2 M hydrochloric acid dissolved in methanol was subsequently added to the tube, followed by thorough mixing. The prepared samples were subjected to extraction by placing the tubes in a water bath at 42ºC with agitation at 250 rpm for 45 minutes. Following incubation, the tubes were centrifuged at 14,000 rpm for 5 minutes to allow the sedimentation of the lingonberry waste. After centrifugation, 250 µl of the supernatant was carefully transferred to a new tube. Subsequently, 200 µl of Folin-Ciocalteu reagent and 550 µl of 25% sodium carbonate solution were added to the mixture, and the tubes were incubated in a water bath at 42ºC for an additional 9 minutes. After incubation and allowing the samples to cool to room temperature, the total phenolic content was measured spectrophotometrically at 765 nm, expressed as a percentage of gallic acid equivalents.

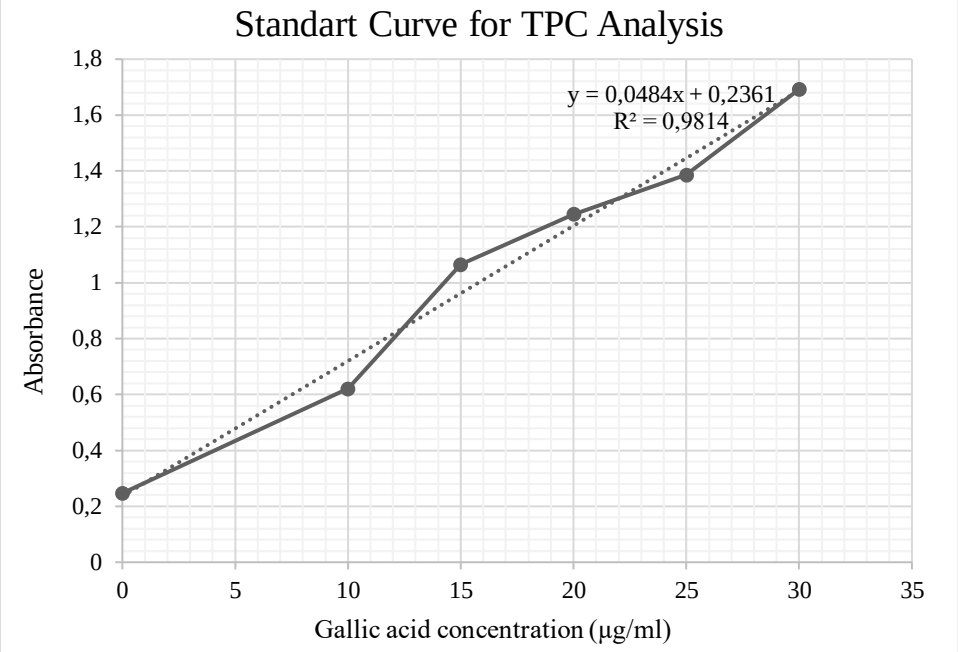

Figure 1. Standard chart of total phenolic compound

Effect of lingonberry waste on laccase production

This study aimed to assess whether the inclusion of phenolic compound-rich lingonberry waste in the nutrient medium could enhance the synthesis of laccase enzyme in white-rot fungi through solid-state fermentation (SSF). To achieve this, wheat bran—commonly reported in the literature as a primary substrate for the SSF of white-rot fungi—was selected as the main substrate. Specifically, *Trametes versicolor*, a well-known laccase-producing white-rot fungus, was utilized in this investigation to evaluate the potential effects of lingonberry waste on enzyme production.

The experiment was conducted in 250 mL Erlenmeyer flasks, each containing 10 g of substrate as the working volume. To evaluate the influence of phenolic compounds on laccase enzyme production, lingonberry waste was incorporated at varying concentrations of 0%, 5%, 10%, 15%, 20%, and 25%. For each fraction, 10 g of solid substrate was used, and the mixture was adjusted to an initial moisture content of 70% by the addition of water. The moistened substrate was then uniformly distributed across the base of the Erlenmeyer flask, achieving a layer thickness of approximately 0.5 cm. The prepared solid-state medium was subsequently sterilized in an autoclave at 121ºC and 1 bar of pressure for 15 minutes to ensure aseptic conditions.

Following sterilization, the Erlenmeyer flasks containing the substrate fractions were disinfected with a 70% isopropyl alcohol solution and transferred to a laminar flow biosafety

cabinet to maintain sterile conditions. A 5% inoculum (inoculation seed/solid substrate ratio) was introduced into each fraction. After inoculation, the flasks were incubated under static conditions for a duration of 7 days. Upon completion of the incubation period, the extraction process was subsequently carried out.

The extraction process was conducted using distilled water as the extraction solvent. Distilled water was added to the samples at a ratio of 1:5 (w/v), and the mixture was agitated with a glass rod, then left to stand for 30 minutes. Following this period, the mixture was filtered through a press cloth. The resulting filtrate was centrifuged at 11,000 rpm for 20 minutes. After centrifugation, the supernatant and pellet were separated by decantation. The supernatant was subsequently used for the determination of laccase enzyme activity.

Laccase enzyme activity was determined through spectrophotometric measurements at a wavelength of 420 nm for a duration of 1 minute at 25ºC, utilizing (2,2′-Azino-bis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) as the substrate. A 1 mM ABTS solution was prepared by mixing it with a citrate buffer solution at pH 5. A blank control was established using 900 µl of citrate buffer solution at pH 3 and 100 µl of the ABTS solution. The laccase activity measurement was conducted using 880 µl of citrate buffer solution at pH 3 and 20 µl of the enzyme sample.

Effect of lingonberry waste on mycelial growth

To evaluate the influence of lingonberry waste on mycelial growth, the growth of *Ganoderma lucidum* was examined in Potato Dextrose Agar (PDA) medium under controlled conditions, as well as in nutrient media containing varying percentages of lingonberry waste. The experimental design was established for a duration of 5 days. Throughout the experiment, the activation process and colonization rate of the mycelium within the nutrient media in the Petri dishes were meticulously monitored.

Results

According to the obtained results, the total phenol content of lingonberry waste was 29.54 mg GAE/g. This result showed that lingonberry waste had a significant phenolic compound content.

Table 1. Laccase activity (U/L) of different lingonberry waste concentrations

%Lingonberry Waste	Laccase Enzyme (U/L)
0	287,49
5	328,52
10	350,52
15	431,15
20	473,93
25	422,40

Table 1 illustrates the correlation between the concentration of lingonberry waste and laccase enzyme activity (U/L) in a solid-state fermentation system utilizing *Trametes versicolor*. The findings reveal a positive correlation between lingonberry waste addition and laccase activity, with an initial measurement of 287.49 U/L at 0% waste. As the concentration of lingonberry waste increased, laccase production rose steadily, reaching a maximum of 473.93 U/L at 20% waste, which denotes the highest enzymatic activity recorded in this study. This enhancement in laccase activity is attributed to the phenolic compounds in lingonberry waste, which likely promote the expression of laccase-encoding genes or act as substrates that boost enzymatic activity. However, an increase to 25% lingonberry waste resulted in a decline in laccase activity to 422.4 U/L, suggesting a potential inhibitory effect at elevated concentrations, possibly due to toxicity or metabolic stress on the fungal cells. This inflection point underscores the necessity of optimizing phenolic compound concentrations to achieve a balance between enzyme induction and fungal viability, indicating that a 20% concentration of lingonberry waste yields the most efficient laccase production in this system.

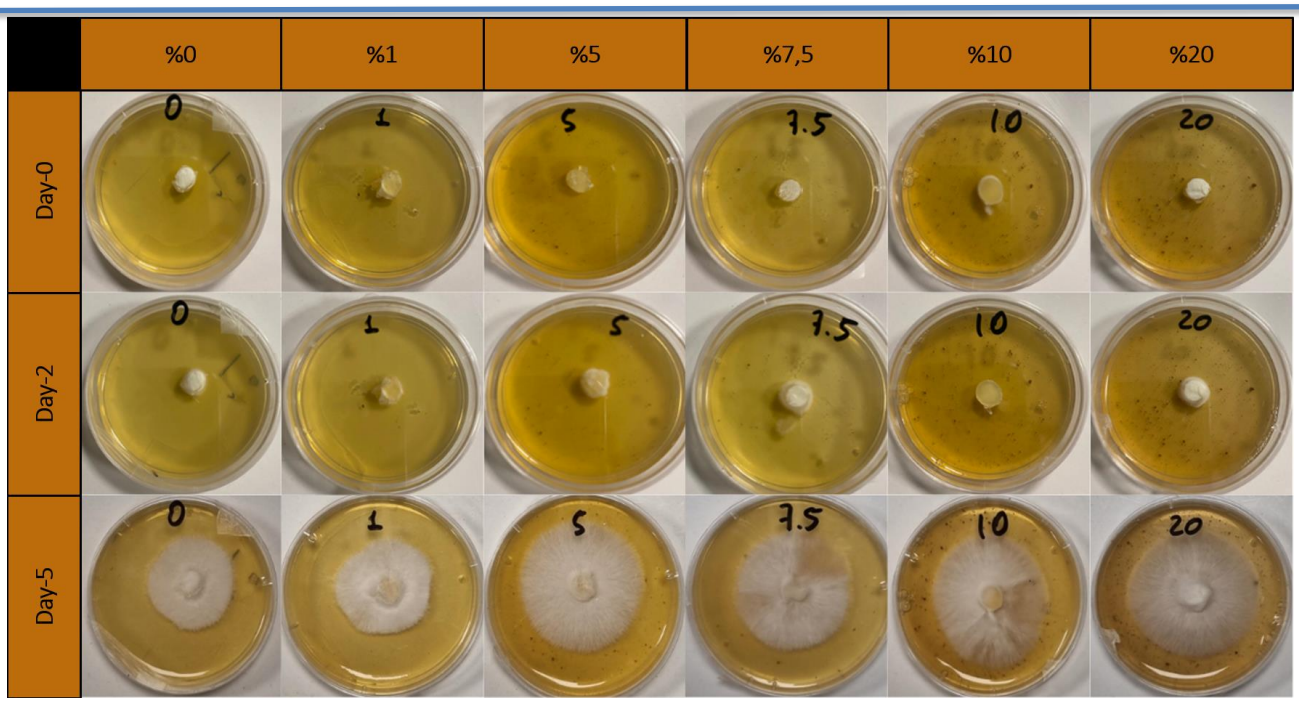

Figure 2. Effect of Lingonberry wastes for mycelial growth

The growth of fungal mycelium was evaluated in agar media supplemented with varying concentrations of lingonberry waste (1%, 5%, 7.5%, 10%, and 20%) over two time points: Day 2 and Day 5. On Day 2, mycelial development was observed in all samples, with the control group (0% lingonberry waste) showing moderate growth from the inoculation point. The 1% and 5% waste groups exhibited similar growth patterns, indicating that low concentrations of phenolic compounds support mycelial activation. However, the 7.5%, 10%, and 20% groups demonstrated minimal growth, suggesting an inhibitory effect of higher phenolic concentrations.

By Day 5, significant mycelial development was noted across the samples. The control group displayed extensive colonization, while the 1% and 5% groups maintained substantial growth dynamics. The 7.5% group showed moderate colonization, whereas the 10% and 20% groups exhibited slower and less uniform growth, with the 20% sample showing the most inhibited colonization. This comparison highlights that lower concentrations of lingonberry waste facilitate mycelial growth, whereas higher concentrations negatively impact fungal colonization, with a pronounced delay in growth evident in the latter groups.

The findings indicate that low concentrations of phenolic compounds from lingonberry waste can be effectively metabolized or tolerated by fungi, thereby enhancing mycelial growth.

Conversely, elevated concentrations exert inhibitory effects, likely due to the toxicity or metabolic burden associated with excess phenolic compounds. These compounds may disrupt essential cellular processes required for fungal growth and colonization. Consequently, optimizing phenolic-rich substrate concentrations is crucial in solid-state fermentation applications to promote efficient fungal activation and colonization.

Discussion

The results of this study indicate that lingonberry waste, rich in phenolic compounds, can both stimulate and inhibit the growth of white rot fungi depending on the concentration used. At lower concentrations (1% and 5%), mycelial growth proceeded at a rate comparable to the control group, suggesting that moderate levels of phenolic compounds may act as metabolic enhancers, potentially inducing the expression of enzymes such as laccase, which facilitate lignin degradation and promote fungal growth. However, at higher concentrations (10% and 20%), a clear inhibitory effect on both fungal activation and colonization was observed. This delay in growth likely results from the increased toxicity or metabolic stress imposed by the high levels of phenolic compounds, which can disrupt essential cellular processes such as membrane integrity, enzyme function, and cellular respiration. The findings are consistent with previous research, which suggests that while phenolic compounds can serve as substrates or inducers for certain ligninolytic enzymes, their accumulation in excess can hinder fungal growth by creating an unfavorable oxidative environment or by directly inhibiting fungal metabolic pathways. The significant reduction in growth observed in the 20% group supports this hypothesis, as the fungus appears unable to cope with the high phenolic load. Furthermore, the observed recovery in the 7.5% and 10% groups by Day 5, albeit limited, suggests that the fungus can gradually adapt to moderate phenolic concentrations, though at a cost to colonization efficiency. These results underscore the importance of carefully optimizing the concentration of phenolic-rich substrates in solid-state fermentation systems. While phenolic compounds can enhance enzyme production and fungal growth at lower concentrations, exceeding a critical threshold leads to significant growth inhibition. Future research should focus on determining the precise phenolic thresholds for various fungal species and exploring potential strategies to mitigate the inhibitory effects of high phenolic concentrations, such as co-culturing with other microorganisms or employing adaptive evolution techniques to enhance fungal tolerance.

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Antimicrobial activity of oak lichen (*Evernia prunastri*, L.) against some fish pathogens

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Abstract

Intensive aquaculture leads to high mortality rates and economic losses due to infectious fish diseases. Overuse of antibiotics has led to the spread of multidrug-resistant strains. This study investigates the antimicrobial activity of oak lichen against selected fish pathogens. We evaluated the antimicrobial activity using different methods, including disc diffusion, minimum inhibition concentration (MIC), and minimum bactericidal concentration (MBC). The ethanol extract from the oak lichen *Evernia prunastri* effectively killed all tested bacteria except L. *garvieae*, B. *subtilis*, and P. *aeruginosa*. The study suggests exploring lichen-based compounds to treat infectious diseases potentially affecting fish farming. We need more research to optimize the application of lichen extracts in aquaculture settings.

Keywords: Evernia prunastri, fish pathogens, oak lichen, antimicrobial activity

Meşe Likeninin (*Evernia prunastri*, L.) Bazı Balık Patojenlerine Karşı Antimikrobiyal Aktivitesi

Entansif su ürünleri yetiştiriciliği, bulaşıcı balık hastalıkları nedeniyle yüksek ölüm oranlarına ve ekonomik kayıplara neden olmaktadır. Antibiyotiklerin aşırı kullanımı, çoklu ilaca dirençli suşların yayılmasına yol açmıştır. Bu çalışma meşe likeninin seçilmiş balık patojenlerine karşı antimikrobiyal aktivitesini araştırmaktadır. Antimikrobiyal aktivite disk difüzyon, minimum inhibisyon konsantrasyonu (MIC) ve minimum bakterisidal konsantrasyon (MBC) gibi farklı yöntemler kullanarak değerlendirilmiştir. Meşe likeni *Evernia prunastri*'den elde edilen etanol özütü, L. *garvieae*, *B. subtilis* ve *P. aeruginosa* hariç test edilen tüm bakterileri etkili bir şekilde inhibe etmiştir. Çalışma, balık yetiştiriciliğini potansiyel olarak etkileyen bulaşıcı hastalıkları tedavi etmek için liken bazlı bileşiklerin araştırılmasını önermektedir. Akuakültür ortamlarında liken ekstraktlarının uygulanmasını optimize etmek için daha fazla araştırma yapılması gerekmektedir.

Anahtar kelimeler: Evernia prunastri, balık patojenleri, meşe likeni, antimikrobiyal aktivite

Introduction

The aquaculture sector is growing nationally and globally in tandem with consumer demand. In aquacultures with high stocking densities, fish are susceptible to infectious diseases caused by stress factors such as physical handling, poor water quality, and sudden temperature fluctuations. Inadequate control of these diseases can lead to restricted growth, weakened immune systems, and significant mortality (Noga, 2010; Baba, 2017). In this case, companies could suffer substantial economic losses. Good aquaculture practices consist of protocols designed to optimize production efficiency, improve product quality, and ensure environmental sustainability. Therefore, effective disease management is essential in aquaculture (Schwarz et al., 2019).

Bacteria, viruses, fungi, and parasites typically cause illness in fish. Antimicrobial medications, particularly antibiotics, are employed to counteract these microorganisms. However, the overuse of antibiotics has resulted in the rise of multidrug-resistant bacteria (Coates et al., 2002). Consequently, the identification and application of natural antibacterial agents is gaining significance. Plant-based natural compounds serve as an environmentally sustainable alternative to synthetic medications (Harbottle et al., 2006). In recent years, various studies have examined the application of plant extracts in aquatic products for preventative and therapeutic purposes (Reverter et al., 2014). Algal, cyanobacteria, and fungi form lichens symbiotically. Historically, people have used lichens to create food, dye, alcohol, and perfume and have also found extensive use in medicine. Traditional medicine uses lichens to treat infectious disorders (Crawford., 2019; Varol, 2019).

Evernia prunastri (L.), also known as oak lichen, is a prevalent lichen species. It primarily occurs on the trunks and branches of oak trees, as well as on the bark of other deciduous trees and conifers, including fir and pine; also, Türkiye's lichen flora is noteworthy (Baytop, 1984). Studies have shown that chemicals from lichen have many biological effects, such as antibacterial, antifungal, antiviral, antioxidant (Jeon et al., 2009). Burkholder et al. conducted the first study on antibacterial properties in 1944. This investigation revealed that some analogous metabolites with antibiotic characteristics were efficient against gram-positive bacteria but ineffective against gram-negative bacteria. Previous studies have documented disparate outcomes despite using identical lichen species and solvents in antibacterial activity assays (Türkan et al., 2013; Gül et al., 2020).

The climatic conditions that impact lichen growth and the harvest time considerably influence the diversity and abundance of secondary metabolites produced by the lichen (Aoussar et al., 2020).

This research investigates the antibacterial efficacy of the lichen species Evernia prunastri against specific fish infections. The goal is to develop long-lasting and environmentally friendly ways to control diseases in aquaculture by using disk diffusion, minimum inhibitory concentration (MIC), and minimum bactericidal concentration (MBC) methods.

Material and Method

Supply of Plants and Bacterial Strains

Samples of *E. prunastri* lichen used in the study came from oak trees (Quercus sp.) on the campus of Çanakkale Onsekiz Mart University, Yenice Vocational School. Özcan Şimşek identified the species. Before extracting the material, we cleaned the residues in the plant samples under suitable conditions. Different bacterial strains isolated from fish (*Yersinia ruckeri* E42 KX388238, *Edwardsiella tarda* SY-ED1 KY126838, *Lactococcus garvieae* SY-LG1 KY118086, *Aeromonas hydrophila* SY-AH2 MG844996, *Aeromonas veronii* SY-AV10 MG563680, and *Plesiomonas shigelloides* SY-PS16 MG574356) were obtained from Sevdan Yılmaz (Marine Sciences and Technology Faculty at Çanakkale Onsekiz Mart University).

Additional bacterial strains included in the study (*Staphylococcus haemolyticus* ATCC 43252, *Acinetobacter baumanii* ATCC 19606, *Staphylococcus aureus* ATCC 6538P, *Escherichia coli* NRRL B-3704, *Bacillus subtilis* ATCC 6633, *Proteus vulgaris* ATCC 13315, *Pseudomonas aeruginosa* ATCC 27853) were obtained from Nurcihan Hacıoğlu Doğru (Çanakkale Onsekiz Mart University, Faculty of Science, Department of Biology).

Obtaining Extracts

After drying the plant material at room temperature, a mechanical grinder ground it into a powder, and a Soxhlet apparatus extracted a 15-gram sample using 150 mL of 96% ethanol for 12 hours. For the experiment, we prepared the solvent by dissolving it in different amounts of evaporated dimethyl sulfoxide (DMSO) using an evaporator. We then sterilized the solvent by filtering it.

Tests for antimicrobial activity

The antimicrobial activity of the lichen extract was evaluated using the disk diffusion method (Bauer, 1966), which enabled the detection of microbial presence or absence. After the right amount of time had passed, the inhibition zones on Mueller Hinton Agar (MHA) were measured and compared to those on a control disk containing penicillin (P10:10µg/disk) (CLSI, 2006). We used the microdilution method (Wikler, 2006) to determine the MIC values of all the test microorganisms to see how the plant extract inhibited microorganism growth. We conducted the MIC measurements in triplicate used a microplate reader at a wavelength of 550 nm. We used streptomycin (S10) as an antibiotic control. We put dots from the plaque wells above the MIC value onto MHA agar and let them grow to find the MIC and non-reproductive MIC values. We accepted the concentration at which no reproduction occurred as the Minimum Bactericidal Concentration (MBC) for the bacteria. We conducted all analyses using three repeated trials.

Results and Discussion

The findings of the antimicrobial activity of *E. prunastri* lichen are presented in Table 1. The disc diffusion method revealed that the ethanol extract of *E. prunastri* lichen exhibited a superior antibacterial effect against all test bacteria, apart from *B. subtilis* ATCC 6633, *L. garvieae* SY-LG1 KY118086 and *P. aeruginosa* ATCC 27853. These findings indicate that the extract displays a more pronounced antibacterial activity than the comparison antibiotic P10. As a control, only ethanol, methanol, acetone and ethyl acetate impregnated discs showed a zone diameter of 0-1 mm.The MIC values of the plant extracts against all test bacteria ranged between 0.625-2.5 µg/mL. However, similar to the disc diffusion method, higher MIC values were detected in all test cultures except B. *subtilis* ATCC 6633, L. *garvieae* SY-LG1 KY118086 and P. *aeruginosa* ATCC 27853 bacteria than the comparator antibiotic S10.

MBC values of lichen extract varied between 0.625-5 µg/mL. In addition, the lowest MBC value (0.625 µg/mL) was obtained against Y. *ruckeri* E42 KX388238, E. *tarda* SY-ED1 KY126838, P. *shigelloides* SY-PS16 MG574356 and S. *haemolyticus* ATCC 43252 test microorganisms and the highest MBC value (5 µg/mL) was obtained against P. *aeruginosa* ATCC 27853 test bacteria.

Table 1. Findings on the antimicrobial activity of the lichen extract.

Microorganisms	Antimicrobial Test Methods				
	* Disc Diffusion		MIC		MBC
	Lichen Extract (mm)	Control (P10) (mm)	Lichen Extract (µg/mL)	Control (S10) (µg/mL)	Lichen Extract (µg/mL)
Yersinia ruckeri *E42 KX388238*	**28.00**	15.0	**0.625**	1.25	**0.625**
Edwardsiella tarda *SY-ED1 KY126838*	**25.00**	17.0	**0.625**	2.0	**0.625**
Lactococcus garvieae *SY-LG1 KY118086*	10.00	10.0	2.5	2.0	2.5
Aeromonas hydrophila *SY-AH2 MG844996*	**17.00**	12.0	**1.25**	2.0	1.25
Aeromonas veronii *SY-AV10 MG563680*	**14.00**	12.0	**1.25**	2.0	1.25
Plesiomonas shigelloides *SY-PS16 MG574356*	**27.00**	15.0	**0.625**	2.0	**0.625**
Staphylococcus haemolyticus ATCC 43252	**18.00**	14.0	**0.625**	4.0	**0.625**
Acinetobacter baumanii ATCC 19606	**16.00**	12.0	**1.25**	4.0	1.25
Staphylococcus aureus ATCC 6538P	**16.00**	15.0	**1.25**	5.0	1.25
Escherichia coli NRRL B-3704	**18.00**	16.0	**1.25**	4.0	1.25
Bacillus subtilis ATCC 6633	12.00	14.0	2.5	2.0	1.25
Proteus vulgaris ATCC 13315	**25.00**	13.0	**0.625**	4.0	1.25
Pseudomonas aeruginosa ATCC 27853	8.00	8.0	2.5	1.0	5

(*): The numbers indicate the diameters of the inhibition zones.
P10: Penicillin (10ug/disc); S10: Streptomycin (10ug/disc)

Rowe et al. (1999) investigated the antimicrobial effect on some lichens in southern Spain. Researchers found that lichens containing usnic acid had a powerful effect against gram-positive bacteria. Another study (Aslan et al., 2006) looked at the antioxidant and antimicrobial properties of methanol extracts from *Cladonia foliacea, Dermatocarpon miniatum, Evernia divaricata, E. prunastri,* and *Neofuscella pulla* lichen species in a lab setting. They discovered that the extracts were effective against some bacteria and fungi but not yeasts. Cansaran et al. (2006), studied how different amounts of usnic acid from *Rhizoplaca chrysoleuca, R. melanopthalma*, and *R. peltata* affected bacteria such as *Bacillus subtilis,* B. *megaterium, Enterococcus faecalis, Escherichia coli, Proteus mirabilis, Staphylococcus aureus,* and *Pseudomonas aeruginosa*. Researchers have observed an increase in the antimicrobial effectiveness of usnic acid as its amount increases.

Gül et al. (2020) studied how well ethanol and methanol extracts of the lichen *Pseudevernia furfurace* killed four types of bacteria: *E. coli, S. aureus, B. cereus,* and *Candida albicans*. They found that *S. aureus* was the most sensitive strain to the ethanol extract, and *C. albicans* was the most sensitive strain to the methanol extract. Mitrović et al. (2011) studied the antimicrobial activity of the methanol extracts of *E. prunastri*. According to these studies, the methanol extracts of *E. prunastri* exhibited antimicrobial activity against certain test bacteria and fungi. Ilçim et al. (1995) studied how the chloroform extract of *Parmelia furfuracea* (L.) Zopf killed bacteria. They found that the chloroform extract of *P. furfuracea* killed the bacteria in the test. Türkan et al. (2013) investigated the antimicrobial effects of *Pseudevernia furfuracea* (L.) Zopf on raw leather treated with acetone extract. They found that the acetone and chloroform extracts of *P. furfuracea* were effective against the test bacteria. Literature review reveals that studies with *E. prunastri* lichen species are limited. Our study is a preliminary study on the antimicrobial effect of *E. prunastri* species against fish pathogens.

In conclusion, the ethanol extract of oak lichen *E. prunastri* exhibits potent antimicrobial activity against fish pathogens and has a potential application in fish farming. Further research is required to understand its mechanisms and improve its application. The high rate of antibiotic resistance, which has become a threat to public health, further emphasises the importance of working with this lichen species as a natural drug source. This necessitates the purification of secondary metabolites with antibiotic potential from this lichen and a comprehensive study against various pathogenic microorganisms.

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The Importance of Mushroom Gastronomy in the Formation of New Tourism Destinations: A Global and Turkish Perspective

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Abstract

Mushroom gastronomy has been gaining increasing importance worldwide and in Türkiye in recent years in terms of nutritional value and economic benefit. Mushrooms not only add flavor to dishes but also stand out as a healthy and sustainable food source. In various world cuisines, the rich diversity of mushrooms contributes significantly to cultural gastronomic richness by creating local flavors. In this context, mushroom gastronomy greatly contributes to the diversity and sustainability of regional flavors in both global and Turkish cuisine.

With the growing popularity of gastronomic tourism, mushroom gastronomy has also become an important attraction for tourist destinations. Conscious and experience-focused tourists increasingly prefer not only tasting delicious dishes during their travels but also participating in the production, processing, and presentation rituals of local products. Mushroom gastronomy meets these demands, contributing to the development of gastronomic tourism in Türkiye and globally.

From a sustainability perspective, mushroom gastronomy offers an approach that is environmentally friendly and supports the preservation of biodiversity. Supporting local agriculture and production methods not only contributes to the economic development of regional communities but also helps preserve traditional culinary cultures. In Türkiye, particularly in regions known for their wide variety of mushrooms, this gastronomic culture not only supports sustainable tourism but also significantly contributes to the economic and social development of local communities, offering a promising future.

In conclusion, mushroom gastronomy stands out as an important factor that preserves local cultural values in both global and Turkish cuisine, supports sustainable tourism, and contributes to the creation of new tourist destinations by offering gourmet experiences. For a sustainable future and the continuation of rich gastronomic cultures, mushroom gastronomy holds significant potential at both local and global levels.

Keywords: Mushroom tourism, mushroom gastronomy, tourism destinations, sustainable tourism.

Yeni Turizm Destinasyonlarının Oluşmasında Mantar Gastronomisinin Dünya ve Türkiye Açısından Önemi

Mantar gastronomisi, hem besin değeri hem de ekonomik getirisi açısından son yıllarda dünya genelinde ve Türkiye'de giderek daha fazla önem kazanmaktadır. Mantarlar, mutfaklarda sadece lezzet katmakla kalmayıp, aynı zamanda sağlıklı ve sürdürülebilir bir gıda kaynağı olarak öne çıkmaktadır. Dünyanın farklı mutfaklarında, mantarların zengin çeşitliliği kullanılarak yerel tatların yaratılması, kültürel gastronomi zenginliğine önemli bir katkı sağlamaktadır. Bu bağlamda, mantar gastronomisi hem dünya mutfaklarında hem de Türkiye mutfağında yöresel lezzetlerin çeşitliliğine ve sürdürülebilirliğe büyük katkı sunmaktadır.

Gastronomi turizminin giderek popülerleşmesiyle birlikte, mantar gastronomisi, turistik destinasyonlar açısından da önemli bir çekim unsuru haline gelmiştir. Özellikle bilinçli ve deneyim odaklı turistler, seyahatlerinde artık yalnızca lezzetli yemekler tatmanın ötesinde, yerel ürünlerin üretim, işleme ve sunum ritüellerine katılmayı, bu süreçleri deneyimlemeyi tercih etmektedir. Mantar gastronomisi, bu talepleri karşılayarak hem Türkiye'de hem de dünya genelinde gastronomi turizminin gelişimine katkıda bulunur.

Sürdürülebilirlik açısından bakıldığında, mantar gastronomisi, çevreye duyarlı ve biyolojik çeşitliliği koruyan bir yaklaşım sunar. Yerel tarım ve üretim yöntemlerinin desteklenmesi, bölgesel halkın ekonomik kalkınmasına katkı sağlarken aynı zamanda geleneksel mutfak kültürlerinin korunmasına da yardımcı olur. Türkiye'de özellikle zengin mantar çeşitliliğiyle bilinen bölgelerde bu gastronomi kültürü, yerel halkın ekonomik ve sosyal gelişimine katkı sağlarken, sürdürülebilir turizmi destekleyen bir unsur haline gelmiştir.

Sonuç olarak, mantar gastronomisi hem dünya mutfaklarında hem de Türkiye mutfağında yerel kültürel değerleri koruyan, sürdürülebilir turizmi destekleyen ve gurme deneyimler sunarak yeni turistik destinasyonların oluşumuna katkı sağlayan önemli bir faktör olarak öne çıkmaktadır. Sürdürülebilir bir gelecek ve zengin gastronomi kültürlerinin devamı açısından mantar gastronomisi hem yerel hem de küresel düzeyde büyük bir potansiyele sahiptir.

Anahtar kelimeler: Mantar turizmi, mantar gastronomisi, turizm destinasyonları, sürdürülebilir turizm.

The Importance of Mushroom Tourism and Mushroom Gastronomy

Gastronomy tourism plays a significant role in preserving cultural heritage and creating various opportunities for local businesses in rural areas, including employment (Fusté-Forné, 2019). This type of tourism caters to tourists' desire to explore different flavors and attracts those seeking quality meals. A gastronomy tourist discovers tourism destinations through experiences such as visiting local markets, tasting local products, learning about local food rituals, and participating in gastronomic events. Therefore, gastronomy tourism stands out as a multifaceted type of tourism, as it not only involves tasting delicious food but also allows for the experience of local cultures and traditions.

Mushroom gastronomy and mushroom tourism are concepts that support and enhance each other. Since their discovery by humanity, mushrooms have been considered essential sources of nutrition and health (Chang, 1980; Roncero-Ramos, Delgado-Andrade, 2017). In recent years, wild mushrooms growing naturally in their environments have started to attract people's attention. Particularly in terms of gastronomy tourism, mushrooms and the dishes made from them are becoming increasingly economically significant as a fundamental food source for local cultures. Studies in this context highlight the gastronomic and economic potential of mushrooms and enhance the touristic appeal of this natural resource (Pérez-Álvarez et al., 2023).

Mushrooms and yeasts are widely used in the food industry, especially in alcoholic beverages such as wine and beer. In addition to their role as auxiliary ingredients in the production of various food products, mushrooms hold an essential place in gastronomy. Edible mushrooms can be cultivated under suitable climates and conditions or collected from the wild. Mushroom cultivation and foraging are economically significant sectors (Chand & Singh, 2022). The collection of edible wild mushrooms offers substantial mycological potential for the development of a region based on its natural resources. The interest in mushrooms is not limited to their collection and sale; mushroom foraging activities also attract individuals. In this context, mushroom tourism, also known as mycotourism, includes these examples (Secco et al., 2010).

The Importance of Mushroom Gastronomy

Nutritional Value: Mushrooms are rich in protein, vitamins, minerals, and fiber. They are also high in antioxidants, which help strengthen the immune system (Mau et al., 2001; Baars, 2017).

***Sustainability**:* Mushrooms are relatively easy to cultivate and are environmentally friendly. Therefore, they can play a significant role as a sustainable food source (Chiu et al., 2000).

***Cultural Richness**:* Mushrooms hold a significant place in global cuisines. Different cultures utilize various mushroom species in diverse ways, making them an essential part of traditional dishes. This role of mushrooms in preserving cultural richness not only connects us to our heritage but also enriches our culinary experiences.

***Gourmet Experience**:* Mushrooms are also highly popular in gourmet cuisine. When combined with different cooking techniques and other flavors, they offer gourmets a unique culinary experience.

An Overview of the Culinary and Tourism Uses of Mushrooms

The culture of food and drink can be considered an essential part of a vacation. Mycotourism addresses the relationship between gastronomy, tourism, and nature. Mushroom tours, organized with expert guides in destinations suitable in terms of soil, climate, and geographical features, play a significant role as a sustainable tourism activity in the economic development of regions rich in mycological resources. Therefore, it is also regarded as a unique tourism product that enhances the attractiveness of a destination. In this context, mycotourism offers unique gastronomic experiences, where individuals search for edible wild mushrooms in their natural habitats, learn about new species, and explore the flavors of collected mushrooms, promising an intriguing and enriching journey.

Mushrooms are also gaining increasing importance in tourism. This type of tourism, known as mycotourism, has become a touristic activity by combining the gathering of mushrooms in nature with gastronomic experiences.

Mycotourism: Mycotourism offers tourists the experience of discovering and collecting edible wild mushrooms in nature through organized mushroom foraging tours. These tours are typically conducted with guides who provide information on identifying, gathering, and cooking mushrooms.

***Gastronomic Experiences**:* In addition to mushroom foraging, mycotourism tours include gastronomic experiences such as tasting and cooking dishes prepared with the collected

mushrooms. These experiences allow tourists to familiarize themselves with local culinary culture and explore regional flavors.

Economic Contribution: Mycotourism provides significant economic benefits as a sustainable tourism activity in mushroom-rich regions. These benefits include the creation of new income sources for local communities, the support of the region's economic development, and the preservation of traditional culinary cultures. By attracting tourists who are interested in gastronomy and nature, mycotourism contributes to the diversification of the local economy and the promotion of sustainable tourism practices (Suazo & Viana-Lora, 2022).

In conclusion, the use of mushrooms in cuisine and tourism is of great importance in terms of both gastronomic richness and sustainable tourism (Jiménez-Ruiz et al., 2017). While the unique flavors and nutritional values provided by mushrooms make them indispensable in the world of gastronomy, mycotourism activities contribute to tourism by offering unforgettable experiences closely connected with nature.

Popular Mushroom Tourism Destinations in the World and Türkiye

Mycotourism, which has been an emerging trend for over 15 years worldwide, offers not only the opportunity to learn about and collect various mushroom species but also to participate in a range of activities related to the destination. These activities include attending exhibitions and conferences, participating in cycling tours, nature walks, cooking classes, culinary workshops, photography competitions, shopping at local markets selling specialty products, dining at local restaurants, staying in authentic accommodations, and bird watching, among others (Pilz & Molina, 2002, p. 4; de Frutos Madrazo et al., 2012, p. 82; Romanogli, 2018, p. 71; Jiménez-Ruiz et al., 2019; Thomé-Ortiz, 2020).

Flavor Profiles and Culinary Uses of Different Mushroom Varieties

The flavor profiles and culinary uses of different mushroom varieties are quite diverse. Here are some common mushroom types and how they are used in the kitchen:

Shiitake Mushrooms

- *Flavor Profile:* Shiitake mushrooms offer a rich, meaty, and umami taste with a subtle smoky aroma.

- *Use:* A staple in Asian cuisine, shiitake mushrooms are used in soups, stir-fries, sauces, and pasta dishes. They can also be rehydrated from their dried form and incorporated into various dishes.

Porcini Mushrooms

- *Flavor Profile:* Porcini mushrooms have an intense, nutty, and meaty flavor, which becomes even more profound when dried.
- *Use:* Ideal for risotto, pasta, meat dishes, and soups, dried porcini mushrooms are soaked in water before use, and the resulting mushroom broth is used to add depth to dishes.

Button Mushrooms

- *Flavor Profile:* Button mushrooms have a mild, neutral flavor, offering a soft and delicate taste.
- *Use:* They can be used raw or cooked in salads, omelets, sandwiches, pizzas, and various other dishes. Known for their versatility, button mushrooms are suitable for nearly any recipe.

Oyster Mushrooms

- *Flavor Profile:* Oyster mushrooms have a light, sweet taste reminiscent of seafood.
- *Use:* Oyster mushrooms are popular in sautés, stir-fries, soups, and stews, as well as in vegetable and vegan/vegetarian dishes due to their delicate texture.

Truffle

- *Flavor Profile:* Truffles have an intense, earthy, nutty flavor with a hint of musky aroma. They are also known for their strong scent.
- *Use:* Truffles are typically grated or thinly sliced over simple dishes like pasta, risotto, eggs, and potatoes to enhance flavor.

Morel Mushrooms

- *Flavor Profile*: Morel mushrooms offer an intense, meaty, and slightly nutty taste.
- *Use:* They are commonly used in creamy sauces, meat dishes, and pasta.

King Oyster Mushrooms

- *Flavor Profile:* King oyster mushrooms have a dense, meaty texture with a slightly sweet taste, often resembling the texture of meat.
- *Use:* They can be sliced, grilled, or sautéed and are often used as a meat substitute in vegan and vegetarian dishes.

Chanterelle Mushrooms

- *Flavor Profile:* Chanterelle mushrooms have a mild peppery, fruity, and sweet taste.
- *Use:* They are used in sauces, omelets, risottos, and meat dishes. Due to their delicate texture, they are best cooked using quick methods.

Maitake Mushrooms

- *Flavor Profile:* Maitake mushrooms have an intense, meaty flavor with a slight peppery note.
- *Use:* They are used in soups, sautéed dishes, pasta, and grilled preparations. Their health benefits also contribute to their popularity.

Enoki Mushrooms

- *Flavor Profile:* Enoki mushrooms have a light, delicate, and slightly sweet taste.
- *Use:* They are used raw in salads, soups, and sushi, and can also be sautéed or used as a garnish in hot dishes.

These mushroom varieties offer a wide range of culinary applications, each bringing unique flavors and textures to dishes.

Restaurants and Chefs Offering Mushroom Delicacies Worldwide

Many restaurants and chefs present mushrooms in delicious and creative ways. These establishments and culinary professionals have established significant positions in the gastronomy world by using mushrooms not just as ingredients but as the stars of their dishes. Some notable restaurants and chefs renowned for their expertise with mushrooms include:

Restaurants

- *Eleven Madison Park, New York, USA*

- *Chef:* Daniel Humm
- *Features:* This three-Michelin-star restaurant is famous for its creative and sophisticated mushroom dishes. Their menus frequently feature specialty mushrooms such as truffles and porcini.

- *Noma, Copenhagen, Denmark*
  - *Chef:* René Redzepi
  - *Features:* World-renowned Noma is known for its innovative mushroom dishes. It offers a gastronomic experience that is deeply connected with nature by using wild mushrooms foraged in forests.
- *The French Laundry, Yountville, California, USA*
  - *Chef:* Thomas Keller
  - *Features:* This three-Michelin-star restaurant is renowned for its sophisticated and elegant mushroom dishes. It is famous for its use of truffles, risottos, and various mushroom preparations.
- *Mushroom Restaurant, Beijing, China*
  - *Features*: As the name suggests, this restaurant specializes exclusively in mushroom dishes. It offers both traditional and modern dishes using various types of mushrooms.
- *La Grenouillère, Montreuil, France*
  - *Chef:* Alexandre Gauthier
  - *Features:* This Michelin-starred restaurant is known for its mushroom dishes inspired by nature. It creates inventive flavors using local and seasonal mushrooms.

Chefs

- *Massimo Bottura*
  - *Restaurant: Osteria Francescana, Modena, Italy*
  - *Features:* Owner and head chef of the three-Michelin-star Osteria Francescana, Bottura is renowned for modernizing Italian cuisine. He expertly uses mushrooms in risotto and pasta dishes.

- *Grant Achatz*
    - *Restaurant: Alinea, Chicago, USA*
    - *Features:* Utilizing molecular gastronomy techniques, Achatz presents mushrooms in innovative and creative ways. At Alinea, mushroom-based flavors are featured in visually and gastronomically captivating presentations.

- *Alice Waters*
    - *Restaurant: Chez Panisse, Berkeley, California, USA*
    - *Features:* Waters focuses on local and organic products, offering simple yet flavorful mushroom dishes by using seasonal and fresh ingredients.
- *Heston Blumenthal*
    - *Restaurant: The Fat Duck, Bray, England*
    - *Features:* Head chef of the three-Michelin-star The Fat Duck, Blumenthal uses mushrooms in scientific and creative ways to offer extraordinary flavors.
- *Yoshihiro Narisawa*
    - *Restaurant: Narisawa, Tokyo, Japan*
    - *Features:* Combining Japanese cuisine with modern techniques, Narisawa presents mushrooms as an integral part of nature. His menus frequently feature maitake and shiitake mushrooms.

Restaurants and Chefs Offering Mushroom Delicacies in Türkiye

These restaurants and chefs have established significant positions in the gastronomic world by using mushrooms not merely as ingredients but as central elements in their dishes. The rich flavor profiles and creative uses of mushrooms are key factors that distinguish these establishments and chefs in the culinary world. In Türkiye, some numerous restaurants and chefs offer mushroom-based delicacies, often utilizing local and wild mushroom varieties to create innovative and flavorful dishes.

Restaurants

- *Neolokal (İstanbul)*
    - *Chef:* Maksut Aşkar
    - *Features:* Led by Chef Maksut Aşkar, this restaurant reinterprets modern Turkish cuisine using local and sustainable ingredients. The menu features innovative dishes prepared with various types of mushrooms.
- *Mikla (İstanbul)*
    - *Chef:* Mehmet Gürs
    - *Features:* Under the leadership of Chef Mehmet Gürs, Mikla offers dishes based on local ingredients and Anatolian cuisine. The menu incorporates mushrooms and other local, seasonal ingredients.
- *Nusr-Et Steakhouse (İstanbul)*
    - *Features:* Known for its meat dishes, Nusr-Et al. includes mushroom-based sauces on its menu. Several branches of the restaurant feature dishes enriched with various types of mushrooms.
- *Zencefil (İstanbul)*
    - *Features:* Located in Beyoğlu, İstanbul, Zencefil is recognized for its vegetarian and vegan options. The menu includes a variety of delicious dishes prepared with mushrooms.
- *Hünkar (İstanbul)*
    - *Features:* Offering traditional Turkish cuisine with a modern touch, Hünkar includes classic dishes such as mushroom-stuffed vegetables and mushroom casserole in its menu.

Chefs

- *Maksut Aşkar*
    - *Restaurant:* Neolokal

- *Features:* Known as the chef of Neolokal, Maksut Aşkar frequently uses local ingredients such as mushrooms in his menu. He modernizes Turkish cuisine while highlighting local flavors.

- *Mehmet Gürs*
  - *Restaurant:* Mikla
  - *Features:* Chef Mehmet Gürs, known for the "New Anatolian Cuisine" concept, often features local mushroom varieties in his menu.

- *Ali Ronay*
  - *Features:* A pioneering chef in modern Turkish cuisine, Ali Ronay creates innovative flavors using local ingredients such as mushrooms.

- *Cihan Kıpçak*
  - *Restaurant:* Spago İstanbul
  - *Features:* Chef Cihan Kıpçak of Spago İstanbul is one of the chefs who interprets mushrooms in various ways within modern cuisine.

These restaurants and chefs make significant contributions to Türkiye's gastronomic scene by highlighting mushroom-based delicacies. They offer enjoyable experiences for mushroom enthusiasts by presenting traditional Turkish cuisine with modern interpretations through the use of local mushrooms.

Local Restaurants Highlighting Mushroom Gastronomy in Türkiye

In Türkiye, there are several local restaurants renowned for their mushroom-based dishes. These establishments are particularly prevalent in regions where mushrooms grow abundantly.

- *Zigana Yayla Restaurant (Trabzon)*
  - *Features:* Located at the foothills of Mount Zigana, this restaurant offers a variety of wild mushrooms found in the region. It is especially known for its dishes made from mountain mushrooms.

- *Şile Mantarcı Baba (İstanbul)*

- *Features:* Situated in the Şile district of Istanbul, this establishment is also known for its natural mushroom foraging activities. It offers a range of mushroom dishes, including mushroom soup and mushroom stir-fry.

- *Doğal Mantar Evi (Bolu)*
    - *Features:* This restaurant in Bolu serves dishes made from wild mushrooms collected from local forests. It is particularly famous for its mushroom sauté and mushroom casserole.

- *Kastamonu Mantar Evi (Kastamonu)*
    - *Features:* Located in Kastamonu, this venue showcases the region's natural mushrooms. Diners can enjoy mushroom soup and mushroom sauce with meat dishes.

These restaurants highlight natural mushrooms by featuring a variety of mushroom dishes on their menus. It is possible to find local restaurants specializing in mushrooms throughout different regions of Türkiye.

Mushroom Foraging Tours and Mushroom Cooking Classes: Gastronomic Experiences

Mushroom foraging tours and mushroom cooking classes offer unique experiences that blend nature and gastronomy. These activities appeal to both nature enthusiasts and gourmets, providing opportunities to explore local culture and discover the flavors offered by nature. Here are the details of these gastronomic experiences:

Mushroom Foraging Tours

1. *Immersive Nature Experience*
    - Mushroom foraging tours allow participants to explore edible wild mushrooms in natural settings under the guidance of expert guides. These tours are typically conducted in forested areas, parks, or rural regions (Madrazo, Peña, & Laleona, 2020).
2. *Education and Awareness*
    - Guides provide participants with information about the diversity of mushrooms, including which species are edible and which are toxic. They also teach how to

properly forage for mushrooms, including how to protect natural habitats without causing damage.

3. *Seasonal and Regional Variations*
    - Mushroom foraging tours vary depending on the seasonal availability of specific mushroom species and regional climatic conditions. For instance, porcini and truffle foraging tours are popular in many parts of Europe during the autumn months.
4. *Economic and Sustainable Tourism*
    - These tours contribute to local economies and are considered part of sustainable tourism activities. Mushroom foraging tours create additional income sources for local guides and farmers.

Mushroom Cooking Classes

1. *Creativity in the Kitchen*
    - Mushroom cooking classes provide participants with practical knowledge on how to clean, prepare, and cook mushrooms. These classes offer an excellent opportunity to explore the flavor profiles of mushrooms and learn various cooking techniques.
2. *Training with Professional Chefs*
    - These classes are often led by renowned chefs or mushroom specialists. Participants receive training in professional kitchens, learning the intricacies of preparing dishes with mushrooms.
3. *Variety of Recipes and Techniques*
    - The classes include a range of recipes using different mushroom types. Instruction covers the preparation of dishes such as mushroom soups, risottos, pasta sauces, sautéed mushrooms, and stuffed mushrooms. Additionally, topics like mushroom drying, marinating, and preservation are also addressed.
4. *Cultural and Gastronomic Exploration*
    - Mushroom cooking classes offer opportunities to explore local culinary traditions and utilize local ingredients. These classes provide an unforgettable experience for gastronomy enthusiasts and an opportunity to discover new flavors.

Featured Mushroom Foraging Tours and Cooking Classes

1. *Truffle Hunting Tours in France*
    - *Region:* Provence and Dordogne
    - *Features:* Tours with local truffle hunters and their dogs involve locating and foraging for truffles. Following the tours, cooking classes and tastings of dishes prepared with the foraged truffles are organized.
2. *Porcini and Chanterelle Foraging Tours in Italy*
    - *Region:* Tuscany and Piedmont
    - *Features:* Foraging for porcini and chanterelle mushrooms in forests with local guides. The tours include education on recognizing and foraging mushrooms. Additionally, cooking classes featuring dishes prepared with foraged mushrooms are offered.
3. *Mycotourism in the United States*
    - *Region:* Pacific Northwest (Oregon and Washington)
    - *Features:* Tours in this region involve foraging various wild mushrooms (morel, maitake, chanterelle). The tours provide comprehensive education on mushroom identification, foraging, and cooking.
4. *Mushroom Festivals and Classes in Spain*
    - *Region:* Catalonia and the Basque Country
    - *Features:* Local mushroom festivals are filled with foraging tours and cooking classes. These events provide excellent opportunities to experience the region's gastronomic culture.

These gastronomic experiences not only offer participants the chance to explore mushroom flavors but also facilitate a closer connection with nature and a deeper understanding of local cultures.

Conclusion

Mushroom gastronomy and mushroom tourism are of significant importance for supporting sustainable tourism and creating new tourist destinations. These two areas not only offer a nature-based form of tourism but also contribute to the preservation of local cultures, traditions, and natural resources. Mushroom gastronomy enhances local cuisines and ensures the continuity of regional gastronomic cultures by leveraging the rich mycological potential provided by nature. In this process, mushroom tourism helps diversify tourism by offering alternative and unique experiences for nature enthusiasts and gastronomy aficionados.

Both mushroom gastronomy and tourism create a synergistic relationship that supports and strengthens each other, contributing to local economies while also promoting environmental sustainability. The integration of these two fields offers important opportunities for diversifying tourist destinations, supporting local producers, and promoting gastronomic culture on a global scale. The ecological, economic, and cultural value of mushrooms not only creates unique experiences for local communities and visitors but also facilitates the development of a tourism approach that is harmonious with nature. In this context, mushroom gastronomy and tourism play a crucial role in the preservation of natural and cultural heritage, the empowerment of local communities, and the achievement of sustainable tourism goals.

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Examination Of The Distribution Of *Candida* Species Isolated From Blood Cultures In A University Hospital

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Abstract

Candidemia is an infectious disease caused by *Candida* species. It is an important bloodstream infection that is difficult to diagnose and treat and has a high mortality rate and usually occurs in intensive care units of hospitals. The most commonly isolated candidemia agent is *Candida albicans*. However, in recent years, the incidence of candidemia caused by non-albicans *Candida* species has begun to increase. This study aimed to determine the frequency and species distribution of *Candida* in blood cultures coming to the laboratory from various clinical units between July 2022 and July 2024. Blood samples inoculated into blood culture bottles were incubated in a BACTEC automatic blood culture device (Becton Dickinson, USA). *Candida* species were identified using conventional methods from automated cultures that gave a positive signal. Identification of the identified *Candida* species to the species level was performed using the VITEK 2 Compact® automated system (BioMérieux, France). Of the 13,772 blood samples, 270 (2%) were positive for *Candida* spp. *Candida albicans* was detected in 112 (%41,6) of the positive samples, while non-albicans species were detected in 158 (%58,4). The most frequently isolated non-albicans species was *Candida parapsilosis*, 110 (%40,8). As a result, the typing of *Candida* species treated in intensive care units, especially in newborns, and the determination of antifungal lesions are important in terms of giving treatment direction.

Keywords: Blood culture, *Candida albicans, Candida* species, Candidemia.

Bir Üniversite Hastanesinde Kan Kültürlerinden İzole Edilen *Candida* Türlerinin Dağiliminin İncelenmesi

Özet

Kandidemi, *Candida* türleri tarafından oluşturulan bir enfeksiyon hastalığıdır. Genellikle hastanelerin yoğun bakım ünitelerinde ortaya çıkan erken tanısı ve tedavisi zor, mortalitesi yüksek önemli kan dolaşımı enfeksiyonlarındandır. En sık izole edilen kandidemi etkeni *Candida albicans*'dır. Ancak son yıllarda non-albicans *Candida* türleri ile gelişen kandidemi insidansında artış görülmeye başlanmıştır. Bu çalışmada Temmuz 2022-Temmuz 2024 tarihleri arasında çeşitli klinik ünitelerden laboratuvara gelen kan kültürlerinde *Candida*'nın sıklığı ve tür dağılımının belirlenmesi amaçlanmıştır. Kan kültürü şişelerine ekilen kan örnekleri, BACTEC otomatik kan kültürü cihazında (Becton Dickinson, ABD) inkübe edildi. Pozitif sinyal veren otomatik kültürlerden geleneksel yöntemler kullanılarak *Candida* türleri tanımlandı. Tanımlanan *Candida* türlerinin tür düzeyinde tanımlanması, VITEK 2 Compact® otomatik sistemi (BioMérieux, Fransa) kullanılarak gerçekleştirildi. 13,772 kan örneğinin 270'inde (%2) *Candida* spp. pozitif olarak bulunmuştur. Pozitif örneklerin 112'sinde (%40,8) *Candida albicans* saptanırken, 158'inde (%58,4) non-albicans türleri tespit edilmiştir. Non-albicans türlerinden ise en sık 110 (%40,8) oranında *Candida parapsilosis* izole edilmiştir. Sonuç olarak özellikle yenidoğanlarda, yoğun bakım ünitelerinde tedavi gören hastalarda *Candida* türlerinin tiplendirilmesi ve antifungal duyarlılıklarının belirlenmesi, tedaviye yön vermesi açısından önemlidir.

Anahtar Kelimeler: Kan kültürü, *Candida albicans, Candida* türleri, Kandidemi.

INTRODUCTION:

Candida species are one of the most common causes of invasive fungal infections worldwide (Kullberg ve Arendrup, 2015). These, cause infection more frequently, especially in immunosuppressed patients in intensive care units. Isolation of *Candida* species from one or more blood cultures is defined as candidemia and is a serious clinical condition with high mortality (Etiz et al., 2015).

Risk factors for *Candida* infections include the use of broad-spectrum antimicrobial agents, prolonged intensive care stay, mechanical ventilation, total parenteral nutrition, hemodialysis, parenteral nutrition, presence of concomitant diseases (Behçet's disease, diabetes mellitus, hypertension, etc.), invasive procedures such as central venous catheters, nasogastric catheters, peripheral venous catheters, surgical operations, and organ transplantation (Blumberg et al., 2001, Duel et al., 2002).

More than 30 species of *Candida* can cause invasive candidiasis. *Candida albicans* is the most common species. Other species are *Candida glabrata, Candida parapsilosis, Candida tropicalis, Candida krusei, Candida lusitaniae, Candida guilliermondii* and a few rare isolated species (Pfaller et al., 2014).

The main factors affecting the distribution of *Candida* species are geography, patient age, and use of antifungal agents. *Candida parapsilosis* is more common in the southern hemisphere (Latin America and Australia) or southern Europe than in North America or northern Europe. *Candida glabrata* becomes more common with increasing patient age. Although *Candida albicans* is the predominant species worldwide, accounting for approximately two-thirds of *Candida* infections, the epidemiology of candidiasis is changing. Over the last two decades, species other than *C. albicans* (especially *C. glabrata, C. krusei, C. tropicalis*, and *C. parapsilosis*) have emerged. These non-albicans *Candida* species are now isolated from up to 50% of all cases in some centers (Arendrup 2010).

This study aims to determine the frequency and species distribution of *Candida* in blood cultures coming to the laboratory from various clinical units between July 2022 and July 2024.

MATERIALS AND METHODS:

Automated blood cultures sent from various clinical units to Selçuk University Faculty of Medicine Medical Microbiology Laboratory between July 2022 and July 2024 were included in the study. Repetitive isolates isolated from the same patient were not included in the study. Blood samples sent in appropriate BACTEC culture bottle were incubated in the BACTEC automatic blood culture device (Becton Dickinson, USA). The media were followed for seven days and from the bottles giving the reproductive signal, gram staining was done, EMB and 5% sheep blood agar was planted and incubated at 37° C for 24 hours. Samples in which yeast cells were observed in gram staining were passagedto Sabouraud desctrose agar medium and incubated at 37°C for 24 hours. Identification of the identified *Candida* species to the species level was performed using the VITEK 2 Compact® automated system (BioMérieux, France). The results were examined retrospectively through hospital automation.

RESULTS

Candida species was detected in 270 (2%) of 13,772 blood cultures sent to our laboratory. When the distribution by gender was examined, it was seen that 186 (69%) samples belonged to male patients and 84 (31%) samples belonged to female patients. Of the 270 positive blood cultures, *C. albicans* was detected in 112 (%41,6) and non-albicans *Candida* species in 158 (%58,4). Among the non-albicans species, *C. parapsilosis* was the most frequently isolated in 110 (%40,8) samples. The distribution of *Candida* species is shown in Table 1.

Table 1. Distribution of *Candida* species.

***Candida* species**	**n**	**%**
C. albicans	112	41,6
C. parapsilosis	110	40,8
C. glabrata	26	9,7
C. tropicalis	8	3
C. dubliniensis	3	1,1
C. guilliermondii	3	1,1
C. lusitaniae	3	1,1
C. auris	2	0,7

While the highest positivity was detected in patients aged 60 and over with a rate of 49,3%, it was followed by patients aged 18 and under with a rate of 25,9%. The distribution of patients according to age groups is given in Table 2.

Table 3. Age distribution of patients.

Age groups	**n**	**%**
18≤	70	25,9
19-59	67	24,8
60≥	133	49,3

It was determined that *Candida* was isolated mostly from blood cultures coming from the medical oncology service. The distribution in other clinical units is distributed in Table 3.

Table 3. Distribution of clinical units.

Clinical units	**n**	**%**
Medical Oncology service	41	15,2
Anesthesia and Reanimation intensive care	37	13,7
Internal Medicine intensive care	30	11,1
Nephrology service	29	10,7
Child Gastroenterology and Nutrition service	28	10,4
General Surgery intensive care	24	8,9
Neonatal intensive care unit	19	7
Brain and Neurosurgery intensive care	16	5,9
Others*	46	17,1

*Pediatric intensive care, Emergency Medicine, Chest Diseases intensive care, Hematology service, Child Surgery, Urology service, Infectious Diseases service, Child Oncology, Internal Medicine Service, Cardiology intensive care, Pediatric Neurology, Child Health and Diseases service, General Surgery, Chest Diseases Service, Palliative Care Center, Cardiovascular Surgery intensive care.

Discussions

Nowadays, infections caused by *Candida* species, especially candidemia, are becoming more critical with the increasing number of patients at risk in intensive care units. More than 80% of the fungi causing nosocomial infections are *Candida* species (Sarı et al., 2018).

Various studies have found that candidemia is more common in men (55-59%) (Bedini et al., 2006, Colombo et al., 2006, Yapar et al., 2006). In our study, in line with these studies, 69% more *Candida* species were detected in male patients.

In the study conducted by Gültekin et al., *Candida* strains were mostly detected in cases over 60 years of age. Similarly, when the average age was calculated separately in adults in various studies; 55- Diekema et al. stated that 67% of the cases they detected were over 50 years of age. When the distribution at the species level was examined according to age distribution in our study, the highest rate of 49,3% was detected in the 60≥ age group.

C.albicans ranks first and *C.parapsilosis* ranks second, although different rates are given from various centers in cases of candidemia reported from our country. Gultekin et al. they found *C.albicans* to be 49%, *C. parapsilosis* to 23%, and *C. tropicalis* to 14%, while Caliskan et al. 57%, 14%, 14%, Öztürk et al. 53%, 30%, 5.5% were identified as. In a study conducted in our country, fungal agents were detected in 67 (4.9%) of 1379 positive blood cultures in an eight-year period. It was stated that *Candida* spp. was present in 57 (85.1%) of the agents. Of the 57 *Candida* species grown in blood culture, 49 (86%) were *Candida* species other than *C. albicans*, and *C. tropicalis* was detected most frequently (51%) (Yılmaz et al., 2015). In the study by Gülmez et al., *C. albicans* was the most frequently detected species with 47.3%, followed by *C. parapsilosis* with 21.7%. In a similar study conducted in this patient population, the most common species among *Candida* infections were determined as *C. albicans* (59.1%), *C. tropicalis* (27.3%), and *C. parapsilosis* (13.6%) (Ergül et al., 2017). In our study, the most frequently detected *Candida* species in blood culture samples were *C. albicans* (%41,6), *C. parapsilosis* (%40,8), *C. glabrata* (%9,7) and *C. tropicalis* (%3).

In conclusion, in our study, *C. albicans* was the most frequently isolated in blood cultures, and *C. parapsilosis* and *C. glabrata* were the most frequently isolated non-albicans species. This study provides information about the epidemiology of invasive candidiasis caused by *Candida* species. Determining the frequency and species distribution of *Candida* infections is extremely important in updating local epidemiological data at certain intervals, taking necessary precautions, and guiding the selection of empirical antifungal therapy. There is also a need for more comprehensive studies on candidemia in our country, where the number of cases is high, predisposing factors, patient groups, and regional distributions are examined.

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ORAL PRESENTATIONS

Agricultural and Food Mycology / Toxicology

Isolation, Identification, and Comparison of Microfungi on Stored Commercial Wheat and Siyez Wheat in İhsangazi District of Kastamonu

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Siyez (*Triticum monococcum L.*) wheat, the most primitive form dating back to approximately 10,000 years ago, is an integral part of cultural heritage. Siyez wheat is mainly produced in the İhsangazi district of Kastamonu province and is a traditional product for the people of this region. With the demand for healthy foods and local products in recent years, the demand for Siyez has also increased. The wheat obtained after harvest is stored in warehouses in villages for specific periods. Storage moulds cause significant losses in wheat quality and economic terms by causing problems such as reduced germination, undesirable odour formation and colour loss. In addition, mycotoxins produced by microfungi such as *Aspergillus*, *Penicillium*, *Fusarium* and *Alternaria*, which can be pathogenic before and after harvest, cause significant health problems. Although Siyez and commercial wheat varieties have been compared regarding many characteristics, they have not been compared regarding microfungus formation. This study aimed to determine the distribution of microfungi in stored siyez and commercial wheat varieties. For this purpose, 20 commercial wheat and 20 site wheat samples were collected from different warehouses in the İhsangazi district of Kastamonu province in the 2022 harvest season and stored in warehouses. The temperature and humidity of the warehouses where the samples were taken were measured, and the microfungi carried on the wheat grains were isolated and identified using cultural methods. As a result of the identifications, 22 different species were identified in the analysed siyez wheat samples and 28 different species were identified in commercial wheat samples. Ten genera (*Penicillium*, *Mucor*, *Aspergillus*, *Cladosporium*, *Geotrichum*, *Alternaria*, *Rhizopus*, *Ulocladium*, *Trichoderma* and *Epicoccum*) were identified from siyez wheat samples and 11 genera (*Penicillium*, *Acremonium*, *Aspergillus*, *Cladosporium*, *Mucor*, *Alternaria*, *Ulocladium*, *Geotrichum*, *Phoma*, *Fusarium* and *Rhizopus*) from commercial wheat samples.

Keywords: Stored wheat, einkorn wheat, microfungus, cultural identification.

Heavy metal content in the mushroom *Dissingia leucomelaena*: Carcinogenic and non-carcinogenic risk assessment

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The study aimed to determine the carcinogenic and non-carcinogenic risk assessments of Cd, Pb, As, and Hg elemental impurity levels potentially accumulating in *Dissingia leucomelaena* macrofungus. The levels of Cd, Pb, As, and Hg heavy metals in *Dissingia leucomelaena* macrofungus collected in the Çanakkale region were determined by chromatographic analysis method. The non-carcinogenic risk assessment of heavy metal levels for an adult human weighing 70 kg was determined by calculating the Estimated Daily Intake (EDI), Target Hazard Quotient (THQ), and Hazard Index (HI) values, and the carcinogenic risk calculation determined by calculating the CR value. Cd, Pb, As, and Hg levels in dried mushrooms were 463.20, 443.21, 673.15, and 38.38 µg/kg, respectively. The EDI values for Cd, Pb, As, and Hg were $4.4x10^{-5}$, $4.1x10^{-5}$, $6.3x10^{-5}$, and $3.7\ x10^{-5}$, respectively. The THQ value of each metal was found to be less than one. The effect of all elements in the mushroom on the HI value was less than one. When the cancer risk (CR) values for Cd, Pb, and As were calculated, it was observed that the CR values of Pb and As did not exceed the United States Environmental Protection Agency (USEPA) criteria. In contrast, the CR value of Cd was close to the criteria threshold. Elemental impurities commonly found in nature can accumulate in fungi through soil, water, air, or other pathways. Since these elemental impurities can cause various health problems in the human body, it was essential to perform controlled elemental impurity analyses and risk assessments of mushrooms, which have widespread food consumption.

Keywords: Heavy metal, mushroom, risk assessment

Heat Resistant Molds on Fruits and Fruit-Containing Products

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Heat-resistant molds (HRM) are microorganisms that can withstand heat treatment of food, maintain their viability and be reactivated during thermal processes. HRMs are important in the food industry because, due to their heat-resistant structures called ascospores, cleistothecia and gymnothecia, they are resistant to processes such as pasteurization, high pressure and ultrasound, and cause various product deteriorations during storage by synthesizing various mycotoxins and enzymes. These deteriorations lead to various quality losses such as phase separation in beverages, changes in taste and odor, bulging in canned foods, deterioration of organoleptic structure in fruits, and the formation of visible hyphal structures on the surface. Among the HRMs causing deterioration in foods, the main genera are *Byssochlamys*, *Neosartorya*, *Talaromyces*, and *Eupenicillium*. In addition, it is stated in the literature that various heat-resistant genera such as *Paecilomyces*, *Monascus*, *Hamigera* and *Rasamsonia* have been isolated from foods. *Byssochlamys* species have taken their place as the most identified and researched HRM genus in foods due to the various mycotoxins (Byssochlamic acid, Byssotoxin A, patulin) and enzymes (proteinase, peptinase, lyase, amylase, etc.) they synthesize. The main source of HRMs is the soil and fruits that come into contact with the soil. Therefore, the most commonly reported food sources are strawberries, blueberries, which grow in the soil, as well as apples, grapes, figs, pineapples, etc., which fall into the soil and become contaminated. Other foods in which HRMs have been isolated include fruit juices, baby foods, wine, milk and dairy products, such as fruit containing ice cream and kefir, as well as margarine, tomato paste, and bakery products. Considering the problems and risks HRMs pose to the food industry and public health, the necessity for further research on this topic, measures to be taken, and the prevention of HRM development are among the important issues of today.

Keywords: Heat resistance, molds, fruit and fruit products.

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Investigation of *Fusarium* spp. on *Humulus lupulus* L. (HOPs) and in the Soils in which it is Grown at Pazaryeri/Bilecik Region

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Humulus lupulus L. (HOPs) is a perennial, climbing, pleasure plant from the *Cannabinaceae* family, used in the pharmaceutical and cosmetic industry. In Türkiye, industrial cultivation is carried out only in Pazaryeri /Bilecik. The aim of this study was to determine the presence, distribution and frequency of members of the *Fusarium* genus, a plant parasitic fungus, in the soils where HOPs grow and to shed light on future studies.

In the study, soil and plant sampling were carried out from the mentioned fields. Sampling was carried out in September 2022 and August 2023 from the same fields at 4 different locations. Spezieller Nahrstoffarmer agar (SNA) and Selective *Fusarium* Agar (SFA) +Rose Bengal were used for *Fusarium* isolation. Isolation of the *Fusarium* spp. from soil samples was done by soil dilution method. Plant samples were placed directly in the medium and incubated at 25°C for 14 days.

After purification and morphological investigation, 98 isolates belong to 8 different *Fusarium* species were determined. Of the 98 isolates examined within the scope of the study, 25 (25.51%) were found to belong to *F. oxysporum*, 17 (17.35%) to *F. venenatum* and 15 (15.31%) to *F. solani*. This was followed by *F. acuminatum* and *F. equiseti* with 13 (13.27%), *F. camptoceras* with 10 (10.20%). Other recorded species, *F. coeruleum* and *F. redolens* were determined in the range of 2-3 (2.04-3.06%), respectively. *Fusarium venenatum* and *Fusarium camptoceras* were identified as new records for Türkiye.

Keywords: *Fusarium* spp., *Humulus lupulus*, Pazaryeri, soil.

Fungal Diseases Causing Drying in Protea Ornamental Plants in Hatay Province

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The genus Protea belongs to the family Proteaceae and includes about 60 genera and 1400 species. More than 800 of these species originate from Australia and 400 from Africa. Protea plants come in different shapes and sizes and can grow as shrubs or trees and are particularly recognisable by their showy flowers. One of the best-known species is the King Protea (Protea cynaroides), which is characterized by its large and striking flowers. Protea plants have a high value as ornamental plants and are preferred in landscaping and floral design due to their long vase life. Some species have also been used for ethnomedical purposes. All protea species are evergreen, and their cultivation is becoming widespread due to their showy leaf and flower colours. In Türkiye, protea plant cultivation is generally export-oriented, quite limited and generally carried out in hot and dry climates, in regions with Mediterranean climate. A study was carried out in an area where 'Safari Sunset' and 'Gold Strike' varieties of protea were cultivated in Kırıkhan district of Hatay. As a result of the examinations carried out in this area, 50% plant mortality was observed. Disease isolations were made in the laboratory from 25 diseased plant samples taken from different parts of the garden and 20 different isolates were obtained in PDA medium. As a result of morphological diagnosis, *Macrophomina* (4), *Phytophthora* (4), *Fusarium* (5), *Rhizoctonia* (4), *Diaporthe* (4) genera were identified. Molecularly, *Macrophomina phaseolina, Phytophthora cinnamomi, Fusarium oxysporum, Fusarium solani, Rhizoctonia solani, Fusarium acuminatum* and *Diaporthe ambugue* species were identified.

Keywords: Ornamental plant, protea, drying, identification.

Environmental Mycology

Airborne Fungi Diversity in Dust Transport in Çanakkale on May 17, 2024

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Microorganisms are found almost everywhere on Earth, and their diversity in the air is influenced by environmental factors. Dust is transported by wind erosion from arid and semi-arid areas under strong winds. As a result, particles carry the physical, chemical, and biological properties of the sources and roads where the dust is formed. Dust transportation reduces air quality by increasing the particle density in the atmosphere. It can affect the transportation and spread of microorganisms in the air, particularly spores, which can travel thousands of kilometres with dust. Consequently, it can elevate the concentration of mould spores in the air or lead to the dissemination of specific types of mould. There was a significant observation of dust transportation in Türkiye, particularly in May 2024. This study focused on investigating the diversity of mould in the air during the observed dust transportation in Çanakkale on May 17, 2024. The investigation took place in the front garden and backyard of Çanakkale Onsekiz Mart University Terzioğlu Campus Health Services Vocational School using the gravimetric method. To conduct the investigation, petri dishes containing Dichloran Rose Bengal Chloramphenicol Agar and Dichloran 18% Glycreol Agar media were left open at human breath height for 15 minutes. After 3-5 days of incubation at 25°C, moulds with different colony morphology observed in the Petri dishes were purified by single-point cultivation on Potato Dextrose Agar medium. Subsequently, after 7-14 days of incubation at 25°C and the obtained isolates were identified at the genus level. The study involved collecting 58 isolates from the petri dishes, which were determined to belong to the genera *Alternaria, Bipolaris, Cladosporium, Cladophialophora,* and *Exophiala*. Out of these isolates, 32 were found to be sterile hyphae (sterile mycelia). Consequently, if released into the air during dust transportation, these mould species can lead to health issues, especially allergic reactions and respiratory diseases. The presence of allergenic species like *Alternaria* and *Cladosporium* can pose increased health risks to sensitive individuals.

Keywords: Allergen mould, airborne mould, dust transport.

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Dimensional Analysis of Truffle Mushroom Usage in Restaurants within the Muğla Region

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Truffles, a significant component of Türkiye's rich biodiversity, are unique fungi that grow underground, unlike most above-ground species. This study investigates the consumption patterns of truffles in restaurant establishments across Muğla province and its districts. Data were collected through a questionnaire and analyzed using frequency tables, percentage values, and graphical representations. The chi-square test was employed to determine significant differences between variables, providing insights into key trends. The findings indicate that awareness of truffle mushrooms among chefs is relatively low, with those who use truffles incorporating them primarily in sauces, spices, and salads. However, 79.8% of restaurants avoid using truffles due to their high cost, and 56.3% face difficulties in sourcing them due to limited cultivation. Notably, foreign tourists demonstrate a significantly higher demand for truffles (83.7%) compared to domestic tourists, underscoring the need to increase local awareness. This study provides critical insights for potential investors by highlighting the economic and gastronomic opportunities that truffles present alongside the existing challenges in their market. It emphasizes that truffle consumption and awareness in Türkiye could be significantly enhanced by encouraging truffle cultivation, offering financial and logistical assistance, and establishing training programs.

Keywords: Truffles, culinary practices, restaurant industry, Muğla, Türkiye.

Fungal Biodiversity

Wild Edible Macrofungi Determined in Ayaş District (Ankara)

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Macrofungi, known to have nutritional value for human beings from past to present, continue to be an alternative to other foods in nutrition. Although cultivated mushrooms are frequently consumed in regions with access to market chains, wild mushroom consumption maintains its importance in local communities that do not yet have access to this chain or continue to maintain their traditional eating habits. In this study, edible macrofungi naturally growing within the borders of Ayaş (Ankara-Türkiye) district were investigated. Macrofungal samples were collected between 2023-2024. According to the results obtained from field and laboratory studies, 30 edible macrofungi species belonging to 2 classes, 5 orders, 17 families and 26 genera within Ascomycota and Basidiomycota were identified. Routine mycological methods were followed for idendification. Of the 30 species, 4 belongs to the Ascomycota and 26 belong to the Basidiomycota. *Lycoperdon* Pers., was found to be the most crowded genus in term of edible species occuring in the region with three species. Two other genera, *Agaricus* L. and *Tricholoma* (Fr.) Staude, are repserented with two edible species while rest of the 23 genera are represented with only one edible species. Among the determined edible species, *Agaricus campestris* L., *Lactarius deliciosus* (L.) Gray, *Laetiporus sulphureus* (Bull.) Murrill, *Morchella esculenta* (L.) Pers., *Pleurotus ostreatus* (Jacq.) P. Kumm. and *Russula delica* Fr. are collected and consumed by the local people. *Lactarius deliciosus* have local economic importance.

Keywords: Ayaş, wild edible macrofungi, Türkiye.

Comparative Analysis of Macrofungal Diversity in Morocco and Türkiye: Environmental Influences on Species Richness and Ecological Distribution

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This study aims to systematically compare the macrofungal diversity between Morocco and Türkiye, emphasizing the significant variations in species richness and ecological distribution. By synthesizing data from various published sources, we developed a preliminary catalog of macrofungal species across different regions of Morocco and compared it with the catalog of species in Türkiye, which lists 2700 species. Our findings reveal that while both countries share several common genera, they also harbor unique species adapted to their specific environmental conditions. This comparative analysis underscores the critical importance of regional biodiversity and highlights the necessity for targeted conservation efforts to safeguard these valuable fungal resources. The results contribute significantly to the understanding of fungal diversity in Morocco and Türkiye, filling existing knowledge gaps and emphasizing the need for sustained research and robust conservation strategies. Such efforts are essential to protect these ecologically and economically important species, ensuring their preservation for future generations.

Keywords: Macrofungi, Morocco, Türkiye, biodiversity, ecosystems, conservation, climate impact, species richness.

Rediscovery of *Schenella pityophila* in Türkiye: In-Depth Morphological and Molecular Analyses for Accurate Identification and Characterization

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This research comprehensively examines fungal samples from the Dalaman district in Muğla province, Türkiye. The study employed a robust combination of morphological and molecular techniques, including DNA sequencing of the nrITS, nrLSU rDNA regions, and the TEF1a gene, coupled with thorough morphological characterization. The specimens were identified as *Schenella pityophila* (Malençon & Riousset), Estrada & Lado, indicating a new locality record for this species in Türkiye. The study details the molecular phylogeny of the specimen, as well as its location, habitat observations, geographical coordinates, and collection date, along with photographs and illustrations showcasing the species' macro- and micromorphological features. Additionally, illustrations of microscopic structures and SEM images provide a comprehensive view of the species' characteristics. These findings are contrasted with previous reports of *S. pityophila* in Türkiye. By investigating specimens from a previously undocumented area, the study aims to enhance the current understanding of *Schenella pityophila*'s distribution and offer valuable insights into its morphology and phylogeny. This work significantly contributes to the knowledge of *Schenella pityophila* in Türkiye and highlights the importance of combining morphological and molecular methods for precise species identification. This pioneering study in Türkiye integrates molecular and detailed morphological data for *S. pityophila*, providing a comprehensive and in-depth analysis that enhances our understanding of this species characteristics and evolutionary relationships.

Keywords: *Schenella pityophila*, molecular phylogenetics, morphological characterization, fungal distribution, Türkiye.

Halotolerance and Alkalitolerance Properties of Microfungi from Lake Acıgöl/Türkiye

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Microfungi are among the most important organisms in the world, not only because of their vital role in ecosystem functions, but also because of their effects on humans and human-related activities. Microfungi are cosmopolitan and can be found in extreme environments such as dry, hot, cold, salty, alkaline, and acidic. Halophilic/halotolerant microfungi can grow in extremely salty environments, while alkaliphilic/alkalitolerants microfungi are adapted to alkaline environments. This study aimed to determine the halotolerance and alkalitolerance properties of microfungi isolated from Acıgöl Lake, which is located in Denizli/Türkiye province and has salty and alkaline conditions. For halotolerance, single-point cultivation was performed on MEA plates containing 0, 5 %, 10 %, and 15 % salt, and for alkalitolerance, on plates containing alkaline medium adjusted to pH 7, 8, 9, 10, and 11, and colony diameters were measured and evaluated after 7 days of incubation. Of the 146 isolates, 41 % belonged to *Aspergillus*, 40 % to *Penicillium*, 11 % to *Cladosporium*, 2 % to *Alternaria*, 2 % to *Mucor*, 1 % to *Neocamarosporium*, 1 % to *Nothophoma*, 1 % to *Scopulariopsis*, and 1 % to *Trichoderma*. 80 % of these isolates showed halophilic and 20 % to halotolerant properties. Species belonging to the genera *Alternaria*, *Nothophoma*, *Mucor*, and *Trichoderma* showed only halotolerant properties and no halophiles were found. New records for Türkiye include *Aspergillus urmiensis*, *Cladosporium limoniforme*, and *Neocamarosporium obiones*. *Scopulariopsis albida* was facultatively alkalitolerant, while other isolates were found to have strong, moderate, and weak alkalitolerant properties. Knowing the halotolerance and alkalitolerance properties of these microfungi will contribute to their evaluation in terms of both biodiversity and biotechnology.

Keywords: Microfungi, halophilic, alkaliphilic, *Aspergillus*.

First Record of *Helicogloea lagerheimii* (Phleogenaceae) in Türkiye

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This study focuses on the macrofungal specimens gathered during a comprehensive field survey conducted in the Çukurca district of Hakkari in 2023. Each specimen was photographed in situ and analyzed using well-established mycological techniques. Detailed morphological analysis was crucial for the accurate identification of the collected samples. Notably, this research represents the first identification of *Helicogloea lagerheimii* Pat. at the genus level in Türkiye. The identified specimens have been preserved and are now deposited in the Fungarium of Van Yüzüncü Yıl University, Faculty of Science, Department of Biology (VANF). The genus *Helicogloea*, first described in 1892, belongs to the *Phleogenaceae* family within the *Basidiomycot*a division. This study not only records the presence of Helicogloea lagerheimii in Türkiye but also explores its biological characteristics, ecological importance, and potential ethnomycological applications. Moreover, the discovery of *H. lagerheimii* in the Çukurca district highlights the ecological diversity and richness of the region's mycobiota, underscoring the necessity for continued mycological research in the under-explored regions of the country. The documentation of *H. lagerheimii* in Çukurca accentuates the area's diverse mycobiota and reinforces the need for ongoing mycological exploration in Türkiye's less-studied regions.

Keywords: Biodiversity, Çukurca, *Helicogloea lagerheimii*, Basidiomycota, Türkiye.

The Discovery of Polyphasic Taxonomy of Isolates of Heat-Resistant *Paecilomyces* and Its Close Genera Found in Soil Samples Taken from Some Locations in Different Provinces of Türkiye

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Heat-resistant *Paecilomyces* species are microfungi that can survive at high temperatures and thrive under these extreme conditions. These species play an important role in industrial applications and biotechnological processes because of their resistance to high heat, allowing them to be used in various functions. It is important for the food industry to evaluate the contamination risk of spores of this genus.

In our ongoing study, the presence and biodiversity of heat-resistant *Paecilomyces* and its related genera in agricultural soils are being investigated. The isolated strains have been cultured on diagnostic media and subjected to molecular analysis through morphological examination and ITS (Internal Transcribed Spacer) gene region studies. The project samples predominantly belong to the species *Paecilomyces niveus*, which has not yet been reported for Türkiye. Additionally, *Paecilomyces lilacinus* (currently known as *Purpureocillium lilacinum*) has been identified for the first time in samples from Malatya. The study also encountered *Paecilomyces dactylethromorphus*, a species not yet recorded in Türkiye. Consequently, we identified a diversity of heat-resistant, pathogenic, and saprophytic microfungi belong to *Paecilomyces* genus in agricultural soils that including species that represent new records for Türkiye. This research represents preliminary findings, and the final results are expected to be confirmed upon completion of the study.

Keywords: *Paecilomyces*, fungal biodiversity, Türkiye.

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Polyphasic Taxonomy of Heat Resistant *Hamigera* Isolates from Soil Samples Taken from Some Locations in Different Provinces of Türkiye

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In soil ecosystems, fungal species that can adapt to high temperature conditions are of significant ecological and biotechnological importance. In this context, the heat-resistant genus *Hamigera* is noteworthy for its resistance to high temperatures, making it a valuable subject for research from a polyphasic taxonomy perspective. Additionally, recent studies conducted in Türkiye indicate that the *Hamigera* genus requires further validation.

As a result of the study, it was aimed to make morphological, microscopic, and multilocus molecular diagnoses of the heat-resistant *Hamigera* genus members of Türkiye and to identify new records for Türkiye that could be obtained within the scope of this study.

Fifty isolates obtained from the project were grouped morphologically, and 21 representative isolates were selected for phylogenetic analysis. Based on these results, heat-resistant *Hamigera* species were identified in Türkiye. The project samples predominantly contained *Hamigera avellenea*, found in Balıkesir, Sakarya, Uşak, Ordu, Zonguldak, Sinop, İstanbul, and Edirne soils. Additionally, *Hamigera paravellanea* was observed in İstanbul and Balıkesir soils, while *Hamigera inflata* was found only in Elazığ soil. Consequently, we have determined the presence of various heat-resistant saprotrophic microfungus species belong to *Hamigera* genus in Türkiye and identified species that represent new records for the country.

Keywords: *Hamigera*, heat resistant molds, soilborne molds, biodiversity, Türkiye.

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Examination of The Aegean Region in Terms of Truffle Potential

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Truffles, belong to the Tuber genus of the Tuberaceae family and are the fruit of a mycorrhizal fungi have been worldwide regarded as ecologically and commercially valuable. Truffle mushroom, known for its culinary value, has a very high nutritional value. Truffles, are a distinct category of hypogeous fungi known for their unique aroma and exceptional nutritional value. Truffles are expensive because they are rare and difficult to grow, making them one of the most expensive foods in the world**.** The fact that it is difficult to find in nature and is gastronomically valuable has led to the development of culturing methods of truffle mushrooms. Truffles can grow in temperate climates, including regions of Türkiye, Italy, France, Spain, Australia and the US. Interest in truffle hunting and trade in Türkiye has been increasing in recent years.

In this study, truffle species were determined in different localities of Aydın, Denizli, Muğla, Uşak and the truffle potential of these provinces were revealed. Growing naturally in Aegean region, obtained from the field studies constitute the main materials. Photographs of the collected specimens were taken and their ecological and morphological characteristic were recorded. This study aimed to determine the location naturally grown in Agean region. These locations have potention of truffle orphans.

Keywords: Truffle, Aegean Region, Türkiye.

Effects of Growth Media on the Diversity of Culturable Fungi from Lichens of Bursa, Türkiye

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Research-based pharmaceutical industry plays a unique role in developing new drugs. Endolichenic fungi (ELF) species which live in lichens are considered as the biggest active substance for future. Since they contain undiscovered metabolites that are candidates for drug active substances, ELF soon attracted great attention from the biopharmaceutical and biomedical fields. This study aims to collect lichens from Türkiye and identify ELF&EPF species they contain with culture-dependent methods, and to lay foundations of ELF&EPF culture library specific for Türkiye. The lichen species were determined under the stereo microscope using the classical method. Surface sterilization was performed on *Peltigera praetextata*, *Ramalina farinacea*, *Physconia distorta*. Sterilised samples were dried, cut into smaller pieces and then plated on Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA). The culture medium with various compounds were also prepared (MEA/Fe, MEA/Mg, MEA/K, PDA/Fe, PDA/Mg and PDA/K). Fungal species were identified according the morphologies and colors of the surfaces of the colonies seen on media by using identification keys. As a result, 21 different families were detected from *P. praetextata* on MEA&PDA media, while 8, 2 and 2 different families were detected from Fe, Mg, K containing media, respectively. While 3 different families were detected from *R. farinacea* on MEA&PDA media, 1, 2 and 1 different families were detected from the media containing Fe, Mg and K, respectively. Finally, while 9 different families were detected from *P. distorta* on MEA&PDA media, 5, 1 and 4 different families were detected from the media containing Fe, Mg, K, respectively. According to the results, ELF&EPF family diversity was observed in the optimisation media. It is thought that this study will contribute to future research in increasing the success of the diversity of ELF&EPF isolated from lichens.

Keywords: Endolichenic fungi, epilichenic fungi, lichens, culture bank, biodiversity.

Acknowledgements: This study was funded by the Scientific and Technological Research Council of Türkiye (TUBITAK) Project No: 221N004.

Comparison of Endolichenic Fungi Biodiversity of *Pseudevernia furfuracea* from Bursa-Türkiye, by Advanced Isolation Techniques and Metabarcoding Analysis

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Endolichenic fungi (ELF) are known as natural resources that have unique secondary metabolites with diverse bioactivity. The culturing of these biological resources for health and industrial studies is becoming increasingly important. However, metagenomic studies have shown that traditional culturing techniques allow the isolation of a limited diversity of ELFs and that advanced isolation techniques need to be developed. In this study, isolation techniques and metabarcoding analysis were used to compare ELF diversity. Internal transcribed spacer (ITS) metabarcoding analysis was performed to determine the fungal diversity of *Pseudevernia furfuracea* thallus. ELF isolation has been conducted using traditional media and iron, magnesium, and potassium-enriched media. Accordingly, it was observed that a total of 26 ELF from 12 families were cultivated, while metagenomic data revealed that fungi belonging to 298 different families were present in *P. furfuracea*. On the other hand, it has been determined that using different media allows the culturing of ELF that cannot be isolated from traditional fungal media. 4 different families (Coniochaetaceae, Hypoxylaceae, Nectriaceae, and Xylariaceae) could be isolated on conventional media. In addition to these families, 8 different families (Aspergillaceae, Diatrypaceae, Didymellaceae, Lasiosphaeriaceae, Mucoraceae, Sporormiaceae, Stachybotryaceae, and Zythiaceae) could be cultured using enriched media. Approximately 1.3% of the 298 families could be isolated with conventional media, whereas enriched media allowed for the cultivation of approximately 2.6% of different families, three times more in total. These results show that optimizing the medium content with different minerals increases the diversity of isolates. Therefore, it is assumed that the culturing techniques can be improved by analyzing the ELF diversity of

lichens through metabarcoding analysis and optimizing the content of the medium in light of the metagenomic data. Thus, it is thought that it may enable the discovery of potential natural resources that can be used in health and different industries.

Keywords: Lichen, metabarcoding, endolichenic fungi, enriched media, isolation.

Acknowledgements: This study was funded by the Scientific and Technological Research Council of Türkiye (TUBITAK) Project No: 221N004.

A Rare Microfungus Record from Türkiye

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The description of *Giulia* Tassi, a monotypic genus, is based on the work of Flaminio Tassi. (Index Fungorum 2024). The type species, *Giulia tenuis* (Sacc.) Tassi ex Sacc. & D. Sacc., is saprotrophic and grows on dry branches, leaves, sometimes on living leaves etc. of hosts. Plant samples infected with microfungus constituting the material of the study were collected from Kazdağları (Balıkesir/Edremit). Host plant samples were dried in accordance with herbarium rules and identified using 'Flora of Türkiye and East Aegean Islands' (Davis, 1965-1985). The prepared slides were examined with a Leica DM3000 research microscope. The microfungus sample was identified using the relevant literature (Sutton, 1980, Nag Raj 1993 and Rungjindamai et al., 2008). In this study, which was carried out to determine the microfungi of trees and shrubs in the Kazdağları National Park area, *G. tenuis* described on *Ruscus aculeatus* L. living cladodes is a new record at the genus level for Türkiye mycobiota. Detailed descriptions of the species are given with macroscopic and microscopic features and supported with photographs.

Keywords: *Giulia*, Kazdağları National Park, microfungus, new record.

Acknowledgements: This study was supported by TÜBİTAK with project number 119Z047.

Fungal Biotechnology

Partial Purification and Characterization of Beta-Galactosidase Enzyme Isolated from *Aspergillus brasiliensis*

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β-Galactosidases (EC 3.2.1.23), commonly known as lactases, are widely used in the lactose-free or low-lactose dairy products in the dairy industry and the synthesis of galacto-oligosaccharides. The fact that β-galactosidases obtained from *Aspergillus* species have an extracellular character compared to other microorganisms, show activity at low pH and have high thermal stability is significant in terms of being more applicable in the industry. The aim of this study was to partial purified and characterized the β-galactosidase enzyme from the non-mycotoxin-producing *Aspergillus. brasiliensis*.

β-Galactosidase enzyme from *A. brasiliensis* was produced the liquid culture fermentations. All the fermentations were performed in during 14 days at 150 rpm and 25±2 °C and after that, the fermentation broth was filtered. The fermentation liquids were concentrated by ultrafiltration and used for the crude enzyme characterization.

As a result of partial characterization studies, the optimum temperature of β-galactosidase enzyme was determined as 60 °C and the optimum pH as 4.5. It was determined that the thermal stability of the enzyme was quite stable in the range of 4-30 °C, it lost 43% of its activity at 70 °C and 91% at 80 °C and gradually lost its activity as the temperature increased. While the pH stability of β-galactosidase was well maintained in the pH range of 4,0-6.0, 50% decrease in activity was detected at values above these pH values.

The high stability of β-galactosidase enzyme against acidic pH and high temperatures is noteworthy for the use of the enzyme in different biotechnological applications, especially in the dairy industry.

Keywords: *Aspergillus brasiliensis*, beta-galactosidase, lactose intolerance, galacto-oligosaccharides.

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Evaluation Secondary Metabolites Profiles of *Aspergillus brasiliensis* by Plug Extraction Method

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Aspergillus section *Nigri* (Black Aspergilli), a group of filamentous fungi, includes several species of economic and social interest. Species of this group can be worldwide, in a variety of habitats. These species are known as mycotoxin-producing human and animal pathogens. In addition to their pathogenic properties, this group includes important species used in industrial, medical, pharmaceutical and biotechnological fields. The study aimed to screen and compare secondary metabolite profiles of *Aspergillus brasiliensis* species, a member of *Aspergillus* section *Nigri* (AsN), using HPLC-DAD under the conditions described.

In order to obtain crude extracts of *A. brasiliensis* species, spore solutions of the species were prepared and inoculated into three different media (Yeast Extract Sucrose Agar, Czapek Yeast Autolysate Agar and Czapek Yeast Autolysate + 0.5% NaCl Agar) by three-point inoculation method and incubated at 25±2°C for 7 days. Crude extracts were extracted from different media by Plate Extraction Method and prepared in equal concentrations. Crude extracts were then analysed by HPLC-DAD and secondary metabolite profiles were determined. HPLC-DAD profiles of the crude extracts were analysed and total peak area, total peak area that can be obtained from mass and extract were calculated and compared.

As a result, the secondary metabolite profiles of crude extracts obtained from Plate Extraction Method and three different media were similar and the medium with the highest extract mass was determined Yeast Extract Sucrose Agar. All species grown on Yeast Extract Sucrose Agar were also classified using the K-means algorithm and chemo phenotypic dendrograms were prepared.

After evaluating all the data, it was determined that YES agar medium with the highest extract mass was the most suitable medium for further studies.

Keywords: *Aspergillus brasiliensis,* secondary metabolites, plug extraction method.

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Current Artificial Intelligence Applications in Mycology

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Artificial intelligence applications support scientists in many fields. In microbiology, artificial intelligence speeds up and more accurately evaluates data. By automating the data evaluation process, artificial intelligence makes a significant contribution to the prevention, diagnosis, and treatment of infectious diseases, especially in medicine.

The use of artificial intelligence in mycology has also been demonstrated in many studies conducted with fungi. Deep neural networks and machine learning were used for classification using microscopic images of molds. Using neural networks (CNN), an 80% to 100% accuracy rate has been achieved in identifying fungi from microscopic images of the species. Artificial intelligence has been useful in fungal cytopathology of thyroid gland and cervical lesions. Artificial intelligence was used in a study to classify pathogenic fungal species of fungal keratitis using corneal confocal microscopy images. Studies have shown that the quality and efficiency of production can be increased in bioprocesses using fungi with the help of artificial intelligence. The most important factor limiting the use of artificial intelligence in mycology is the need for a large amount of accurate and high-quality data. In addition, the margin of error in the results obtained solely based on data obtained from artificial intelligence should be considered. Despite these limitations, it is understood that artificial intelligence will save cost and time by increasing the quality of studies in mycology.

This review aims to evaluate recent studies using artificial intelligence in mycology and contribute to ongoing and future studies in this field.

Keywords: Artificial Intelligence, microbiology, mycology.

Macrofungus Species Selection for Mycelial Composite Production

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Mycelial composite is a biomaterial that is lightweight, durable, heat and sound insulating, fire resistant, self-renewing, non-toxic, biodegradable and has a low ecological footprint. It has formed by the growth of fungal mycelia on a lignocellulosic substrate and binding the substrate particles together. The primary aim of this study is to better understand the biology of mycelial composite production. For this purpose, a total of 59 macrofungus strains isolated from different regions of Türkiye were examined in terms of biological parameters related to mycelial composite production. Macrofungus isolates were determined according to the type of rot (brown rot, white rot) and hyphal system (monomitic, dimitic, trimitic). As biological research parameters; mycelial colony diameter, mycelial colony growth rate, mycelial colony density, mycelium hardness, lignocellulosic enzyme (laccase, manganese dependent and independent peroxidase and lignin peroxidase) production were used. As a result, *Ganoderma applanatum*, *Ganoderma resinaceum*, *Lentinus tigrinus*, *Panus neostrigosus*, *Stereum hirsutum*, *Trametes gibbosa*, *Trametes pubescens*, *Trametes ochracea*, and *Trametes versicolor* species were selected as promising species for mycelial composite production. Species such as *Ganoderma carnosum*, *Ganoderma lucidum*, *Leucogyrophana pseudomollusca* and *Trametes trogii* were not preferred because they did not have a hard mycelial structure and isolates such as *Neoantrodia infirma* and *Phellinus pomaceus* were not preferred because of their low mycelial colony growth rate. The selected isolates will be evaluated in terms of research parameters related to the mechanical properties of mycelial composite.

Keywords: Biological parameters, macrofungi, mycelial composite.

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Screening of Fungi Isolated from Hypersaline Environments for EPS Production and Production Optimization with Selected Isolate *Penicillium allii*

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Various stress tolerance mechanisms are responsible for the adaptation of microorganisms to extreme conditions, and they develop defense methods by producing different metabolites. Polysaccharides, one of the metabolites produced by fungi adapted to extreme conditions, attract biotechnological interest due to their diversity and different molecular structures. In this study, 62 halophilic/halotolerant fungal isolates from Acıgöl and Çamaltı Salt Pans were screened for EPS production, and medium optimization was performed for the selected isolate. After 7 days of incubation in liquid medium, EPS in the supernatant was separated by cold ethanol extraction. The carbohydrate structure of the obtained EPS was confirmed by the phenol-sulfuric acid method. EPS production conditions for *Penicillium allii*, identified as halophilic by halotolerant testing, were optimized using the Box-Behnken experimental design. According to the design, which examined 5 factors at 3 levels from the medium components, there was a linear relationship between EPS production and the highest concentrations of carbon, nitrogen, and phosphate sources used in the study. For NaCl concentration, the situation was different, with EPS production increasing at the lower concentration studied. It was suggested that *P. allii*, due to its halophilic nature, might increase EPS production as a defense mechanism at relatively low salt concentrations. The amount of EPS obtained under optimum conditions showed a 4.5-fold increase compared to non-optimized conditions. The obtained EPS were partially purified by dialysis and analyzed. It was determined that the EPS contained 99.4% carbohydrate, 0.024% protein, and 0.53% uronic acid. Metabolites produced by fungi adapted to extreme conditions, especially exopolysaccharides, show biotechnological promise due to their diversity and different molecular structures.

Keywords: Exopolysaccharide, halophilic fungus, Box-Behnken.

Biotechnological Potential of Macrofungi Isolated from Bilecik Province, Türkiye

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From a biotechnological perspective, macrofungi are a relatively neglected group of organisms in Türkiye. In this study, 205 different macrofungi isolates belonging to 125 species were investigated for their industrial enzyme production, dye and endocrine disrupting compounds biodegradation, and plant growth regulator (gibberellic acid and indole acetic acid) production capacities. The industrial enzyme production, dye and endocrine disrupting compounds biodegradation activities of the isolates were screened on solid media. On the other hand, plant growth regulator production by the isolates was investigated on Czapek Dox Medium, a liquid medium. The highest enzymatic index results for laccase, amylase, protease, tyrosinase, urease, cellulase and xylanase were presented by *Crepidotus variabilis* (5,18), *Morchella vaporaria* (1,76), *Auricularia auricula-judae* (2,05), *Fuscoporia torulosa* (3,87), *Hebeloma mesophaeum* (8,18), *Laccaria laccata* (3,37) and *Otidea concinna* (6,02), respectively. On the other hand, the highest dye biodegradation and endocrine disrupting activities for Remazol Brilliant Blue R, Amaranth, Crystal Violet, Malachite green and Bisphenol A were obtained from *Auriscalpium vulgare* (4,05), *Phellinus pomaceus* (1,46), *Gymnopilus sapineus* (3,13), *Leucoagaricus leucothites* (3,84), and *Gloeophyllum sepiarium* (1,41), respectively. The highest gibberellic acid and indole acetic acid production amounts were determined as 368,52 µg/ml for indole acetic acid and 64,89 µg/ml for gibberellic acid from *Naematelia encephala* and *Auricularia auricula-judae,* respectively. In this study, the degradation of endocrine disrupting compounds by macrofungus species were investigated for the first time in Türkiye.

Keywords: Biodegradation, endocrine disrupting activity, enzyme, macrofungus, plant growth regulator.

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Mycelium as a Next-Generation Green Building Material: Comparative Analysis with Conventional Environmentally Harmful Products

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The construction industry is responsible for approximately 40% of the environmental damage due to carbon emissions resulting from high energy consumption, production processes, product logistics, and application methods. The production and use processes of traditional building materials contribute to the depletion of natural resources and the disruption of ecological balance. In this context, the search for sustainable and eco-friendly materials is becoming increasingly important. This study emphasizes the potential and significance of fungal mycelium for the construction industry.

Mycelium biocomposites not only offer environmental benefits but also exhibit important performance criteria such as thermal performance, acoustic performance, compressive strength, flexural strength, and radioactive shielding properties. In this research, the characteristics of the developed mycelium composites are compared with commonly used and environmentally harmful alternatives in the construction industry. The comparison is based on thermal conductivity, acoustic performance, compressive strength, and flexural strength tests, and the values of widely used products such as MDF, rock wool, and gypsum board in the literature are considered.

The findings demonstrate that mycelium biocomposites are not only a sustainable alternative but also superior in some performance metrics. Specifically, they can compete with existing products in thermal performance and acoustic performance, and they exhibit superior compressive strength and flexural strength compared to certain products. Given the current environmental impacts of the construction industry, mycelium-based materials stand out as an innovative solution that preserves ecological balance and offers a sustainable building practice in the long term.

Keywords: Mycelium composites, construction industry, biomaterials, biodegredable solutions, biodesign.

A Research on The Production of Insulation Materials from Some Fungi Mycelia

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It was aimed to investigate the manufacturability of mycelium-based, environmentally friendly insulation materials. *Ganoderma* sp, *Schizophyllum commune* collected from Aydın province and Pleurotus ostreatus ready-made mycels obtained from Agroma Mantar company were used as materials. Molds suitable for the production of test samples were prepared with a 3D printer and trials were carried out in the mushroom production tent and air conditioning automation system. Agricultural residues such as wheat straw, corn stalk and cotton straw were studied as a substrate for mycelium growth. Agricultural residues were inoculated with mycelium and after 14 days of incubation at 27°C in 60-80% humidity, molding was done and incubation was continued for another 7 days. The samples removed from the mold were dried in a Pasteur oven at 70 °C for 8 hours. The material was produced, compression, tensile, bending, thermal conductivity tests and FTIR analysis were performed. At the end of the trials, wheat straw as substrate, temperature 27 °C, humidity 60-80% were determined as optimum. In order to determine the best inoculum amount, mycelium was inoculated into compost medium containing wheat straw in various ratios such as ½ and ¼ of the petri dish after the mycelium was developed in a petri dish containing malt extract agar. Mycelial growth was observed using three types of fungi and three different substrates. It was determined that the best fungus was Ganoderma sp and the best substrate was wheat straw.

Keywords: Composite material, mushroom, mycelium material, mycelial insulation.

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Endolichenic Fungi from *Ramelina* sp. as Potential Quorum Sensing Inhibitors

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Bacterial antibiotic resistance threatens human health by causing serious infections. There is an increasing need for alternative strategies to control this global problem. Inhibiting the ability of bacteria to cause disease is one of these innovative strategies. Bacteria are known to regulate virulence genes according to changes in cell population density through the quorum sensing (QS) system. In this context, QS inhibition is considered a promising method in the fight against antibiotic resistance. Lichens, which have been used in the treatment of diseases from past to present, are defined as synergistic organisms between fungi and algae and/or cyanobacteria. In addition to lichenised fungi, lichens are also known to contain a different group of non-obligate microfungi called endolichenic fungi (ELF). Since ELF affect the metabolism and ecological role of lichens in various ways, they are of interest as potential sources for biotechnological applications. ELF, which have the ability to produce unique bioactive metabolites, are considered to be a promising natural source of QS inhibitors. In this study, it was aimed to investigate the QS inhibitor (QSI) properties of ELF species isolated from *Ramelina* sp.. Accordingly, ELF samples were isolated from *Ramelina* sp. lichen collected from Bursa, Türkiye and cultured. Ethyl acetate extracts with final concentrations of 240, 120 and 60 µg/ml were applied to *Vibrio harveyi* BAA-1117 QS AI-2 biosensor strains. In QS inhibition tests performed in 96-well microplates, absorbance and bioluminescence were measured every 15 minutes for 20 hours. The strongest to weakest bioluminescence inhibition activity was observed in samples treated with ELF TK16-B06 and TK16-P10, respectively. The data obtained from the study support that ELF are a promising source for anti-QS studies.

Key Words: Endolichenic fungi**,** quorum sensing, lichens, *Ramelina* sp.

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Production of Composite Materials from Mycelium: Potential and Applications in Türkiye

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Cellulose-reinforced mycelium composites offer an innovative and sustainable approach to construction materials for architectural structures. Mycelium, the root structure of fungi, can be combined with a variety of natural substrates to create a strong and lightweight material with environmental benefits. Incorporating a mycelium matrix into natural cellulose, such as hemp wood, improves the material's mechanical properties, which provide improved strength. A fire-resistant, lightweight, and flexible composite is obtained. Natural cellulose-fed mycelium composites offer sustainability through the use of agricultural waste. This composite material reduces the carbon footprint compared to traditional construction materials. In addition, the lightweight yet durable nature of the resulting material is used for a variety of construction applications. Moreover, the use of fungal mycelia in composite material types opens up a vast design space. It offers the opportunity to produce a wide range of materials, from trinkets to lampshades, from packaging to building and construction. These materials, all made from mycelium-based composites, are a more environmentally sustainable alternative to traditional polymer-based composites. The versatility of mycelium-based composites is truly inspiring, offering a multitude of possibilities for sustainable design and construction. Türkiye's abundant organic resources, such as hemp wood, can be converted into low-cost and biodegradable composite materials using fung mycelia. As Pexa pipe, we have been exploring the production of bio-based materials instead of styrofoam, which we have been using as pipe distribution panels for years. Our efforts have led to the creation of a biocomposite material pipe distribution panel consisting of fung mycelia (obtained from suitable fungi) and hemp wood. This pipe distribution panel has successfully passed all R&D studies, demonstrating its thermal resistance, pressure, and other required tests. These successful results provide reassurance about the viability and quality of mycelium-based composites.

Keywords: Mycelia, composite material, insulation, hemp wood.

Fungal Chemistry and Biochemistry

Total Phenolic Content and DPPH Antioxidant Activity of Lion's Mane Mushroom (*Hericium erinaceus*)

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Lion's Mane Mushroom (*Hericium erinaceus*) is a fungus traditionally used in medicine and recognized for its various health benefits. The aim of this study was to determine the total phenolic content and DPPH antioxidant activity of Lion's Mane Mushroom. In this study, the lyophilized solid form of the mushroom was used to perform measurements of total phenolic content and antioxidant activity. Total phenolic content was determined using the Folin-Ciocalteu method and expressed as gallic acid equivalents. Antioxidant activity was evaluated using the DPPH radical scavenging assay, and the degree of DPPH radical neutralization was measured. The results revealed that Lion's Mane Mushroom has a high phenolic content and exhibits significant antioxidant activity. The data indicates that the mushroom possesses a high antioxidant capacity that could have potential positive health effects. These findings underscore the need for further exploration of Lion's Mane Mushroom's applications in food and health fields. Future research is important to more thoroughly investigate the mushroom's effectiveness and identify potential application areas.

Keywords: Lion's Mane Mushroom, *Hericium erinaceus*, total phenolic content, DPPH, antioxidant activity.

Medical and Veterinary Mycology

Microfungal Contamination in Barn Environments: Health Risks and Economic Effects for Animals and Veterinarians

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Microfungal contamination of food and feed can pose significant health risks to humans and animals, leading to global economic losses. It causes a decrease in feed consumption, utilization, live weight gain and reproductive capacity in animals. Loss of marketability occurs in animal products due to contamination. Microfungal-related diseases are increasing due to increased susceptibility to infectious diseases and immunosuppression. Animal deaths occur due to fungal infections. In addition, veterinarians who spend most of their hours in barns face various health problems. The common microfungi we found in the barns in our study are *Aspergillus, Penicillium, Cladosporium*, and *Alternaria*.

Exposure to microfungi can lead to allergic reactions such as rhinitis, conjunctivitis and sinusitis. Individuals with asthma may experience wheezing, cough and shortness of breath. Aspergillosis caused by *Aspergillus* species can cause severe invasive disease in immunocompromised individuals. Some fungi can cause ringworm or other skin infections. Some microfungi produce mycotoxins that have various toxic effects, such as immunosuppression, liver damage, and carcinogenic effects. Long-term exposure to high levels of microfungi may contribute to the development of COPD. Repeated exposure may lead to chronic fatigue, weakness and decreased general well-being.

Microfungi in the indoor air of barns pose significant health risks to veterinarians by primarily affecting the respiratory system, causing skin infections and toxic effects. Implementing effective control measures and preventive strategies to reduce these risks and ensure the well-being of veterinarians working in such environments is essential. Regular monitoring of health and maintaining good indoor air quality is necessary to manage the effects of exposure to microfungi.

The economic impacts of microfungal contamination in the livestock sector underscore the need for stringent control measures to protect animal and human health.

No human, animal or environmental health; one health! Veterinarians are an indispensable component of public health services around the world.

Keywords: Veterinary physician, mycofungi, health risks, economic impact.

Green Synthesis of Copper Oxide Nanoparticles Using Okra Fruit Extract and Doped Shapes and Assessment of Their Antifungal Applications

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The increasing prevalence of multidrug-resistant pathogens necessitates the development of new antifungal therapies. This phenomenon is leading to treatment failures and a subsequent rise in morbidity and mortality rates. To address this growing clinical challenge, there is an urgent need for novel therapeutic platforms. In recent decades, nanotechnology has emerged as a promising avenue for the development of innovative materials with potent antifungal properties. In the present study describes the green synthesis of copper oxide nanoparticles (CuO-NPs) using okra fruit extract, along with their silver (Ag)- and selenium (Se)-doped forms. The synthesis process, leveraging the phytochemical properties of okra, offers an eco-friendly alternative to conventional physical and chemical methods. Characterization of the synthesized NPs was conducted using various analytical techniques, including XRD, FTIR, UV-vis, FESEM, and EDX. The CuO-NPs had a monoclinic structure with spherical shape, an average size of 57 nm. Antifungal efficacy was evaluated against clinical and reference isolates of *Candida*, *Rhizopus*, and *Aspergillus* species. The antifungal activity of the NPs was assessed using the broth microdilution method as per CLSI guidelines. The CuO-NPs displayed moderate antifungal properties, with MICs ranging from 250 to 500 µg/mL. However, the incorporation of Ag with CuO-NPs significantly enhanced antifungal activity, reducing MICs to a range of 125-250 µg/mL. Notably, CuO-NPs doped with 10% Ag exhibited the most potent antifungal effect, particularly against *Candida* and *Rhizopus* spp. The *Aspergillus* spp. demonstrated a higher level of resistance, requiring higher nanoparticle concentrations for effective inhibition. Similarly, CuO-NPs doped with Se also exhibited improved antifungal activity compared to the undoped counterparts. The 10% Se-doped CuO-NPs exhibited the most pronounced inhibitory effect, with lower MICs against all tested fungal strains. These findings indicate that NPs

synthesized using plant extract have the potential to be developed as effective antifungal agents with promising applications in the biomedical field.

Keywords: Copper oxide nanoparticles; green synthesis; doping; antifungal.

Rosmarinic Acid Exhibits Antifungal and Antibiofilm Activities Against *Candida* Species: Insights into Gene Expression and Morphological Changes

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Candida species can cause superficial to severe invasive infections in immunocompromised patients. The persistence of *Candida* infections is due to its ability to form biofilms, which renders it resistant to antifungal drugs and host immunity. Given the limited number of antifungal drugs and growing concerns about antifungal resistance, the use of natural compounds as alternative antimicrobials is becoming necessary. Rosmarinic acid is a polyphenolic compound that occurs naturally in many *Lamiaceae* plants and has various biological activities. The aim of this study was to evaluate the antifungal activity of rosmarinic acid against *Candida* species, in particular its effect on *C. albicans* biofilms, and to explore the underlying mechanisms. The antifungal effect of rosmarinic acid on fluconazole-susceptible and -resistant *Candida* species was determined using the CLSI M27-A3 microdilution method. The biofilm-forming ability of *C. albicans* isolates was assessed by crystal violet assay. The antibiofilm activity of rosmarinic acid on *C. albicans* was examined using MTT assay and FESEM analysis. The expression of biofilm-related genes was analyzed using qRT-PCR. The statistical analysis was performed using ANOVA. A total of 28 *Candida* strains, 24 clinical and 4 reference, were included. The MIC values of rosmarinic acid ranged from 160 to 1280 µg/ml. Rosmarinic acid significantly reduced the expression levels of adhesion-related genes (ALS3, HWP1 and ECE1), hyphal development genes (UME6 and HGC1) and hyphal cAMP-dependent protein kinase regulators (CYR1, RAS1 and EFG1) at 640 µg/ml. FESEM analysis revealed a reduction in the compact cell network of hyphae, disruption of the smooth membrane surface and pore formation on the cell surface in the treatment groups compared with the control. These results suggest that rosmarinic acid may have promising natural compound therapeutic potential in the prevention of biofilm-associated *Candida* infections by emphasizing its antibiofilm activity and mechanism against *C. albicans*.

Keywords: Rosmarinic acid; *Candida albicans*; antifungal; biofilm-related genes; FESEM.

The Role of Molecular Methods in Dermatophyte Diagnosis

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Dermatophytes, which are involved in keratinized tissues such as hair, scalp, skin and nails, are fungi that are very common both in the world and in our country and cause infections called dermatophytosis. Species belonging to the Epidermophyton, Microsporum and Trichophyton genera constitute dermatophytes. Accurate and rapid diagnosis of these pathogens is very important as it will lead to effective antifungal treatment. An important problem is that direct microscopy, one of the traditional methods, cannot distinguish 100% positive clinical samples, and culture isolation, another traditional method, takes 2-4 weeks and cannot fully distinguish fungal pathogens in clinical samples. Scientific studies conducted in this context reveal that molecular methods can detect dermatophyte pathogens in clinical samples in the most accurate, fastest and most reliable way. Within the scope of molecular-based microbiological diagnosis, Polymerase Chain Reaction (PCR) is used, in which the enzymatic amplification of a specific DNA sequence is used using forward and reverse primers and many copies are created. Real Time PCR (Real Time PCR), Multiplex PCR, Randomly Amplified Polymorphic DNA PCR (RAPD-PCR), Restriction Fragment Length Polymorphism PCR (PCR-RFLP) and Many types of PCR are used for the diagnosis of dermatophytes, such as nested PCR. Fungal barcode gene regions such as Actin, Beta Tubulin, CHS-1 (Chitin Synthase-1), ITS (Internal Transcribed Spacer), Calmodulin, NTS (Non-Transcribed Spacer) are used in diagnosis with PCR. As a result, molecular diagnostic methods used in the detection of dermatophytes are considered the gold standard today.

Keywords: Dermatophyte, molecular methods, polymerase chain reaction (PCR).

Investigation of the Presence of *Candida auris* in Blood Cultures with the MALDI-TOF MS System

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Candida auris is a remarkable new fungal pathogen in hospital diseases that can be caused in intensive care units and with its multi-drug power. Candida auris causes nosocomial infections and epidemics. For this reason, it has gained importance in recent years. In our study, unidentified yeasts whose growth was detected in blood cultures between 01.01.2010 and 01.08.2024 in the Microbiology Laboratory were evaluated. A total of 1084 yeast fungi were detected. Respectively, *Candida parapsilosis* 406, *Candida albicans* 332, *Candida glabrata* 126, *Candida tropicalis* 98, *Candida* spp. 65, *Candida krusei* 21, *Candida kefyr* 8, *Candida guilliermondii* 6, *Candida famata* 4, *Candida lusitaniae* 3, *Candida utilis* 3, *Candida dubliniensis* 1, *Candida ciferii* 1. In addition, 10 yeast isolates (*Trichosporon* spp. 4, *Cryptococcus* spp. 2, *Saccharomyces cerevisiae* 2, *Saprochaete capitata* 1, *Geotrichum* spp. 1) other than *Candida albicans* were recorded. Additionally, 65 of these mushrooms could not be identified. Unidentified strains were passaged again and 61 of them were revived. Unidentified fungi isolated from blood culture samples were analyzed by matrix-mediated laser desorption ionization-time-of-flight-mass spectrometry (MALDI-TOF MS) method. According to the feeding method, 45 of the strains were named *Candida parapsilosis*, 5 were *Candida albicans*, 4 were *Candida tropicalis*, 3 were *Candida krusei*, and the other 4 were named *Candida auris*, *Candida guilliermondii*, *Candida lypolitica* and *Trichosporon asahii*. This recording is used to determine whether *Candida auris* is present in unidentified yeasts, as well as to determine the yeasts that grow in blood samples, to examine the appearance of different species and their changes over time.

Keywords: Blood culture, yeast, *Candida auris*, MALDI-TOF MS.

Inhibitory effect of methylene blue on *Candida albicans* clinical isolates

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Methylene blue is a phenothiazine group chemical. It is currently used as a dye, an antidote, and pharyngitis remedy. In this study, we aimed to investigate the antifungal effect of methylene blue on *C. albicans* clinical isolates. Thirty *Candida albicans* strains isolated from the samples of the patients sent to the medical microbiology laboratory of Gaziantep University Hospital were included in the study. Antifungal susceptibility testing against methylene blue was performed using the agar dilution method. Mueller Hinton agar media were prepared containing increasing concentrations of methylene blue (0.0625, 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, 32, 64 and 128 mcg/ml). Fungal suspensions were adjusted to a standard of 0.5 McFarland (108 CFU/ml) and 10 microliters of the fungal inoculum were subcultured into these media. Serial passages were incubated at 37 °C. The minimum concentration of methylene blue that inhibited the growth of fungal colonies on the agar surface after 48 hours was determined as the minimum inhibitory concentration (MIC). The average age of 30 patients from whom *C. albicans* strains were isolated was 58.7 years. Nine of the strains were isolated from broncho-alveolar lavage, eight from urine and six from blood cultures (and seven from other samples). The MIC value for methylene blue was found to be 8 mcg/ml in 14 isolates and 16 mcg/ml in 16 isolates. The MIC_{90} value was determined as 16 mcg/ml. Methylene blue compound is used at high concentrations (>1000 mcg/ml) in some licensed drug preparations for treatment of local bacterial infections. In our study, methylene blue inhibited all *C. albicans* clinical strains at lower doses (16 mcg/ml). If the effectiveness of methylene blue, which is not routinely used as an antifungal, could be supported by new in-vivo studies, this substance may be a new promising antifungal agent.

Keywords: Methylene blue, *Candida albicans*, antifungal.

Examination of Galactomannan Antigen Test Results in The Diagnosis of Patients with Suspect of Invasive Aspergillosis

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Invasive aspergillosis (IA) is one of the most common causes of mortality and morbidity in patients with immunodeficiency. Galactomannan (GM) is a polysaccharide found in the cell walls of many *Aspergillus* species and is important for early diagnosis and treatment of invasive aspergillosis. This study aimed to evaluate the results of the galactomannan antigen test in patients with suspected invasive aspergillosis.

Serum and Bronchoalveolar lavage (BAL) samples sent to Selçuk University Faculty of Medicine Medical Microbiology Laboratory between January 2020 and July 2024 with a GM antigen request with a pre-diagnosis of IA were included in the study. Detection of GM antigens is performed by the Magnetic Bead Coated Chemiluminescence method using horseradish peroxidase horseradish peroxidase (HRP)-labeled anti-*Aspergillus* galactomannan antibodies on the FACIS-I instrument with the Fully Automated Chemiluminescence Immunoassay System (Genobio Pharmaceutical China) Study results were investigated retrospectively via hospital electronic automation.

Of 5645 patients with a preliminary diagnosis of IA were included in this study. GM antigen positivity was detected in 867 (15.3%) of these patients. Of the positive patients, 462 (53.3%) were male and 405 (46.7%) were female. Positivity was detected in 492 blood and 375 BAL samples. Patients with GM positivity; 282 (32.6%) leukemia, 167 (19.2%) pneumonia, 142 (16.3%) lymphoma, 97 (11.2%) various malignancies, and 77 (19.2%) were diagnosed with acute bronchitis or bronchiectasis. Of the patient samples detected to be antigen positive, 343 (39.5%) were from the Hematology Unit, 292 (33.6%) were from the Chest Diseases Unit, 156 (18.1%) were from the Internal Medicine Unit, and 51 (5.9%) were sent from the Anesthesia and Reanimation Unit.

As a result, it was concluded that checking GM levels in serum or BAL samples would be useful in the early diagnosis and treatment of IA infections. Therefore, since GM test results are

compatible with clinical data, using it at appropriate frequency in the serological diagnosis of IA infections will contribute to reducing mortality and morbidity.

Keywords: Bronchoalveolar lavage, galactomannan antigen, invasive aspergillosis, magnetic bead coated chemiluminescence, serum.

In Silico Evaluation of Anticandidal Activity of Main Constituents of *Melaleuca quinquenervia* (Niaouli Oil) against *Candida albicans*

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In this study, we tested the potential anticandidal activity of *Melaleuca quinquenervia* (Niaouli Oil) essential oil (MQEO) against *Candida albicans* using in silico analyses. The molecular docking targets were selected to inhibit ergosterol biosynthesis in *Candida albicans*: Erg11 (CYP51) (PDB ID: 5V5Z). To support the inhibition of Beta-1,3 glucan synthesis and structural degradation, as this step can lead to resistance against echinocandins, *Candida albicans* Methionine Synthase (PDB ID: 4L61) was chosen. Additionally, *Homo sapiens* Methionine Synthase (PDB ID: 2O2K) was included to compare similar structures found in human mechanisms. The ligands to be docked to these targets were identified as the three main volatile compounds found in MQEO: Viridiflorol, alpha-pinene, and eucalyptol. Each ligand underwent separate molecular docking procedures with the selected targets, and nine affinity results were obtained for each interaction. The numerical results, visual outcomes, and potential chemical bonds were compared. The three interactions with the best affinity scores ("4L61_Eucalyptol," "4L61_Viridiflorol," and "5V5Z_Eucalyptol") were selected for further detailed examination. These interactions, which were deemed sufficiently strong in terms of binding, were assessed for their potential as therapeutic antagonist agents using the 'ADMET' drug analysis test. The results provided insights for the next steps in the study. The "Boiled Egg" test found that all ligands could cross the blood-brain barrier and were not expelled from the central nervous system by P-Glycoprotein. Despite this, the eucalyptol compound, which achieved the highest affinity scores, showed successful results in the ADMET tests with only minor deviations. Eucalyptol, which is predicted to be effective against *Candida albicans* and other microbial organisms with similar properties, is considered to have potential as an antimicrobial therapeutic agent and is worthy of further development and observation in more comprehensive and varied experiments. The in silico analyses suggest that this pursuit is consistent and reasonable.

Keywords: *Candida albicans*, *in silico*, molecular docking, ADMET, anticandidal activity.

In Silico Evaluation of Antimicrobial Activity of Luteon Terpenoid against *Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Candida albicans*

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This study aimed to evaluate the effectiveness of the luteon terpenoid against key protein targets in the Gram-negative bacteria *Klebsiella pneumoniae, Pseudomonas aeruginosa,* and the fungal pathogen *Candida albicans*. The global health threat posed by antimicrobial resistance necessitates the development of novel therapeutic strategies. In this study, the proteins KPC-2 beta-lactamase (PDB code: 2OV5) and AcrB multidrug efflux pump (PDB code: 4DX5) from *Klebsiella pneumoniae*, PBP3 (PDB code: 3PBR) and MexA-MexB-OprM efflux pump (PDB code: 6TA6) from *Pseudomonas aeruginosa*, as well as CYP51 (PDB code: 5V5Z) and methionine synthase (PDB code: 4L61) from *Candida albicans*, were examined.

The interactions of the luteon terpenoid with these proteins were analyzed using molecular docking studies, and ADME (Absorption, Distribution, Metabolism, Excretion) tests were performed. The docking results revealed that the luteon terpenoid exhibited high binding affinities against critical proteins such as KPC-2 beta-lactamase, AcrB, PBP3, MexB, CYP51, and methionine synthase. ADME analysis indicated that while the luteon terpenoid generally displayed favorable bioavailability profiles, it showed some weaknesses in terms of lipophilicity and water solubility.

The findings suggest that luteon terpenoid could be effective against both bacterial and fungal pathogens and holds significant potential for developing new treatment approaches against multidrug-resistant organisms. This study demonstrates the promise of luteon terpenoid as a therapeutic agent in combating antimicrobial resistance, providing a solid foundation for future research.

Keywords: Molecular docking, luteon terpenoid, antibiotic resistance, antifungal resistance.

Medicinal Mushroom

Hymenochaetoid Medicinal Macrofungi in Central Asia: A Comprehensive Study of Their Diversity, Distribution, Ethnomycological Importance, and Medicinal Properties

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Macrofungi are indispensable to human societies, not only as a source of nutrition and medicine, but also as vital economic assets. Despite their significance, ethnomycological research has lagged, leading to inconsistencies in the documentation and use of medicinal fungi. This gap is pronounced in Central Asia, a region rich in biodiversity where the valuable medicinal resource of Hymenochaetoid fungi is understudied. This research provides a detailed overview of beneficial Hymenochaetoid macrofungi in Central Asia, focusing on their traditional uses and potential in pharmaceuticals and nutraceuticals. The review identified 43 Hymenochaetoid species across 18 genera. The genera with the largest number of species are *Fomitiporia*, *Fulvifomes*, *Fuscoporia*, *Inocutis*, *Inonotus*, *Phellinus*, and *Phylloporia*, comprising a total of 29 species. The distribution of

medicinal Hymenochaetoid macrofungi shows Kazakhstan and Uzbekistan with 30 and 29 species, respectively. Kyrgyzstan has 19 species, indicating moderate diversity; Turkmenistan and Tajikistan have 11 and 10 species, respectively, representing the lowest diversity and highlighting the need for more in-depth research. Hymenochaetoid fungi were found on 125 host plant species from 42 genera and 25 families, with *Rosaceae* and *Salicaceae* being the most common host families. Out of 43 Hymenochaetoid species, 33 have been subjected to studies for bioactive compounds, mainly phenolics, terpenoids, and polysaccharides. These compounds, demonstrated antioxidant, antidiabetic, and antitumor activities, among others. From the 43 species, *Fomitiporia punctata*, *Fuscoporia torulosa*, *Inonotus hispidus*, *I. obliquus*, *Phellinus igniarius*, *P. pomaceus*, *P. pini*, *Sanghuangporus lonicerinus*, and *Tropicoporus linteus* were reported in traditional medicine for therapeutic applications as cancers and diabetes highlighting the ethnomedicinal significance of these Hymenochaetoid fungi in Central Asia. However, despite these promising uses, challenges remain to fully understanding and exploiting the therapeutic potential of mycomedicine. This requires further scientific research, conservation of fungal biodiversity, preservation of traditional knowledge, and integration of traditional practices into modern healthcare systems.

Keywords: Agaricomycetes; Hymenochaetaceae; medicinal mushrooms; host preferences; taxonomic composition.

Antiviral Activity of *Fuscoporia torulosa* (Pers.) T.Wagner & M. Fisch. Against HSV-1 and HSV-2

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In this study, the antiviral activities of aqueous and polysaccharide-enriched hot aqueous extracts obtained from *F. torulosa* against HSV-1 and HSV-2 were investigated. The cytotoxicity of the extracts on Vero cells was investigated and the maximum non-toxic concentration (MNTC) was determined. The antiviral activity of the extracts was evaluated by time-dependent (pre-infection, simultaneously and post-infection). The cytotoxic activity of the extracts and their ability to inhibit virus-induced cytopathic effect (CPE) in tissue culture were evaluated by MTT assay. 50% cytotoxic concentration (CC_{50}) and 50% effective concentration (EC_{50}) were determined using a graphpad prism, and the selectivity index (SI) was calculated from the ratio of CC_{50} to EC_{50}. As a result of the study, it was observed that polysaccharide-enriched hot aqueous extract was more effective against both viruses and showed antiviral activity, especially against HSV-2 at all stages of the infections. The highest Selectivity Index (SI) value of 107.00 was determined in the simultaneous application of polysaccharide-enriched hot aqueous extract against HSV-2. The SI values of the polysaccharide-enriched hot aqueous extract against HSV-1 are respectively; pre-infection 60.59 > post-infection 47.03 > simultaneously 4.71; SI values against HSV-2 were determined as simultaneously 107.00 > pre-infection 85.03 > post-infection 62.34. As a result, antiviral activity differed depending on the extraction method and the stage of viral infection to which the extract was applied.

Keywords: *Fuscoporia torulosa*, cytotoxic activity, antiviral activity, polysaccharide enriched extract.

Acknowledgments: This study was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 1002-A Rapid Support Program with project number 222Z131 and by Selçuk University Scientific Research Projects Coordination Office (BAP) with project number 23401085.

Some Important Species of Mushrooms Known For Medical Purposes

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In addition to being a good source of fiber, mushrooms contain high amounts of water, protein, vitamins, and minerals. Mushrooms have attracted the attention of scientists for many years with their nutritional and medicinal properties. It has been reported that their active ingredients play an active role in the treatment or prevention of many diseases by extracting them. Due to their antibiotic, antioxidant, anti-inflammatory, antiviral, antifungal, anticancer, and antimicrobial properties, many mushroom species are used for medical purposes today.

The most important mushroom species known for medicinal purposes are *Lentinus edodes* (Shiitake), *Ganoderma lucidum* (Reishi), *Grifola frondosa* (Maitake), *Pleurotus ostreatus* (Beech mushroom), *Agaricus blazei* Murrill, *Cordyceps sinesis* (Caterpillar mushroom) etc. Studies have reported that Shiitake mushrooms applied in dried and ground form lowered average plasma cholesterol and reduced tumor growth. It has been reported that 26-oxygenosterol, obtained from Reishi mushroom, lowers total cholesterol. Beta-glucan (Dfraction) extracted from Maitake species, known for its antitumoral effect, has also been shown to have an effect of strengthening the immune system as well as preventing cancer from recurring and spreading. *P. ostreatus*, a good producer of lovastatin, is known as a natural cholesterol reducer, anti-cancer agent and immunomodulator. Rich in beta-D-glucan and ergosterol, containing linoleic acid, palmitorenic acid, vitamins B6 and B12, *Agaricus blazei* Murrill mushroom is a mushroom species that stands out in alternative medicine in Japan. Although the anticancer effect of *Cordyceps sinesis* is widely known, studies have reported that it has antioxidant, anti-aging, positive effects on learning and memory, antidiabetic, correcting impaired reproductive functions, immunomodulatory and positive effects on multiple sclerosis.

It is also supported by clinical studies that many mushroom species have important pharmacological effects. It can be clearly seen from the studies that their therapeutic properties will show very positive results when used safely and consciously, under the supervision of a doctor.

Keywords: Medical mushrooms, therapeutic effect, health.

Molecular Fungal Taxonomy

Uncovering New Mycoviruses in *Lecanicillium aphanocladii*: First Report of Dermatophytosis and Complete Genomic Characterization of LaPMV1 and LaNSRV1

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Fungal pathogen infections, rapid antifungal resistance, and limited diagnostic and therapeutic capabilities constitute a significant global health concern. This study focused on identifying mycoviruses infecting a clinical isolate of *Lecanicillium aphanocladii*, determining their complete or nearly complete genome sequences, elucidating their molecular and phylogenetic characteristics, and investigating their interactions with their hosts. Genomic DNAs of the isolate were extracted using the CTAB method, followed by PCR amplification and sequencing of ITS rDNA regions. The obtained sequences were analyzed using BLASTn for molecular species identification of the fungal isolate. RNA virus infections of the fungal isolate were initially identified by extracting its total dsRNAs and examining them in agarose gel electrophoresis. To determine the sequences of these viral RNA genomes, the extracted dsRNAs were converted into cDNA, amplified by randomized PCR, and subjected to next-generation sequencing. RNA Ligation Mediated Rapid Amplification of cDNA ends (RLM-RACE) method was used to obtain the terminal sequences of the viral genomes. This study reports the molecular characterization of two newly discovered mycoviruses, named "Lecanicillium aphanocladii polymycovirus 1" (LaPMV1) and "Lecanicillium aphanocladii negative-stranded RNA virus 1" (LaNSRV1), found in the clinical isolate of an entomopathogenic, fungicolous, and keratinophilic fungus *Lecanicillium aphanocladii*. Methods such as hyphal tip cutting, thermotherapy, fungicide, and antibiotic treatments were applied to the dermatophyte isolate to eliminate the LaPMV1 infection and observe its phenotypic effects on its host. After virus curing, viral dsRNA analysis and LaPMV1-specific RT-PCR tests confirmed the complete elimination of LaPMV1 infection from the host fungus. The virus-cured isogenic strain exhibited loss of red pigmentation and increased conidia production concerning its infected parental strain.

According to the available literature, this is the first report of mycoviruses infecting *L. aphanocladii*, revealing the complete genomes of two new mycovirus species. Additionally, it is the first documented case of dermatophytosis caused by *Lecanicillium aphanocladii*.

Keywords: Mycoviruses, *Lecanicillium aphanocladii*, dermatophytosis, genomic characterization.

Multigene phylogeny and morphological identification of *Helvella capucina* from Türkiye

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In the current study, *Helvella capucina* collected from Hakkari province in Türkiye is described as a new record using morphological and molecular characters. Ascocarp, hymenium, stipe, ascospores, ascus and paraphyses were used as diagnostic morphological characters. The species, which is placed in section *Elastica*, was characterized by its short-stipitate apothecium; campanulate to bi- to trilobate cap; dark brown to brownish black hymenium; high, solid, glabrous, broadly attached to cap underside, pure white when fresh, drying yellowish stipe; elipsoid, contains a large lipid droplet in the center, surrounded by smaller droplets spores. As molecular characters, the *HSP90* (heat shock protein 90), *RPB2* (RNA polymerase 2) and *TEF1-α* (translation elongation factor 1-alpha) genes were sequenced. Multigene phylogenetic analysis was performed using Bayesian inference method. Both morphological and molecular data separated *Helvella capucina* from its close relatives. Detailed description, colour images of fresh and dried ascomata, along with photographs of microscopic characters and the concatenated phylogenetic tree were provided.

Keywords: *Helvella*, *HSP90*, new record, *RPB2*, *TEF1-α*

New Record and molecular identification of *Tricharina cretea* collected from Nemrut Mountain, Türkiye

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Tricharina is one of the most difficult genera of Pezizales because of morphological similarities among species. The genus is defined with approximately 21 species worldwide and 3 species have been identified in Türkiye so far. In the present study, *Tricharina cretea* is described as a new record from Nemrut Mountain in Türkiye based on morphological and molecular features. The studied specimen was morphologically characterized by its apothecia, which form shallow discs. It appeared dirty-white to whitish-grey on the substrate, with older apothecia showing a beige tint. The surface of the apothecia was adorned with short brownish hairs. The excipulum consisted of cells ranging from globose to prismatic in shape, displaying "textura globulosa" to "t. angularis" structures. The asci were cylindrical, tapering and truncate at the top, operculate, and contained 8 spores. Paraphyses were filiform, slightly thickened, and hyaline. Ascospores were broadly ellipsoid and smooth. As molecular studies, internal transcribed spacer (ITS) region were sequenced and analyzed using Bayesian inference (BI) method. The novel taxon is is closely related to species *Tricharina praecox* var. *praecox* and *Tricharina praecox.* Both morphological and molecular data were sufficient to distinguish *Tricharina cretea* from its close relatives. Detailed description and the concatenated phylogenetic tree were provided.

Keywords: *Tricharina*, ITS, new record, phylogeny.

Genetic Structure of The Population of *Botrytis cinerea* and Molecular Diagnosis of The Fungal Contamination in Strawberry in Aydın Province

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Summary

According to last data, our country is in the third place of strawberry production with 353.173 tons. However, strawberry is exposed to many fungal diseases. These fungal diseases are mainly classified as the diseases over the soil which is affective to parts like leaves and fruits and the diseases under the soil which makes the roots and the neck rots sick. In Aydın province, there isn't a study for molecular identification of fungal contamination in strawberry and for determination of population structure of Botrytis cinerea. For this reason, 347 strains are obtained from the sick plants which are collected from five different areas. From these strains, 11 morphologically different kinds are identified. For molecular identification, rDNA ITS gene part of 78 examples are multiplied and as a result of the compare with GENEBANK data, 20 different kinds that belong to 11 species are determined. Nine microsatellite area are studied to determine the population structure of *Botryris cineara* species. As a result of analysis in five areas, it is determined that there is a genetically structure. As a consequence of this study, both molecular and morphological identification results of the contaminated fungus in strawberry supported each other. It is determined that five Botrytis cineara populations are separated to two groups.

Keywords: Strawberry, rDNA its, *Botrytis cinerea*, Microsatellite, Aydın.

Acknowledgments: This work as financial was supported by the ADU-BAP (Project Number: FEF-14019). This research is a master's thesis.

Myxomycetes

Biodiversity and Ecology of Myxomycetes of Kırka Forest, Eskişehir

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The myxomycetes (plasmodial slime molds) are a group of fungus like organisms usually present in terrestrial ecosystems. The majority of species are probably cosmopolitan. They are particularly abundant to moist temperate forests where potential substrates are plentiful like fallen leaves, logs, stumps and dead wood. Biodiversity survey for myxomycetes was carried out in Kırka Forest, Eskişehir. *Pinus nigra* Arn. ssp. *pallasiana* and *Quercus* ssp. are dominant in the field of research. Bark of living trees, ground litter and wood were collected from study area. At the same time all fruitings of myxomycetes were collected and recorded. The 170 moist chamber cultures were maintained under ambient conditions (ca 23° C) and in diffuse light. The pH of each culture was recorded at 24 hours before excess water was poured off. Diversity and abundance indices, species richness, the mean number of species per genus (S/G) were calculated. Species and substrate relationship was evaluated. A total of 172 records belonging to 52 species 15 genera was recovered. Licea minima as the most common species was recorded 20 times, but 34 species of all species was classified as ocasionally for the study area. Species diversity was H'=3,7813. Substratum pH values were mesuared at 4,32 and 7,05. The pH of the Pinus nigra barks were measured acidically. *Arcyria fasciculata, Collaria nigricapillitia Licea chelonoides, Stemonitis farrensis, Cribraria dictyospora, Cribraria atrofusca, Comatricha robusta, Comatricha orthotricha* were recorded first time for Türkiye mycobiota. Species diversity was quite high. Most of the species identified in the study were preferred to bark microhabitats. Substrate pH is an important factor determining the abundance and distribution of myxomycetes.

Keywords: Biodiversity, myxomyceyes, Eskişehir, ecology.

Climate Change and Myxomycetes

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The Intergovernmental Panel on Climate Change (IPCC) broadly defines climate change as any alteration in climate over time, whether due to natural variability or human activity. This comprehensive definition has significant implications for policy decisions regarding adaptation. In the 21st century, climate change has become a critical global issue, affecting nearly every region and life form, including humans, animals, microbes, and plants. The primary cause of climate change is the increased concentration of greenhouse gases in the atmosphere. Biological organisms may respond to climate change through genetic adaptation or changes in behavior, morphology, and physiology. However, species that fail to adapt to these changes face population declines and possible extinction. Myxomycetes, also known as plasmodial slime molds, are amoeboid microorganisms found in most ecosystems and under diverse ecological conditions. Their conservation status has not been thoroughly evaluated, but they are likely threatened by climate change, habitat destruction, and pollution. Long-term studies show that sporocarp formation in myxomycetes varies among species. Extreme climate events in temperate areas can significantly affect this process. Rare species have been observed during El Niño-Southern Oscillation events. Habitat loss and natural disasters also impact sporocarp production and ecological dynamics. Temperature and moisture are crucial factors limiting the occurrence of myxomycetes, making them vulnerable to climate change. However, assessing their resilience is challenging due to their cryptic life history. Myxomycetes may represent one of the least affected groups of organisms, but anticipated climate changes are expected to impact their distribution and ecology significantly. This is particularly true for species restricted to specific microhabitats, such as alpine snowbanks, or limited geographical areas, like small oceanic islands. Assemblages of myxomycetes in deserts, polar regions, and other ecosystems could also be affected. Understanding and monitoring these impacts is crucial for future conservation efforts.

Keywords: Climate change, myxomycetes, ecology.

POSTER PRESENTATIONS

Aerobiology

Alternaria Spores in Aerobiological Studies in Türkiye

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Aerobiology is the study of organic particles in the air and also includes pollen and spores. Aeropalinology is a sub-branch of palynology that studies pollen and spores in the atmosphere and has common areas of study with aerobiology. The presence of some pollen and spore species in the atmosphere causes allergies in sensitive people. Spores belonging to *Alternaria* species are one of the important fungal genera commonly found in the atmosphere with allergic effects. The genus *Alternaria* is a microfungus that produces many spores in different environments. The presence of these spores in the air varies depending on meteorological factors. In this review, the spores of the genus *Alternaria* were evaluated in the articles published in national or international journals in aerobiological studies on Türkiye since 2000. In this context, the studies that could be accessed by searching on internet search engines were taken as basis. A total of 22 articles were analyzed. Within the scope of these studies, the question of the presence of spores of the genus *Alternaria*, one of the fungi that reproduce with conidial spores, in the atmosphere of Türkiye was sought to be answered. Of these twenty-two articles; two seasonal and petri plate method (Gravimetric), thirteen one-year studies, five of which were Durham, two petri plate (Gravimetric), six Burkard/Air sampling/Lanzoni (Volumetric). Of the six two-year papers, three were Durham (Gravimetric), two were Hirst-type volumetric trap and one was Air sampling, while only one paper was three years old and was Durham (Gravimetric). Gravimetric method was used in nine papers, volumetric method in nine papers and petri plate method in four papers. It was determined that Alternaria spores are present in the atmosphere in almost all seasons, but they vary according to the average wind speed, temperature, relative humidity and total precipitation in certain periods of the year.

Keywords: Aerobiyoloji, *Alternaria* spp., Türkiye.

Agricultural and Food Mycology / Toxicology

Mold Risk in Cacao and Chocolate

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Cacao (*Theobroma cacao*), grown primarily in tropical countries, Africa, Asia and the Americas, is an important ingredient in many foods, including chocolate. Due to their product characteristics, these products are generally resistant to bacterial spoilage but can be susceptible to spoilage due to mold contamination that may occur during cocoa processing. Mold growth may occur due to various factors (such as inadequate sanitation, ineffective drying) during the processing of cocoa. Mold spoilage causes quality losses such as color and taste changes in cocoa and its products. It may also pose a risk to food safety due to the production of various mycotoxins such as aflatoxin and ochratoxin A. Considering both the losses in food businesses and the risks they pose to public health, it is important to prevent mold contamination during the cocoa processing process. The species commonly detected among molds that cause spoilage in cocoa belong to the genera *Aspergillus, Absidia*, *Penicillium, Monascus, Mucor, Paecilomyces, Eurotium* and *Talaromyces*. Toxigenic molds encountered at different stages of cocoa processing include *Aspergillus flavus, Absidia corymbifera, Aspergillus parasiticus, Aspergillus niger, Aspergillus ochraceus* and *Penicillium paneum*. In order to prevent mold formation in cocoa and its products, precautions such as the use of inert gas in packaging, vacuum application and the use of various preservatives (such as benzoic acid, sorbic acid) are generally taken. Controlling mold contamination through good hygiene practices is important for food safety. Due to the risk of exposure to these mycotoxins, especially for children who are interested in chocolate-type cocoa products, it is necessary to monitor and prevent the formation of mycotoxins in these products. Despite the recent increase in information on mold contamination and mycotoxin formation in cocoa and its products, more research is needed regarding the prevention of mold growth and mycotoxin formation.

Keywords: Cocoa, chocolate, mold, mycotoxin, contamination.

An Overview on Genotoxicity of Ochratoxins

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Mycotoxins are secondary metabolites synthesized by various filamentous fungi. Ochratoxins, a group of mycotoxins, are secondary metabolites of various *Aspergillus* (e.g. *Aspergillus ochraceus, Aspergillus carbonarius*) and *Penicillium* (e.g. *Penicillum verrrucosum*) species. Since these fungi are distributed in semi-tropical and temperate climates, they can live in different geographical regions and can be found in peas, beans, soybeans, coffee, cocoa, dried fruit, compound feed, all foods of animal origin and cereals such as rye, corn, rice, wheat, barley. Health problems may occur in animals and humans who eat feed or food contaminated with ochratoxin synthesized by these fungi, which have a wide distribution area. So far, ochratoxin has been found to have many toxic effects such as neurotoxicity, nephrotoxicity, hepatotoxicity and developmental toxicity. The study of genotoxicity, which provides valuable information since it is related to carcinogenicity, is also very important. The aim of this review is to give information about the studies on the genotoxicity of ochratoxins, which can be exposed in all areas of life, which negatively affect human health in the long term.

Keywords: Mycotoxins, ochratoxins, genotoxicity, carcinogenicity.

Probiotic Yeast Isolated from Fermented Foods: Their Characteristics, Benefits, And Applications

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Probiotics are beneficial microorganisms that can be taken in sufficient amounts by the host organism. Yeasts, particularly *Saccharomyces cerevisiae* var. *boulardii*, are commonly used in fermented foods due to their natural resistance to antibiotics. These yeasts have numerous health benefits, including treating gastrointestinal system disorders, combating oxidative stress, and modulating the immune system. They also play a significant role in the food industry, as starter cultures in producing products like bread, wine, beer, kefir, wine, kumiss, pickles and table olives. Yeasts have shown potential as dietary supplements, but they should be carefully selected through in vitro and in vivo tests before being added to food products. The benefits provided by probiotics include reducing cholesterol, producing vitamins, enzymes, and folate, as well as antibacterial and antioxidant activities, and strengthening the immune system. The diversity of yeast species found in fermented foods is quite high, with recent research showing that other species such as *Debaryomyces*, *Pichia*, *Torulaspora*, *Kluyveromyces*, *Hanseniaspora*, *Rhodotorula*, *Wickerhamomyces*, *Candida*, and *Williopsis* also have probiotic potential. A successful potential probiotic strain should possess clinical validation and documentation of health effects, acid and bile stability, colonization of the digestive system, safety assessment, antibiotic resistance, and sensitivity. In recent years, there has been an increase in studies focused on the isolation and characterization of non-*Saccharomyces yeasts*, such as *Pichia*, *Schizosaccharomyces*, *Kluyveromyces*, *Rhodotorula*, and *Candida*, which are considered promising probiotics. Yeasts also play important roles in food biotechnology, such as recombinant protein production, alcohol fermentation, and vitamin biosynthesis. The aim of this study is to provide information about yeasts isolated from probiotic fermented foods and some of their characteristics.

Keywords: Probiotics, yeast, human health, *Saccharomyces cerevisiae*.

Environmental Mycology

Fungal Biomaterials for a Sustainable Future

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In recent years, sustainable materials and their applications have become increasingly important to conserve natural resources and reduce waste. Fungi with advanced enzyme systems are attracting interest as biological materials that can be used to design environmentally friendly and sustainable products by transforming organic waste. Mycelium with its web-like structure combines with organic fibres to produce durable and flexible materials. Using substrates such as agricultural waste, these biocomposites offer economic and environmental benefits. These products include a wide range of items such as paper and leather-like materials, furniture, packaging, cosmetics, textiles and construction materials. The use of fungi in sustainable product design reduces negative environmental impacts and conserves natural resources. Collaboration between researchers from different disciplines such as mycology, biotechnology, industrial design, electronics and materials engineering is contributing to the rapid development of mushroom-based materials and technologies.

As a result, sustainable materials of fungal origin provide numerous benefits to nature, the environment and humanity by helping to protect the natural environment, reduce energy consumption and minimise the carbon footprint. Additionally, waste management and recycling of plastic waste contribute to the economy. It also promotes protective and sustainable lifestyles, ensuring a more livable world for future generations. This review aims to raise awareness of the environmental and economic benefits of fungal-based biocomposites.

Keywords: Fungal biocomposites, biomaterials, sustainable materials, sustainable life.

Fungal Biodiversity

Mycena chlorantha (Fr.) P. Kumm., A New Record for Türkiye

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The large genus *Mycena* (Pers.) Roussel of the family Mycenaceae Overeem, consists of small to miniature species of fungi, some bioluminescent, some poisonous, some secrete latex, usually white spore printed, mostly grayish to brown, and not usually collected for food. Species of *Mycena* are saprotrophic, living in large groups under forests in decaying plant material (leaves, humus, wood, and sometimes grass), some species require specific habitats. *Mycena* species are a cosmopolitan group as they have been reported from almost every part of the world. During field research in Ayaş district, macrofungal samples were found on *Poaceae* sp. stem around Çanuh pond. Color pictures of the samples were taken under natural conditions. Samples were collected after their morphological and ecological characteristics and the coordinates where they lived were recorded. Its micromorphology was examined under a Leica DM 2500 trinocular microscope. From the analysis of the data obtained by following the literature, it was determined that these samples were *Mycena chlorantha* (Fr.) P. Kumm. When the checklists and academic publications on the Turkish macromycota were examined, it was understood that there were no previous records of this species. The sample are kept as fungarium material in the Biology Department of Gazi University.

Keywords: New record, macrofungi, Ankara, Türkiye.

New Macrofungal Records from Dokuz Eylül University Tınaztepe Campus Area: Morphological and Phylogenetic Insights

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Specimens of fungi were collected in 2023 in The Tınaztepe Campus of Dokuz Eylül University, located in the Buca district of İzmir province, Türkiye. This campus, which spans 4.5 square kilometers and is situated 130 to 300 meters above sea level, features diverse plant species dominated by the Turkish pine (*Pinus brutia* Ten.) and the kermes oak (*Quercus coccifera* L.), enhancing its ecological richness and visual appeal. The collected fungal samples (DEU AKATA & SAHIN 45, 76, 87, 88, 119, 126, and 150) underwent morphological examination and nrITS rDNA sequence-based phylogenetic analyses. The analyses revealed that these specimens exhibit microscopic and macroscopic features consistent with the species *Deconica submaritima* (Contu & Guzmán) Noordel., *Cyanosporus caesiosimulans* (G.F. Atk.) B.K. Cui & Shun Liu, *Cystolepiota cystophora* (Malençon) Bon, Ripartites metrodii Huijsman, Clitocybe mediterranea (Vizzini, Contu & Musumeci) E. Ludw., *Melanoleuca decembris* Métrod ex Bon, and *Ramaria apiculata* (Fr.) Donk. Genetic sequences of these samples showed over 99% similarity to these species, confirming their identification. These findings represent new records for the mycobiota of Türkiye. Detailed documentation includes descriptions of the collection sites, habitat observations, geographical coordinates, collection dates, macroscopic photographs, and both macroscopic and microscopic illustrations, alongside a brief discussion of the findings.

Keywords: New records, fungal diversity, morphological examination, phylogenetic analysis, Türkiye.

Barcoding *Aspergillus, Penicillium* and *Talaromyces* strains from the CBS Biobank

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Species classified in *Aspergillus*, *Penicillium*, and *Talaromyces* exhibit diverse properties and include some of the most important food spoilage organisms, mycotoxin producers, human pathogens, and indoor contaminants. The CBS is one of the world's largest biobanks of filamentous fungi and yeasts, and includes approximately 6000 (publicly available) *Aspergillus*, *Penicillium*, and *Talaromyces* strains. Even though various strains have been used as reference in molecular taxonomic studies, many of them are still solely identified using morphology. The aim of this study is to use DNA barcoding to identify all available *Aspergillus*, *Penicillium*, and *Talaromyces* strains in the CBS biobank, and describe newly identified species.

Genomic DNA was extracted from strains lacking DNA sequences. For *Aspergillus* strains, the *CaM* gene was used for molecular identification, while the *BenA* gene was used for *Penicillium* and *Talaromyces* strains. Additional loci (ITS, *RPB2*, *CaM*, and/or *BenA*) were sequenced for potential new species, and phylogenetic analyses were performed on single gene and combined datasets. Macroscopic and microscopic studies were applied to further study the potential new species.

Sequences of approximately 5000 strains were studied. Six new *Aspergillus*, 19 new *Talaromyces*, and 48 new *Penicillium* species were identified through phylogenetic analyses. This study provides a solid foundation for future in-depth investigations into taxa within *Aspergillus*, *Penicillium*, and *Talaromyces*.

Keywords: Identification, biodiversity, biobank, intraspecific variation.

Species Diversity of *Puccinia* Parasitic on Plant Family of Poaceae in Northeastern Uzbekistan

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Puccinia is the largest genus in the order *Pucciniales*, with about 3000~4000 described species. Species of *Puccinia* are especially important and widespread plant pathogens that have a major economic impact on world's cereal and agricultural crops. There are substantial gaps in the current knowledge of rust diversity status in Uzbekistan. There is still no comprehensive study or even preliminary estimation about the number of *Puccinia* species and their effect on plants in Central Asia as a whole. Consequently, this study aims to first, introduce our ongoing survey on this genus in the study area and then, primarily summarizes the results of previous studies in the region, with special view on its Northeastern Uzbekistan. Here we have reported in total 15 species of *Puccinia* were found to be parasitic to 25 plant species belonging to 17 genera of Poaceae family in the study region. The following *Puccinia* species were identified: *P. agropyri* (*Agropyron badamense, Elytrigia repens, E. trichophora, Taeniatherum crinitum*), *P. bromina* (*Anisantha tectorum, Bromus tyttholepis, B. danthoniae, B. lanceolatus, B. oxyodon, Buglossa arvensis*), *P. coronata* (*Agrostis canina*), *P. cynodontis* (*Cynodon dactylon*), *P. dactylidina* (*Dactylis glomerata*), *P. graminis* (*Hordeum bulbosum, Elytrigia trichophora, Taeniatherum crinitum*), *P. hordei* (*Hordeum vulgare*), *P. isiacae* (*Phragmites australis*), *P. moriokaensis* (*Phragmites australis*), *P. obtusata* (*Saccharum spontaneum*), *P. oryzopsidis* (*Piptatherum kokanicum, P. vicarium*), *P. persistens* (*Agrostis gigantea, Elymus drobovii, Elytrigia repens, E. trichophora, Taeniatherum crinitum*), *P. poarum* (*Poa angustifolia, P. annua*), *P. rufipes* (*Imperata cylindrica*), *P. triticina* (*Triticum* spp.).

Keywords: Pucciniales, plant pathogenic fungi, host plants, Central Asia, distribution, taxonomy.

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Fungal Biotechnology

Optimization of Substrate Pretreatment, Enzymatic Hydrolysis and Fermentation Conditions for Biomass Production with *Rhizopus oryzae* NRRL 395 from Stale Bread

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Bread is among the most wasted foods in many countries around the world. According to data from 2019, 4.9 million of bread were wasted daily in Türkiye. Bread contains the necessary nutrients for microbial growth, making it a suitable substrate for fungal biomass production. Fungal biomass has gained importance in human nutrition due to its content of protein, fatty acids, amino acids, dietary fiber, minerals, and antioxidant compounds. The present study, an attempt was made to increase the fermentable sugar content of stale bread using heat-treated dilute acid pretreatment followed by enzymatic hydrolysis. Additionally, the pretreatment method that yields the lowest concentration of 5-hydroxymethylfurfural (HMF) has been investigated. Then, it was concentrated on optimizing fermentation conditions to produce fungal biomass from the *Rhizopus oryzae* NRRL 395. The optimum conditions for pretreatment were the application of 2.5% H_2SO_4, 5% (w/v) solution of stale bread, and heating at 121 °C for 2 min, which yielded 6.60 g/L fermentable sugar and 1.14 mg/100 mL HMF concentration. In addition, pretreated stale bread required 0.05% of enzyme concentration and 2 h of hydrolysis time. It was determined that the fermentation temperature ($p = 0.0008$) and fermentation time ($p = 0.0303$) were statistically significant for biomass yield. The optimum conditions for fermentation were the application of 33 °C, 7 days, 200 rpm and 4.5 pH, which yielded 12.88 g/L biomass. In conclusion, this study has demonstrated the importance of substrate optimization efforts in the production of biomass yield through fungal bioconversion of food waste.

Keywords: Bread, fermentable sugar, fungal biomass, HMF, *Rhizopus oryzae.*

Acknowledgments: This study was supported by Scientific and Technological Research Council of Türkiye (TUBITAK) under the Grant Number 123O298. The authors thank to TUBITAK for their supports.

Production of melanin by *Aspergillus terreus* and Analysis of its Structural Properties

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The plant, animal, and fungal kingdoms of life include the unique pigment known as melanin. The broad and diverse class of brown and black pigments are usually called melanin. Melanin is a secondary metabolite that produced by microorganisms. Fungi contain melanin, a biodegradable natural pigment with multiple biological activities and functional properties. In Ascomycota, including *Aspergillus* species, especially extreme condition originated species, the crucial genes and encoded enzymes for pigment and melanin manufacturing have recently been discovered. The cinnamon-brown color of *Aspergillus terreus* conidia suggests that a pigment is produced to protect against biotic and abiotic stress factors and other extreme environmental conditions, like high NaCl concentrations.

The purpose of the current study was to extract the melanin pigment from *A. terreus* and evaluate its structural characteristics. Through the use of the halotolerant test method, the halotolerant nature of *A. terreus* isolated from Tuz Gölü (Şereflikoçhisar, Ankara) was confirmed in this investigation. And the intracellular and extracellular produced melanin pigmet was analyzed by UV-VIS and FTIR- spectra methods. In addition to these analyses, the melanin production pathway was determined by analyzing the effects of melanin inhibitory agents: sodium azide and phthalic acid. Our results showed that the melanin pigments produced from *A. terreus* intracellular and extracellular possess structural properties very similar to synthetic melanin. In the test with melanin inhibitory agents, a media containing sodium azide that is the inhibitor agent of DOPA melanin biosynthesis, black pigmentation was not observed. Conversely, the dark-pigmented culture was seen in a media that contained phthalic acid, an agent that inhibits the formation of DHN melanin. The study's findings suggest that the DOPA melanin pathway produces the melanin pigment found in *A. terreus*, and thus, DOPA melanin.

Keywords: Melanin, *Aspergillus terreus*, fungal melanin, melanin extraction, melanin characterization.

Research of Laccase-Producing Microfungi in Agricultural Waste and By-Products in Thrace Region

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Every year, a large amount of by-products and wastes are generated from the processing of agricultural products. The utilization of these products in the production of various enzymes widely used in industry and the investigation of fungal producer sources are of interest. In this study, microfungi isolated from agricultural wastes and by-products of Thrace region were screened for laccase enzyme production. The laccase enzyme production of the isolated microfungi was firstly investigated qualitatively using petri plate method. For laccase enzyme determination by this method, four different PDA media containing appropriate amounts of ABTS, guaiacol, tannic acid and bromphenol were used. Microfungi isolated from agricultural products and stored as stock cultures were inoculated on the prepared media and incubated at 25 °C for 7 days. At the end of the incubation period, the presence of the enzyme was determined according to the color changes in the media (blue green in the medium containing ABTS and brown in the media containing guaiacol and tannic acid) and decolorization (in the medium containing bromphenol). The laccase positive microfungi were identified at the genus level by morphological and cultural methods and belonged to the genera *Alternaria*, *Aspergillus*, *Cladosporium*, *Fusarium* and *Trichothecium*. In the continuation of this preliminary screening study, it is aimed to produce the isolated microfungi in fermentation environments using agricultural waste and by-products.

Keywords: Agricultural products, enzyme, laccase, microfungi.

Investigation of the Gene Region Responsible for Ribotoxin Production in Entomopathogenic *Beauveria bassiana*

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Beauveria bassiana is an entomopathogenic fungus that acts as a natural pathogen on many insect species. Recent research has revealed important findings on the toxin production capacity of this fungus. One of the focal points of these studies is the presence of a toxin called Ribotoxin.

Ribotoxins are toxins that have a protein structure and cause cell death by inhibiting the translation mechanism. Ribotoxins produced by *Beauveria bassiana* play an important role in the progression of infection by exerting cytotoxic effects, especially in target insects. These toxins are produced after the penetration of the fungus into the host cell and overcome immune defense mechanisms during the infection process, leading to host death.

Studies on the molecular structure of ribotoxins and their effects on insects help us to understand the potential of *Beauveria bassiana* in biological control. The role of these toxins in the pathogenicity of the fungus is also of great importance for developing new pesticides and improving biocontrol strategies of entomopathogenic fungi.

In our study, *Beauveria bassiana* was isolated from soil samples taken from 17 different villages in Kozak Plateau, Bergama, İzmir. 16 *Beauveria bassiana* were isolated. All isolates were identified by phenotypic and genotypic methods. For genotypic diagnosis, polymerase chain reaction (PCR) method was performed using ITS1 and ITS4 primers, which are universal primers specific for the ITS gene region, a conserved gene region in fungi. The PCR products obtained were sent for sequence analysis. Sequence results from the analysis were evaluated using Finch TV (Blast) and ApE program. Species determination was made by comparing the nucleotide sequences and examining their similarities on the Gene Bank's https://blast.ncbi.nlm.nih.gov/Blast.cgi (NCBI) web page, which is open to the use of researchers. In order to investigate the presence of the ribotoxin gene region in all Beauveria bassiana isolates genotypically identified, PCR was performed with primers KQ1-KQ2, which are specific for the ribotoxin gene region in fungi.

Sequence analysis of all products obtained was performed and the results were analyzed on the NCBI page.

In conclusion, the production of ribotoxins by *Beauveria bassiana* and their role in the infection process is open to in-depth research in both basic science and applied biotechnology. Advances in this field can contribute to the development of more effective and environmentally friendly methods of pest control.

Keywords: *Beauvaria bassiana*, ribotoxin, entomopathogen.

The Screening of The Ribotoxin Production Potential in *Aspergillus* Species

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The aim of the study was to investigate the presence of ribotoxin gene region in *Aspergillus* genus species isolated from cattle feed and to perform ribotoxin-specific spore activity assay of isolates harboring this gene region. Ribotoxins are a family of ribosome inactivating proteins that exhibit a highly specific nucleolytic activity on the phosphodiester bond in the highly conserved sarcin/ricin domain of 28S rRNA, leading to inhibition of protein synthesis and cell death by apoptosis.

In our study, 16 animal feed samples obtained from cattle feed stores in the Aegean Region were used. All of the fungi isolated from these feed samples were identified by phenotypic methods and the diagnosis of 27 isolates belonging to *Aspergillus* genus was confirmed by genotypic methods. For genotypic diagnosis, polymerase chain reaction (PCR) method was performed using ITS1 and ITS4 primers, which are universal primers specific for the ITS gene region, which is a conserved gene region in fungi. The PCR products obtained were sent for sequence analysis. Sequence results from the analysis were evaluated using Finch TV (Blast) and ApE program. Species determination was made by comparing the nucleotide sequences and examining their similarities on the Gene Bank's https://blast.ncbi.nlm.nih.gov/Blast.cgi (NCBI) web page, which is open to the use of researchers. As a result of these examinations, 13 different Aspergillus species were identified in 27 *Aspergillus* isolates.

In order to investigate the presence of the ribotoxin gene region in all genotypically diagnosed *Aspergillus* strains, PCR was performed with primers KQ1-KQ2, which are specific for the ribotoxin gene region in fungi. Sequence analysis of all products obtained was performed and the results were analyzed on the NCBI page. As a result, the presence of cytotoxin clavin/c-sarcin from the mitogillin family in one *Aspergillus clavatus* species and Aspf 1 ribotoxin gene region from the mitogillin family in one *Aspergillus fumigatus* species among 27 isolates was detected.

Spore activation assays were performed for these two fungi with ribotoxin gene regions. With this experiment, it was aimed to analyze the specific activity of ribotoxins by producing α-fragment from 28S rRNA. In the agarose gel electrophoresis performed after the experiment, bands corresponding to the α-fragment specifically produced by ribotoxins were observed for *Aspergillus clavatus*.

Keywords: Ribotoxin, *Aspergillus*, fungal toxins, animal feed, spore activity assay.

Biodiesel Production from Fungi: Mycodiesel

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Many factors such as concerns about climate change caused by increasing levels of greenhouse gases in the atmosphere and the diminishing resources of fossil hydrocarbons are forcing humans to search for alternative liquid fuel sources. Biodiesel is an alternative fuel for diesel engines produced by chemically reacting a vegetable or animal oil with an alcohol such as methanol or ethanol. In other words, it is the reaction of oil and alcohol to form biodiesel and glycerin. Also, glycerin, which is obtained in addition to biodiesel as a result of the reaction, is an important by-product that determines the economics of biodiesel production. Traditional biodiesel production from plants and animals involves high costs and environmental challenges. In contrast, fungi and yeasts grow faster, accumulate high lipid content (up to 60-70% of their dry cell weight), and can be cultivated on low-cost, sustainable carbon sources such as agricultural and industrial waste. Mycodiesel, a form of biodiesel, offers a promising alternative to fossil fuels by using oleaginous microorganisms like fungi and yeasts.

Fungi, particularly species from genera like *Alternaria*, *Aspergillus*, and Chaetomium, alongside yeasts such as *Yarrowia* and *Rhodotorula*, are key candidates for biodiesel production. These microorganisms can be grown year-round and are highly productive, further enhancing their economic feasibility. Additionally, the co-production of other value-added products in a biorefinery model can improve the economic viability of biodiesel production from these microorganisms. Raw materials with high sugar content can be used in ethanol production. While the process holds great potential, challenges remain in scaling up production and reducing costs. However, with ongoing technological advancements, biodiesel from fungi and yeasts is expected to become more widespread and economically viable in the future. In this review, the use of mushrooms as a potential resource in biodiesel production is discussed as it is an economical and ecologically friendly process.

Keywords: Biodiesel, mycodiesel, environmental sustainability, endophytic fungi.

The Use of Filamentous Fungi as an Alternative Protein Source

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Due to the increasing global population, it is an unfortunate reality that the demand for animal and plant-based proteins, which play a crucial role in nutrition, may not be adequately met. Consequently, researchers have been focusing on exploring new sources of protein. One of the most significant alternatives in this regard is the production of single-cell protein (SCP) through the utilization of microorganisms, particularly by processing agricultural and industrial waste/by-products. Single-cell proteins are generally defined as edible biomass or protein extracts derived from the cultures of organisms such as bacteria, yeast, molds, and algae. Filamentous fungi, in particular, offer remarkable potential in this area, providing a valuable source for protein production (mycoprotein). Examples of filamentous fungi used in SCP production through various substrates and different fermentation methods include species from the genera *Aspergillus*, *Cladosporium*, *Fusarium*, *Paecilomyces*, *Penicillium*, *Rhizopus*, and *Trichoderma*. The ability of fungi to produce high-quality proteins rich in essential amino acids, their ease of harvesting from fermentation media due to their filamentous nature, and the richness of fungal biomass in glucans and B-group vitamins, all contribute to their value. Another significant advantage is their ability to utilize a wide range of substrates, including low-quality lignocellulosic waste, making them ideal for sustainable production processes. However, they also have some drawbacks, such as slower growth rates compared to other SCP-producing microorganisms and high nucleic acid content, which is not ideal for human consumption. Studies on fungal SCP are still not yielding sufficient results for direct human consumption. This text will address the production of SCP from filamentous fungi and its potential as an alternative protein source.

Keywords: Filamentous fungi, single cell protein (SCP), biomass, waste/by-production.

Fungal Chemistry and Biochemistry

Exploring the Nutritional and Mycochemical Properties of *Cyclocybe aegerita* from Serbia: Mineral and Polyphenolic Profiles

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This study investigates the nutritional and mycochemical properties of *Cyclocybe aegerita*, a wild mushroom species from Serbia. The analysis encompasses the mineral content of the fruiting bodies, the polyphenolic profile, and the total phenolic content (TP) in hydroethanolic (70% EtOH), hydromethanolic (80% MeOH), chloroform ($CHCl_3$), and hot water (H_2O) extracts. Mineral analysis using Atomic Absorption Spectroscopy (AAS) revealed significant concentrations of macroelements (Ca and Mg) and microelements (Fe, Zn, Cu, Cr, and Mn), underscoring the mushroom's nutritional value. Ca and Mg were present in comparable quantities, with Mg content at 1.86 ± 0.01 mg/g dry weight (d.w.) and Ca at 1.61 ± 0.09 mg/g d.w. Among the microelements, Fe was the most prevalent (196.11 ± 1.61 mg/kg d.w.), followed by Cu and Zn (37.58 ± 0.65 mg/kg d.w. and 33.98 ± 0.01 mg/kg d.w., respectively). LC-MS/MS analysis identified five polyphenolics and quinic acid, with the most abundant hydroxybenzoic acid derivatives being p-hydroxybenzoic acid in the 80% MeOH and 70% EtOH extracts (108.90 µg/g d.w. and 81.86 µg/g d.w., respectively) and cinnamic acid in the 80% MeOH extract (84.83 µg/g d.w.). Quinic acid was particularly prominent, especially in the H_2O and 70% EtOH extracts (485.89 and 451.51 µg/g d.w., respectively). The TP analysis showed that the 70% EtOH extract had the highest TP (22.74 ± 0.42 mg gallic acid equivalents/g d.w.), while the H_2O extract had the lowest (18.29 ± 0.27 mg GAE/g d.w.). The 80% MeOH and $CHCl_3$ extracts contained 21.63 ± 0.42 and 18.80 ± 0.50 mg GAE/g d.w., respectively. Overall, TP levels were relatively similar across all extracts. This study highlights the significant mycochemical profile of *C. aegerita*, indicating its potential in functional foods and pharmaceuticals for health enhancement and disease prevention. Further research is needed to fully explore the therapeutic benefits and medicinal applications of this mushroom.

Keywords: *Cyclocybe aegerita*; extracts; minerals; phenolic compounds; quinic acid.

Antagonistic Potential of An Endophytic *Pezicula* sp. against *Hymenoscyphus fraxineus* and Its Impact on Secondary Metabolites Production

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Ash dieback, a severe disease caused by the fungal pathogen *Hymenoscyphus fraxineus* (Helotiales, Ascomycota) has rapidly spread across Europe, posing a serious threat to various ash species (*Fraxinus* spp.) and ash-related ecosystems. During our search for biological control agents for this devastating disease, a fungal endophyte from the Canary Islands, tentatively identified as *Pezicula* cf. *ericae* using molecular barcoding, deomonstrated strong antagonistic activity against *Hymenoscyphus fraxineus*. The inhibitory effect of *Pezicula* cf. *ericae* 8999 on the radial growth of *Hymenoscyphus fraxineu*s strain 7, known for its high *in-planta* virulence, was evaluated in vitro using dual culture assays, as well as the effect of these interactions on secondary metabolites. Moreover, the secondary metabolic profile of the endophyte was investigated including the bioactivity of the compounds. Using preparative high-performance liquid chromatography (HPLC), the known compounds CJ-17,572 (**1**), mycorrhizin A (**3**) and cryptosporioptides A–C (**4**–**6**) were isolated, along with a new *N*-acetylated dihydroxyphenylalanin derivative **2**, named peziculastatin. Compounds **1** and **3** showed significant in vitro antifungal activity against *Hymenoscyphus fraxineus*. Furthermore, compounds **4**–**6** exhibited strong dispersive effects on preformed biofilms of *S. aureus* at concentrations up to 2 µg/mL, while *C. albicans* biofilm formation was also inhibited. Co-cultivation analysis revealed that the known phytotoxin viridiol as a major metabolite produced by the ash pathogen, while CJ-17,572, was the primary secondary metabolite produced by the endophyte. Notably, CJ-17,572 production, indicated as one of the antifungal component of the strain, was visibly enhanced during the co-cultivation. Our results suggest that the extensive antagonistic effect of *Pezicula* cf. *ericae* against *Hymenoscyphus fraxineus* is strongly associated with the increased production of CJ-17,572 in response to the pathogen exposure. Moreover, these endophytes represent valuable sources of bioactive compounds with potential pharmacological properties.

Keywords: Antagonism, ash endophytes, *Hymenoscyphus fraxineus,* secondary metabolites, structure elucidation.

Lichenology

Biomonitoring of Airborne Microplastics With Lichens in Urban and Rural Areas in Balikesir Province

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Lichens are symbiotic associations formed by certain types of fungi and algae or cyanobacteria. Lichens, which have a wide distribution area, can survive almost everywhere in the world under difficult conditions, from seas to high mountains, from hot regions to the poles. Lichens grow very slowly and can live for many years, so they can be used safely in biomonitoring studies. Lichens that do not have a protective layer can absorb pollutants from the atmosphere and keep them in their thallus for a long time. Tolerant species are indicators of the amount of pollutants in the air as a biomonitoring tool. Due to the increasing production of plastic in recent years, microplastics have become one of the important components of air quality that threatens human health. Today, microplastics spread into the environment due to anthropogenic factors cause many health problems.

In this study, it was aimed to detect and quantify airborne microplastics through epiphytic lichen species in rural and urban areas determined within the borders of Balıkesir province. Lichens collected by biomonitoring method were cleaned and dried. Other organic substances were removed from the environment by applying hydrogen peroxide treatment to the dried samples. Samples were stained with Nile Red fluorescence dye to be examined by fluorescence microscopy technique. In comparison with control and reference lichen samples subjected to the same processes, microplastics detected under the microscope were photographed, and then counted and calculated per unit area on the thallus surface and cross-sections of the samples. Today, airborne microplastic studies have just begun to be carried out in our country, and this study was the first to implement urban and rural microplastic lichen biomonitoring in Balıkesir province.

Keywords: Microplastic, lichen, air pollution, biomonitoring.

Investigation of Airborne Microplastic Accumulation in Lichens in Some Urban Forests of İstanbul Using Fluorescent Techniques

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Plastic particles contain many harmful substances, including microplastics and nanoplastics, which fall under the category of persistent organic pollutants. Microplastic pollution, prevalent in water, soil, and air in urban and industrial areas, has detrimental effects on all living organisms. Microplastics in the air cause serious health problems in humans, such as shortness of breath and cancer.

This study aimed to determine the presence of atmospheric microplastics in some urban forests in İstanbul, where human impact is intense, using bioindicator lichens as biological monitoring tools for air pollutants. Epiphytic lichen species were sampled from natural areas within the city limits. The thallus surfaces and anatomical sections of the lichen samples, along with reference material, were cleaned of other organic substances and examined under a fluorescent microscope using Nile Red fluorescent staining. Yellow microplastic particles, ranging in size from 1-5 mm, were identified and shown in microscope images using fluorescence microscopy. Additionally, a statistical evaluation was conducted based on the microplastic count per mm². The fluorescence microscopy analysis revealed that lichens can absorb and accumulate microplastic particles from the air in their thalli.

It is believed that the source of atmospheric microplastic pollution in urban forest areas may be anthropogenic factors or the long-distance transportation of waste from industrial areas.

Keywords: Microplastic, air pollution, lichen, biomonitoring, fluorescent.

Medical and Veterinary Mycology

Effect of Henna-Apple Vinegar Mixtures Against *Trichophyton rubrum*

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Superficial fungal infections are a common cause of fungal infections affecting large populations. In our region, some habits like wearing thick wool socks and boot-sock type shoes and hygiene problems cause suitable ambient for these fungi to survive. Turkish baths are also considered risky in terms of dermatophyte infections with the humid air and unhygienic conditions.

In our research, we investigated the antifungal effect of henna, a traditional hair and skin dye, prepared with water and 3 types of apple vinegar against *Trichophyton rubrum*. We determined the most effective formulation among the henna mixtures.

Our study is important in terms of determining the antifungal effect of henna and vinegar obtained from *Lawsonia inermis* against fungi. In our study the henna mixtures were treated with the standard inoculum of *T. rubrum* spores by agar well diffusion test. After inoculating the fungal spores to Potato Dextrose Agar surface, 3 wells were opened in each plate and filled with henna+vinegar mixtures prepared with A, B and C vinegars. After incubation in appropriate conditions, while no fungal growth was observed around the henna-water control well, growth was observed around the well including just water. Additionally, antifungal activity was detected in all vinegars and henna mixtures. As a result of our study, we suggest using henna+vinegar mixture and ointments prepared from this mixture to avoid from dermatophytes infection of foot. The ointments to be made will be both economical and ergonomic and will be advantageous because they are made with natural products.

Keywords: Henna, apple vinager, antifungal activity, *Trichophyton rubrum.*

Antifungal Activity of Essential Oil and Ethanolic Propolis Extract Mixtures against Biofilm-Producing *Pichia manshurica*

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Propolis is a bee product produced by honeybees (*Apis mellifera* L.) using plant-based resin mixed with beeswax and salivary enzymes (β-glucosidase). It has extensive biological activity. Essential oils are fragrant oily liquids with various biological activities obtained from different parts of plants. Treating diseases is becoming increasingly challenging due to the rise of antibiotic-resistant microorganisms. Biofilm structure is an important virulence factor that contributes to antibiotic resistance. In this study, we investigated the in vitro antifungal activity of 10 essential oils and mixtures of ethanolic propolis extract and essential oil (1:1, v/v) against *Pichia manshurica*, a strong biofilm producer isolated from the mouths of young individuals, using the agar well diffusion method. The results showed that orange, lemon, garlic, black grape seed, grape seed, pomegranate seed, and black cumin oils did not exhibit antifungal activity. Thyme and rosemary essential oils gave inhibition zones of 23.81±1.45 mm and 35.93±2.00 mm, respectively. It was found that when mixed with propolis at a 1:1 (v/v) ratio, all essential oils except thyme and rosemary exhibited a synergistic effect, leading to a 216% to 297.83% increase in antifungal activity. On the other hand, combining thyme and rosemary essential oil with propolis at the same ratio resulted in an antagonistic effect, causing a reduction in antifungal activity by 24.40% and 13.36%, respectively. Consequently, thyme and rosemary essential oils displayed the highest antifungal activity among the essential oils tested. Furthermore, the study revealed that the impact of propolis on antifungal activity varied depending on the essential oil used, demonstrating both synergistic and antagonistic effects. Therefore, while the benefits of propolis have been scientifically established, it should not be assumed that it consistently enhances the desired activity when interpreting the study's data.

Key Words: *Pichia manshurica,* essential oil, propolis, antifungal activity.

Acknowledgement: This study was carried out in the laboratory prepared within the project scope coded TÜBİTAK 122Z256.

Anticandidal Activity of Ethanolic Propolis Extract and Essential Oil Mixtures Against Biofilm-Producing *Candida albicans*

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Candida species are commonly found in the human body, particularly in the skin, genital, and gastrointestinal systems. Because *Candida* species are resistant to antifungal drugs, researchers are looking for alternative treatment methods. Essential oils from medicinal and edible plants have been known for their antimicrobial properties since ancient times. Propolis, a substance created by honeybees using plant resins, salivary enzymes, and beeswax, also has antimicrobial activity. This study aimed to find inexpensive, simple, and effective therapeutic essential oils that can prevent and control the growth of *Candida albicans*. The agar well diffusion method was used to test 10 essential oils and mixtures of propolis: essential oils (1:1, v/v) to evaluate the anticandidal activity. The results showed that black grape seed, grape seed, pomegranate seed, black cumin, garlic, lemon, and two orange oils tested did not exhibit anticandidal activity. The study found that the anti-candidal activity of black grape seed, grape seed, pomegranate seed, black cumin, lemon, and orange oils mixed with propolis increased between 191.50% and 239.17%. The most effective essential oils were thyme and rosemary, which inhibited Candida growth by 16.96±0.91 mm and 23.38±0.85 mm, respectively. However, when thyme oil was mixed with propolis, its anti-candidal activity decreased by 3.45%, and rosemary oil's activity decreased by 37.08%. These results indicate that not all essential oils mix well with propolis, and some combinations may have antagonistic or synergistic effects. Therefore, it's essential to carefully evaluate and select combinations of essential oils and propolis based on specific conditions. Future research should delve deeper into the biological effects of these mixtures and determine the best formulations.

Key Words: Anticandidal activity, therapeutic essential oil, propolis.

Acknowledgement: This study was carried out in the laboratory prepared within the project scope coded TÜBİTAK 122Z256.

The Prevalence, Predisposing Factors, and Outcomes of *Pneumocystis jirovecii* Pneumonia Among Pediatric Inpatients

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Pneumocystis jirovecii can cause pneumocystosis, which is one of the opportunistic fungal infections that can lead to life-threatening pneumonia in children. Accurate and timely identification of this organism is crucial for effective treatment and patient survival. A recent study conducted in tertiary hospitals in Mashhad, northeastern Iran, and examined bronchoalveolar lavage specimens from pediatric patients using real-time polymerase chain reaction and Giemsa staining. In this study, 180 bronchoalveolar lavage specimens were collected from hospitalized children at risk of respiratory disorders. Various demographic parameters, such as a history of blood disorders and the condition of the immune system were evaluated. The bronchoalveolar lavage specimens were processed by centrifugation, and the pellet was prepared for direct examination using Giemsa staining and DNA extraction following the AmpliSens® kit protocol. *P. jirovecii* was identified using the AmpliSens *P. jirovecii* (*carinii*)-FRT real-time polymerase chain reaction method. Out of the 180 specimens examined, 34 tested positive and eight were considered suspect for the presence of *P. jirovecii* using the real-time polymerase chain reaction method. Interestingly, Giemsa staining only identified this organism in two cases (5.88%) that were positive by the real-time polymerase chain reaction method. The study also found no correlation between positive polymerase chain reaction findings and factors such as sex, illness outcome, underlying diseases, immune system status, neutropenia, or hematological malignancies. The incidence of pneumocystosis pneumonia in predisposed children presenting with pulmonary symptoms, especially those with neutropenia, is significant. Real-time polymerase chain reaction demonstrated high sensitivity in detecting *P. jirovecii* with a high predictive value. Conversely, Giemsa staining showed a high rate of false-negative results, highlighting the potential for misdiagnosis when relying solely on this method.

Keywords: Real-time PCR, Giemsa, pneumonia, *Pneumocystis jirovecii*, pediatrics.

Antifungal Activity of Basil Oil (*Ocinum basilicum*) on Radial Growth of *Aspergillus niger*

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Basil is a widely used plant in the spice and various industries such as cosmetics and medicine. It has been traditionally used in medicine as a carminative, lactation enhancer, stomachic, and antispasmodic. Additionally, it has been reported that its essential oil has different biological activities such as antibacterial, antifungal, and antioxidant. *Aspergillus niger* is a phytopathogen commonly known as "black mould," which contaminates stored foods and causes postharvest decay of fresh fruits, grains, and produce worldwide. While this mould is valuable from a pharmacological perspective due to its production of organic acids, proteins, enzymes, and other secondary metabolites, its spores can also cause allergies and asthma in humans and animals. Therefore, the study was conducted to investigate the potential of basil oil as a preventive or therapeutic agent in the food industry, agriculture or medical applications. For this purpose, *Aspergillus niger* cultures that were 3–5 days old were inoculated onto petri dishes containing 1%, 2%, 5%, and 10% basil oil mixed with PDA (which included 3% dimethyl sulfoxide). After five days of incubation, the diameters of the colonies were measured. The effect of basil oil on *Aspergillus niger* radial growth was calculated considering the control group. The study was carried out in three replications. Surprisingly, the results showed that basil oil did not inhibit the radial growth of *Aspergillus niger*; instead, it increased the radial growth by 7.01% at the 5% concentration and by 27.50% at the 1%concentration. These findings suggest that the use of basil oil as an antifungal agent may not be effective in all cases and may promote the radial growth of *Aspergillus niger* under certain conditions. Therefore, to determine its limitations and potential risks, it is crucial to carefully assess and consider specific conditions when using basil oil preventively or therapeutically, particularly in the food industry and agriculture.

Keywords: *Aspergillus niger*, black mould, basil oil, radial growth inhibition.

Antifungal Activity of Toros Mint Oil on Radial Growth of *Penicillium* sp.

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This research aims to evaluate the antifungal effects of Toros mint oil against *Penicillium* through in vitro experiments. *Penicillium* is a fungus commonly found in food and agricultural products and produces mycotoxins, which lead to health and economic issues. Mint oil exhibits antimicrobial, antifungal, and antioxidant properties due to its phytochemicals such as menthol and mentone. The study aims to determine the effects of Toros mint oil on *Penicillium* and provide effective and environmentally friendly strategies for controlling this microfungus. For this purpose, *Penicillium* sp. cultures that were 3–5 days old were inoculated onto petri dishes containing 1%, 2%, 5%, and 10% Toros mint oil mixed with PDA (which included 3% dimethyl sulfoxide). After five days of incubation, the diameters of the colonies were measured. The effect of Toros mint oil on *Penicillium* sp. radial growth was calculated considering the control group. The study was carried out in three replications. The results clearly demonstrate that Toros mint oil exhibits strong inhibitory effects against *Penicillium*. In studies conducted, Toros mint was observed to provide 46.82% inhibition at a 1% concentration, and as the concentration increases to 2% and above, it achieves 100% inhibition, completely preventing fungal growth. These findings reveal that Toros mint oil possesses significant antifungal effects even at low concentrations, with the potential to completely halt fungal growth at higher levels. This suggests that Toros mint oil could play a crucial role in food preservation strategies and offer solutions to critical issues such as antibiotic resistance. Therefore, Toros mint oil can be considered an effective natural alternative for ensuring food safety and combating pathogens that show resistance to current antimicrobial treatments.

Keywords: *Penicillium*, mint oil, radial growth inhibition.

Antifungal Activity of Garlic Oil on Radial Growth of *Fusarium* sp.

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Fusarium is a soil-borne fungus genus causing significant economic damage to crop through diseases like *Fusarium* wilt and root rot, which also pose health risks due to mycotoxin production. Traditional chemical fungicides used to control *Fusarium* face limitations related to environmental impact and resistance development, leading to increased interest in natural alternatives. Garlic oil, known for its antifungal properties from compounds such as allicin, DADS, and DAS, is being evaluated as a potential biological control agent. This study investigates garlic oil's effectiveness against *Fusarium* species and explores ways to enhance its efficacy, aiming to establish it as a viable biological pesticide and contribute to innovative agricultural management strategies. For this purpose, *Fusarium* sp. cultures that were 3–5 days old were inoculated onto petri dishes containing 1%, 2%, 5%, and 10% garlic oil mixed with PDA (which included 3% dimethyl sulfoxide). After five days of incubation, the diameters of the colonies were measured. The effect of garlic oil on *Fusarium* sp. radial growth was calculated considering the control group. The study was carried out in three replications. The results clearly demonstrate that Taurus mint exhibits strong inhibitory effects against *Penicillium*. This study assessed the effectiveness of garlic oil in inhibiting the growth of *Fusarium* sp. and found that low concentrations (1%) had minimal antifungal effects, reducing radial growth by only 1.57%. Conversely, higher concentrations (5% and 10%) surprisingly increased fungal growth, with 5% garlic oil causing a 12.69% increase and 10% resulting in a 28.74% increase. This suggests that while garlic oil has some antifungal properties, its effectiveness may diminish or even reverse at higher concentrations. The results indicate the need for further research to determine the optimal concentration of garlic oil for controlling *Fusarium* and explore its use in combination with other antifungal agents and application methods to enhance its effectiveness as a biological control agent in agriculture.

Keywords: *Fusarium*, garlic oil, radial growth inhibition.

Medicinal Mushroom

The Importance of *Grifola frondosa* (Dicks.) Gray in Cosmetics

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The maitake mushroom (*Grifola frondosa*), widely found in Asia, especially Japan, China, and Korea, is known for its numerous health benefits. *Grifola frondosa* is a Basidiomycete fungus belonging to the order *Aphyllophorales*, and the family *Polyporaceae*. It typically grows in large clusters and has a highly branched structure. Its medicinal use and nutritional properties have made it a popular natural health product. Maitake mushrooms contain bioactive components called beta-glucans, which have the potential to strengthen the immune system, regulate blood sugar levels, and even protect against some types of cancer. Additionally, they are rich in vitamins and minerals such as B vitamins, vitamin C, vitamin D, potassium, and magnesium.

Maitake mushroom is used in cosmetics for its various skin health benefits. Extracts of this mushroom are found in creams, serums, face masks, and lotions, aiming to leverage its natural properties. Key benefits include antioxidant effect, moisturizing, anti-inflammatory, balancing skin tone and immune-supporting. These products aim to promote healthier, more balanced skin by utilizing maitake mushroom's natural benefits. The use of maitake mushroom in cosmetics is expanding as its potential benefits are further explored.

This review has been prepared based on current studies to reveal the potential benefits of Maitake mushroom in the health and cosmetic fields.

Keywords: Maitake, *Grifola frondosa*, medicinal mushroom, cosmetics.

Pharmaceutical Properties of *Hericium erinaceus* (Bull.) Pers.

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Mushrooms are a unique source of nutrients in the enormous diversity of nature's offerings. These natural delicacies contain around 80% to 90% water and are notable for their 8% to 10% fiber content. This contributes to fiber intake, which is an important part of a healthy diet. Mushrooms are particularly rich in vitamins C and B vitamins (folic acid, thiamine, riboflavin, and niacin). These vitamins are important for energy production, immune system function, and cellular health. Among the minerals found in the fructifying organs of the mushroom, K (potassium), Na (sodium), and P (phosphorus) stand out. It also contains trace amounts of other important minerals, which contribute to a healthy mineral balance (e.g. Cu, Zn, Mg). It is poor in iron and calcium. Mushrooms have antioxidant, anticancer, antimicrobial, antiviral, and antibacterial properties. These properties are of great interest in the fields of gastronomy, medicine, and pharmacology. Their antioxidant properties can reduce cellular damage by fighting free radicals, while their antimicrobial properties can be effective in combating microorganisms. This rich potential for the nutritional value and health benefits of mushrooms fascinates researchers, chefs, and health experts worldwide. The nutritional diversity offered by mushrooms makes them more than just a flavourful culinary ingredient, but an important component of a healthy lifestyle. *Hericium erinaceus* is not only a food source, but also a medicinally important mushroom. From the mycelium to the fruiting body, this mushroom contains a variety of bioactive compounds, thus offering unique medicinal benefits as well as edible values. This review is based on recent research on *Hericium erinaceus*, which is of economic and medicinal interest to both local communities and scientists.

Keywords: *Hericium erinaceus*, medical mycology, Basidiomycota.

Cordyceps: A Mycological Marvel

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Cordyceps, a genus of parasitic fungi, has captivated scientists and the public alike with its unique life cycle and cultural impact and it was later understood for its remarkable parasitic behaviour, especially in insects. These fungi infiltrate and manipulate their hosts, culminating in the host's death in an elevated position, facilitating spore dispersion. The distinct fruiting bodies and intricate hyphal structures of *Cordyceps* highlight their evolutionary adaptation to parasitism Ecologically, *Cordyceps* plays a crucial role in controlling insect populations, acting as a natural biopesticide. This ecological function underscores the importance of fungi in maintaining the balance of ecosystems. Among the various species, *Cordyceps sinensis* and *Cordyceps militaris* are the most studied, particularly for their pharmacological properties. These species have been traditionally used in Asian medicine for their purported health benefits, including anti-inflammatory, immunomodulatory, and anti-tumor effects. Modern scientific investigations have identified several bioactive compounds, such as cordycepin, which is a nucleoside analogue with potential therapeutic applications. Cordycepin has shown promise in inhibiting cancer cell proliferation, regulating immune responses, and providing anti-viral properties, making it a focal point in the development of new drugs. These findings not only underscore the role of *Cordyceps* species in maintaining biological diversity but also highlight their potential contributions to human health. Future research may uncover additional bioactive compounds from *Cordyceps*, leading to innovative therapeutic approaches in various fields of modern medicine. As such, the significance of Cordyceps in pharmaceutical research is increasingly recognized.

Keywords: *Cordyceps*, parasitic fungi, cordycepin, pharmaceutical effects.

Molecular Fungal Taxonomy

First report of *Leucoagaricus viscidulus* in Türkiye: Documenting its Initial Presence on the Asian Continent

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On November 21, 2023, a significant discovery was made with the collection of fungal specimens from Çanakkale Province, Türkiye. These samples underwent rigorous morphological assessments and advanced phylogenetic analyses, including nrITS rDNA sequencing. The specimens, labeled ANK Acar 1305, exhibited remarkable similarity to *Leucoagaricus viscidulus* (Heinem.) Consiglio & Contu in both macroscopic and microscopic characteristics. The genetic analysis corroborated this identification, revealing an impressive sequence similarity of over 99% with *L. viscidulus*. This study confirms the presence of *Leucoagaricus viscidulus* in the Turkish mycobiota for the first time. Comprehensive data accompanying the specimens provide detailed information on the collection site, including precise geographical coordinates and habitat observations. These data thoroughly describe the macroscopic and microscopic features of the specimens, supported by high-resolution photographs and detailed illustrations. The documentation ensures a thorough and precise representation of these findings. This report is framed by comparing *L. viscidulus* with other morphologically and phylogenetically similar species. The study offers extensive geographical, ecological, and morphological data, significantly enhancing the current understanding of *Leucoagaricus viscidulus*. It serves as a critical reference for future mycological research on this species. Reporting *L. viscidulus* in Türkiye notably expands its known global distribution, marking the first documented occurrence of this species on the Asian continent.

Keywords: *Leucoagaricus viscidulus*, new record, Fungal biodiversity, Asia

SONUÇ BİLDİRGESİ

4. ULUSLARARASI AVRASYA MİKOLOJİ KONGRESİ

SONUÇ BİLDİRİSİ

4. Uluslararası Avrasya Mikoloji Kongresi 03-05 Eylül 2024 tarihleri arasında Çanakkale Onsekiz Mart Üniversitesi, Troya Kültür Merkezi'nde iki konferans salonunda 10 oturumda 40 sözlü bildiri, 4 oturumda 17 online bildiri ve ilk oturumdan son oturuma kadar toplam 35 poster sunumu gerçekleştirilmiştir.

Kongrede Prof Dr. Ahmet ASAN hocamızın moderatörlüğünde yapılan "Türkiye'de Mikolojik Çalışmalarla İlgili Önemli Sorunlar" konulu panelde aşağıdaki konular görüşülmüştür.

1- Uluslararası Avrasya Mikoloji Kongresi'nin (5. International Eurasian Mycology Congress (5. EMC)) 2026 yılında Trakya Üniversitesi'nde Doç. Dr. Halide KARABIYIK başkanlığında düzenlenmesine oy birliğiyle karar verilmiştir.

2- "Türkiye'de Mikolojik Çalışmalarla İlgili Önemli Sorunlar" konusunda görüşmeye açılan konular kapsamında,

i. Türkiye'de kültür koleksiyonu ve kültür merkezi açılmasının sağlanması,
ii. Uluslararası katılımın artırılması için çaba sarf edilmesi,
iii. Mikoloji çalışmalarına dahil olan amatör mikologların varlığı ve insan sağlığı için tehlike oluşturmaları,
iv. Kimlere mikolog denmeli, amatör ve profesyonel mikolog tanımının yapılması gerektiği,
v. Farklı bir alemin çalışma alanı olan Mikoloji biliminin, Botanik ve Zooloji gibi değer görerek, üniversitelerde seçmeli dersten çıkarılıp zorunlu ders olması gerektiği,
vi. 5. Uluslararası Avrasya Mikoloji Kongresi'nde sunumların tamamının İngilizce sunulması gerektiği

konuları görüşülmüştür.

Yukarıda belirtilen hususlar 4. Uluslararası Avrasya Mikoloji Kongresi'nin kapanış oturumunda sonuç bildirisi olarak okunmuştur.

EMC'24

Bu sonuç bildirisi bir moderatör, iki panelist ve iki raportör tarafından tutulan raporlar ile "Türkiye'de Mikolojik Çalışmalarla İlgili Önemli Sorunlar" konulu oturumda konuşulan konular göz önüne alınarak hazırlanmış ve imza ile kayıt altına alınmıştır.

05/09/2024

Prof. Dr. Ahmet ASAN
Moderatör

Prof. Dr. Rasime DEMİREL
Panelist

Prof. Dr. Ilgaz AKATA
Panelist

Arş.Gör. Dr. Nihan AKINCI KENANOĞLU
Raportör

Uzman Damla AYDOĞAN
Raportör

Dr.Öğr.Üyesi Tülay BİCAN SÜERDEM
Kongre Başkanı

FINAL DECLARATION

4. INTERNATIONAL EURASIAN MYCOLOGY CONGRESS

FINAL DECLARATION

At the 4th International Eurasian Mycology Congress, 40 oral presentations in 10 sessions, 17 online presentations in 4 sessions and a total of 35 poster presentations from the first session to the last session were held in two conference halls at Çanakkale Onsekiz Mart University, Troya Cultural Center between 03-05 September 2024.

The following topics were discussed in the "Important Problems Related to Mycological Studies in Turkey" panel moderated by Prof. Dr. Ahmet ASAN. It was also read as the final report at the congress

1- It was unanimously decided that the 5th International Eurasian Mycology Congress (5th EMC) will be held in 2026 at Trakya University under the presidency of Assoc. Prof. Dr. Halide KARABIYIK.

2- Within the scope of the topics opened for discussion on “Important Problems Related to Mycological Studies in Turkey”,

i. Ensuring the opening of a culture collection and culture center in Turkey,
ii. Efforts should be made to increase international participation,
iii. The existence of amateur mycologists involved in mycological studies and the danger they pose to human health,
iv. Who should be called a mycologist, and the definition of amateur and professional mycologists should be made,
v. Mycology, which is a field of study in a different realm, should be valued like Botany and Zoology and should be removed from the elective courses at universities and should be made a compulsory course,
vi. All 5th International Eurasian Mycology Congress presentations should be in English.

This final report was prepared by taking into consideration the reports kept by a moderator, two panellists and two rapporteurs and the issues discussed in the session titled “Important Problems Related to Mycological Studies in Turkey” and was recorded with signature.

05/09/2024

Prof. Dr. Ahmet ASAN
Moderatör

Prof. Dr. Rasime DEMİREL
Panelist

Prof. Dr. Ilgaz AKATA
Panelist

Arş.Gör. Dr. Nihan AKINCI KENANOĞLU
Raportör

Uzman Damla AYDOĞAN
Raportör

Dr.Öğr.Üyesi Tülay BİCAN SÜERDEM
Kongre Başkanı


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